Angeles Link – Phase 1
Quarterly Report (Q2 2024)

For the period of April 1, 2024 through June 30, 2024

Appendices

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Appendix 1 – Draft Reports and Preliminary Findings

Angeles Link | Hydrogen Leakage Assessment Draft Report

May 2024

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Snapshots, Tables and Figures

Acronyms and Abbreviations

AB	Assembly Bill
AL	Angeles Link
CAPCOA	California Air Pollution Control Officers Association
CARB	California Air Resources Board
CEC	California Energy Commission
CFR	Code of Federal Regulations
CPUC	California Public Utilities Commission
DOC	Department of Commerce
DOE	Department of Energy
DOT	Department of Transportation
EF	Emission Factor
EPA	Environmental Protection Agency
EPRI	Electric Power Research Institute
FET	Field-Effect Transistor
LDAR	Leak Detection and Repair
LEL	Lower Explosive Limit
LF	Leak Factor
MEMS	Microelectromechanical System
MOS	Metal Oxide Semiconductor
MOSFET	Metal Oxide Semiconductor Field-Effect Transistor
NPC	National Petroleum Council

NIST	National Institute of Standards and Technology
NREL	National Renewable Energy Lab
PEM	Proton-Exchange Membrane
PHMSA	Pipeline and Hazardous Materials Safety Administration
RITA	Research and Innovation Technology Administration
SMR	Steam Methane Reforming
UC	University of California
UCI	University of California Irvine

1.0 EXECUTIVE SUMMARY

Southern California Gas Company (SoCalGas) is proposing to develop a clean renewable hydrogen[1] pipeline system to facilitate transportation of clean renewable hydrogen from multiple regional third-party production sources and storage sites to various delivery points and end users in Central and Southern California, including in the Los Angeles Basin. The California Public Utilities Commission's (CPUC) Phase 1 Decision, approving the Memorandum Account for SoCalGas's proposed Angeles Link project (Angeles Link) requires SoCalGas to assess the risks and mitigations associated with the potential for hydrogen leakage. The leakage assessment evaluates the potential for hydrogen leakage associated with new hydrogen infrastructure (i.e., clean renewable hydrogen transportation and compression, in addition to third party production and storage), as well as opportunities to minimize the potential for hydrogen leakage (Study). While this Study explores the potential for leakage from production, compression, storage, and transportation, the Angeles Link proposal is focused on the transmission of clean renewable hydrogen, including compression and ancillary equipment.

The objective of this Study is to evaluate, through a literature review, a range of values for potential hydrogen leakage, as well as opportunities to minimize the potential for leakage. This range of values is presented as percentages for each component of new proposed infrastructure and as percentages for each minimization opportunity. This Study does not evaluate the potential for leakage at end users' equipment.

Key Findings

The key findings are presented below and are discussed further within this document.

- As described in the literature reviewed for this Study, potential sources of leakage include production equipment such as electrolyzers, compression equipment such as reciprocating and centrifugal compressors, storage equipment such as aboveground vessels and underground salt caverns, and transmission infrastructure such as pipelines.

- The magnitude of the potential for hydrogen leakage depends on the quantity and type of equipment that is used for production, compression, and storage, how the infrastructure is designed and engineered, whether the pipelines are above ground or below ground, the sizing and routing of the pipelines, and how the infrastructure is operated and maintained, amongst other factors.

- Leakage estimation methodologies include direct measurement such as leak detection sensors, as well as information published in the literature based on a variety of

[1] In the California Public Utilities Commission (CPUC) Angeles Link Phase 1 Decision (D).22-12-055 (Phase 1 Decision), clean renewable hydrogen refers to hydrogen that does not exceed 4 kilograms of carbon dioxide equivalent (CO2e) produced on a lifecycle basis per kilogram of hydrogen produced and does not use fossil fuels in the hydrogen production process, where fossil fuels are defined as a mixture of hydrocarbons including coal, petroleum, or natural gas, occurring in and extracted from underground deposits.

methodologies, including calculations via proxies such as natural gas, laboratory experiments, and theory-based models or simulations.

- Mitigations and opportunities to minimize the potential for leakage from various processes are available in the design and engineering of new infrastructure, operation of equipment and systems, as well as maintenance procedures. In addition to design and engineering, the use of existing and emerging sensor technologies support early identification of leaks and facilitate timely repairs, thereby mitigating potential leaks.

Stakeholder Input

The input and feedback from stakeholders including the Planning Advisory Group (PAG) and Community Based Organization Stakeholder Group (CBOSG) has been essential to the development of this draft Leakage Study Report. Some of the feedback that has been received related to this Study is summarized below. All feedback received is included, in its original form, in the quarterly reports submitted to the CPUC and published on SoCalGas' website.[2] Feedback topics that were not addressed are also identified.

Quarter 1 to Quarter 4 2023 Reports

- **EDF Comments**
    - Examine all possible research and literature around hydrogen leakage including listed articles. Examine all possible sources of hydrogen including venting and purging of hydrogen and include in study calculations. Studies have shown that leak detection and prevention at parts per billion level is needed to evaluate climate benefits from use of hydrogen.
- **SCAQMD Feedback**
    - The overview of the hydrogen leakage assessment should clarify whether it will primarily involve modeling or also include assessments of leakage detection methods. Different leakage rates for liquid and gaseous storage should be considered when assessing potential environmental impacts.
- **Food & Water Watch Comments**
    - Evaluate leakage and risks for repurposed gas pipelines. Evaluate leakage and risks for underground and aboveground storage. It is crucial that leakage be measured accurately.
- **CBOSG Feedback Themes**
    - Questions regarding whether study will consider research on existing hydrogen pipelines, research at existing hydrogen facilities, and how the study will identify

[2] https://www.socalgas.com/sustainability/hydrogen/angeles-link

how the leakage will be determined. Suggesting leakage at end users be evaluated. Concerns regarding the difficulty of capturing hydrogen leakage rate at low levels. Identify potential mitigation opportunities including available sensors and emerging leak detection methodologies.

Preliminary Data & Findings Document

- Six comment letters received from Environmental Defense Fund, Communities for a Better Environment, Food and Water Watch, Protect Playa Now, and Physicians for Social Responsibility – Los Angeles, and Air Products
  - First five letters requested volumetric leakage estimates and associated impacts to climate change be discussed and a volumetric analysis be included in the leakage and GHG study reports.
  - Sixth letter shared that leakage rates included for aboveground storage vessels are considered to be too high.

Summary of How Comments were Addressed

- A literature review was conducted for all elements of infrastructure. Estimated leakage rates were evaluated for the anticipated Angeles Link infrastructure, in addition to third party production and storage, as described in Section 4.2.1.

- The potential for leakage at end users was not incorporated since equipment specific details for end users was not available and end users were considered out of scope for this assessment.

- The above ground storage estimated leakage rates were based on the values available in the literature as described in Section 4.2.1 below. The Study notes that a stakeholder has commented that they assume a lower value for leakage rates than the rates presented here.

- Potential leakage from gaseous storage was evaluated whereas liquid storage was not.

- Potential mitigation opportunities including available sensors and emerging leak detection methodologies was included. Information regarding available and emerging direct measurement tools and leakage sensors was incorporated. Existing and emerging technologies regarding hydrogen leak detection sensors and direct measurement tools are presented in Section 4.2 below. These may be used to support mitigation of leakage as discussed in Section 4.4.

- Sources of potential hydrogen leakage including venting and purging are anticipated to be mitigated via leakage capture mechanisms.

- A range of preliminary high-level volumetric estimates of the potential for leakage were developed based on the range of values derived from the literature review. This analysis was developed using the low, medium, and high Angeles Link throughput scenarios. This range of high-level estimates will be used in the parallel Greenhouse Gas (GHG) Study to estimate a range of potential impacts associated with potential leakage that is accounted for when considering the overall expected GHG reductions associated with Angeles Link. This second step of taking the volumetric estimates from potential leakage and using it to estimate the range of potential GHG impacts in the GHG Study, is important and responsive to several stakeholder comments asking for an analysis of the role hydrogen leakage may play as an indirect GHG.

Summary of Literature Provided by Stakeholders

- Specific literature provided by PAG/CBOSG stakeholders has been evaluated and relevant information has been incorporated, as appropriate, including, but not limited to:
    - Environmental Defense Fund, March 2023, As Climate Concerns About Hydrogen Energy Grow, New Tech Unveiled at CERAWeek Delivers Unprecedented Results Measuring Leaks, Other Emissions. https://www.edf.org/media/climate-concerns-about-hydrogen-energy-grow-new-tech-unveiled-ceraweek-delivers-unprecedented
    - Esquivel-Elizondo, Sofia, Alejandra Hormaza Mejia, Tianyi Sun, Eriko Shrestha, Steven P. Hamburg and Ilissa B. Ocko, 2023, Wide Range in Estimates of Hydrogen Emissions from Infrastructure, Frontiers in Energy Research Vol. 11: 1207208, https://www.frontiersin.org/articles/10.3389/fenrg.2023.1207208/full
    - Hauglustaine, D., F. Paulot, W. Collins, R. Derwent, M. Sand and O. Boucher, 2022, Climate benefit of a future hydrogen economy, Comm. in Earth & Environment, 3 Article 295, https://doi.org/10.1038/s43247-022-00626-z
    - Sun, T., E. Shrestha, S. Hamburg, R. Kupers, I. Ocko, 2024, Climate Impacts of Hydrogen and Methane Emissions Can Considerably Reduce the Climate Benefits across Key Hydrogen Use Cases and Time Scales, https://pubs.acs.org/doi/10.1021/acs.est.3c09030
    - Warwick, N.J., A.T. Archibald, P.T. Griffiths, J. Keeble, F.M. O'Connor, J.A. Pyle, and K.P. Shine, 2023, Atmospheric composition and climate impacts of a future hydrogen economy, Atmospheric Chemistry and Physics 23(20) 12451-13467, https://doi.org/10.5194/acp-23-13451-2023

2.0 STUDY APPROACH

The Study evaluates, through a review of existing technical literature, potential sources of hydrogen leakage and leakage mitigation for the production, compression, storage, and transmission of hydrogen associated with Angeles Link and third party hydrogen infrastructure. Where applicable, the Study relies on specific technical information that is available including from other ongoing Phase 1 feasibility studies and other information primarily from existing technical literature. When specific information is not available, estimates based on availability of related data, such as correlations to natural gas, or documented assumptions were developed. Figure 1 depicts the study approach for this Study.

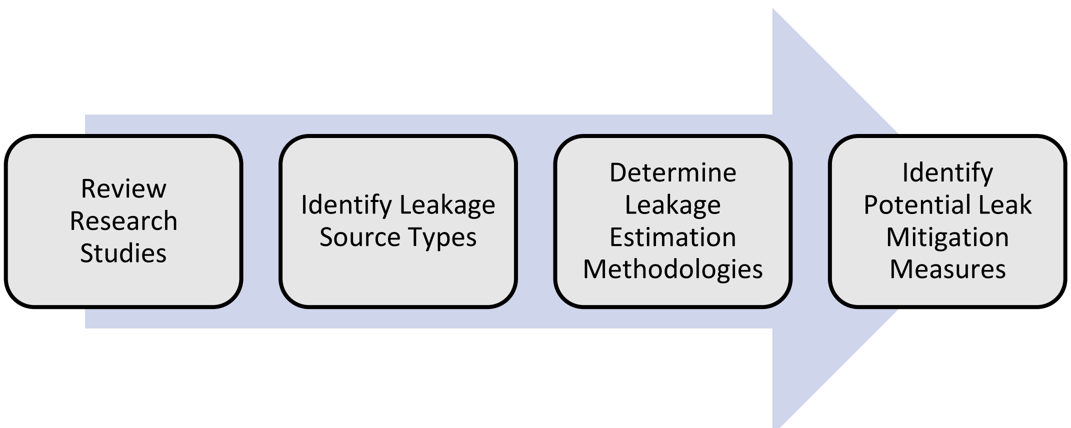

Figure 1 Hydrogen Leakage Study Approach

2.1 TECHNICAL RESEARCH

The Study collected, reviewed, and analyzed technical literature studies and information related to the potential for hydrogen leakage and opportunities to minimize and mitigate hydrogen leakage. The objectives of conducting the technical research were to obtain information to execute the four steps identified in Figure 1 and to develop an understanding of: (1) the availability of recent hydrogen leakage studies; (2) potential leak sources associated with Angeles Link infrastructure; (3) leak estimation methodologies and associated data needs; (4) potential leakage mitigation and minimization opportunities. This analysis included the following:

- Studies from research-based academic institutions such as the University of California Irvine (UCI) Combustion Laboratory, Georgia Institute of Technology, University of Wyoming, Imperial College London, Center on Global Energy Policy at Columbia University; and private organizations such as the Electric Power Research Institute (EPRI), National Petroleum Council (NPC), and Frazer-Nash Consultancy.
- Existing, proposed, and potential future regulatory requirements from federal agencies including the United States Environmental Protection Agency (U.S. EPA), the Pipeline and Hazardous Materials Safety Administration (PHMSA), the United States Department of

Energy (DOE), state agencies such as the California Air Resources Board (CARB) and the California Energy Commission (CEC).

- Technological developments from manufacturers working on hydrogen monitoring technology including sensor development and opportunities to minimize the potential for leakage. Manufacturers include Aerodyne, Fukuda, and PDC Machines.
- Technical literature and data releases from public entities, non-profits, and government agencies and laboratories including the U.S. DOE and the National Renewable Energy Lab (NREL), the Environmental Defense Fund (EDF), Netherlands Environment Assessment Agency, and Joint Research Centre (JRC) of the European Commission.

The research began by investigating a broad range of publications that could be potentially related to the hydrogen leakage. As the study progressed, research was targeted toward topics of the most value to the Study. Types of sources reviewed include, but were not limited to, peer-reviewed scientific papers, scientific and industry white papers, government workshops, regulations, standards, presentations, data releases, manufacturer press releases, news articles, books, blogs, technology reports, and other available sources.

Each reviewed source was evaluated and the key takeaways were summarized to facilitate review of pertinent information from each source. The sources were then further categorized by topic: leakage calculation methodology, measurement technology, etc. The sources consulted were not limited to the United States. Relevant studies from the European Union and the United Kingdom (UK) were also consulted and included as references.

2.1.1 Technical Approach

The technical approach for this Study included identifying sources of potential leakage and opportunities to minimize leakage by reviewing literature published on these topics. Additionally, research was conducted regarding anticipated technological advancements and the expected evolution of regulatory frameworks, such as additional requirements related to measuring and minimizing hydrogen leakage.

Based on the information gathered, leakage estimation methodologies were evaluated. Specifically, two leakage estimation methodologies were identified: total value chain approach (top-down) and component-count level approach (bottom-up).

2.1.1.1 Total Value Chain Approach

The top-down total value chain methodology focuses on assessing mass balance at the system level and evaluating the proportion of product that can be allocated to various components of the system and determining the potential loss of product in the form of leakage. The total value chain approach provides general component (production, compression, above ground and underground storage, and transmission through pipelines) leakage ranges that are summarized from the literature reviewed. Leakage rates are estimated as a percentage of total hydrogen in the respective supply chain component. The total value chain approach provides high-level estimates of potential for leakage based on general datasets.

2.1.1.2 Component-Count Level Approach

The bottom-up component-count level methodology focuses on unit level leakage rates and can be presented as an aggregation of total leakage from anticipated units. The component-count level methodology relies on project-specific and detailed equipment, process, and component counts. These details include: the type and number of production, compression, and storage equipment, as well as details about the piping, including number of valves, flanges, and connections. The component-count level methodology provides more accurate results and can be used for development of more precise leakage estimates.

For those industries with volatile organic compounds (VOC) emissions associated with leakage that regularly estimate and report VOC emissions, the U.S. EPA has developed numerous sets of emission factors and correlation equations for the various types of processes being considered. Historical data collection on emissions from equipment leaks in synthetic organic chemical manufacturing industry, refineries, marketing terminals, and oil and gas production operations have yielded emission factors and correlations for these source categories for natural gas and other hydrocarbon fuels. Since hydrogen does not contain VOC, these EPA methodologies are not applicable. Additionally, emission factors and correlations for hydrogen have not been developed at this time. However, preliminary work has been conducted comparing natural gas leaks with hydrogen leaks for different types of components[3] limited to low pressure systems only.

There are four bottom-up approaches for estimating leakage, in the order of increasing accuracy, that include using: 1) facility-level average emission factors; 2) equipment-level average emission factors; 3) component-level average emission factors; and 4) component-level measurement approaches.[4] The component-level measurement approach has the highest accuracy of the four methods; however, this approach requires measured hydrogen leakage rates, which are currently not available since design & engineering has not yet been developed for Angeles Link infrastructure. The methodology with the next level of accuracy uses the component-level average emission factors. This methodology is consistent with approaches outlined for hydrocarbons in U.S. EPA's 1995 Protocol for Equipment Leak Emission Estimates[5], and later enhanced by California Air Pollution Control Officers Association's (CAPCOA's) 1999 California Implementation Guidelines for Estimating Mass Emissions of Fugitive Hydrocarbon Leaks at

[3] Hormaza Mejia, Alejandra, Jacob Brouwer, Michael Mac Kinnon, 2020, *Hydrogen Leaks at the Same Rate as Natural Gas in Typical Low-Pressure Gas Infrastructure*, International Journal of Hydrogen Energy, Vol 45: 15, 8810-8826, https://www.sciencedirect.com/science/article/abs/pii/S0360319919347275?via%3Dihub

[4] American Petroleum Institute, 2009, Compendium of Greenhouse Gas Emissions Estimation Methodologies for the Oil and Natural Gas Industry, August, available from CARB online at https://ww2.arb.ca.gov/sites/default/files/2020-04/API%20Compendium%202009.pdf

[5] US EPA, 1995, Protocol for Equipment Leak Emission Estimates, Office of Air Quality, EPA-453/R-95-017 November 1995, https://www.epa.gov/sites/default/files/2020-09/documents/protocol_for_equipment_leak_emission_estimates.pdf

Petroleum Facilities,[6] and South Coast Air Quality Management District's (South Coast AQMD) 2015 Guidelines for Reporting VOC emissions from Component Leaks. However, correlation factors for hydrogen are also currently not available based on the research performed.

The component-count level approach can provide project-specific leakage estimates using the equipment and systems information. Under this approach, the following calculation method is used to determine the leakage rates. The leak factor (LF) is an average value determined from data collected during industry case studies. Units are in mass per time such as pounds per hour. The following equation is used to estimate leaks for each type of component separately (valves, flanges, connections, pressure safety valves, fittings, etc.).

LF = (# of components) x (leak rate per component) *(equation 1)*

Since the actual number of components, operating conditions, and equipment/facility specifics are not available at this phase of the project development at the time of preparation of this Study, the component-count level methodology could not be applied. Detailed engineering and design information regarding equipment types and component counts would support the development of leakage estimates once correlation factors and/or direct hydrogen measurement data is more readily available.

2.1.2 Calculation Methodology

The Study identified the total value chain approach as the most appropriate for preparing high level preliminary estimates of the potential for leakage associated with Angeles Link, including the transmission of hydrogen, as well as third party production and storage, since detailed Angeles Link design and engineering information has not been developed and therefore was not available at the time of this Study. Without specific equipment details, pipeline lengths and pressures, and counts of valves and flanges, amongst other detailed design information, the high-level assumptions made for purposes of this Study may lead to a wide range of leakage estimates with relatively low confidence levels.

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[6] CAPCOA and CARB, 1999, California Implementation Guidelines for Estimating Mass Emissions of Fugitive Hydrocarbon Leaks at Petroleum Facilities, February 1999, https://ww2.arb.ca.gov/sites/default/files/2020-04/CAPCOA%201999.pdf

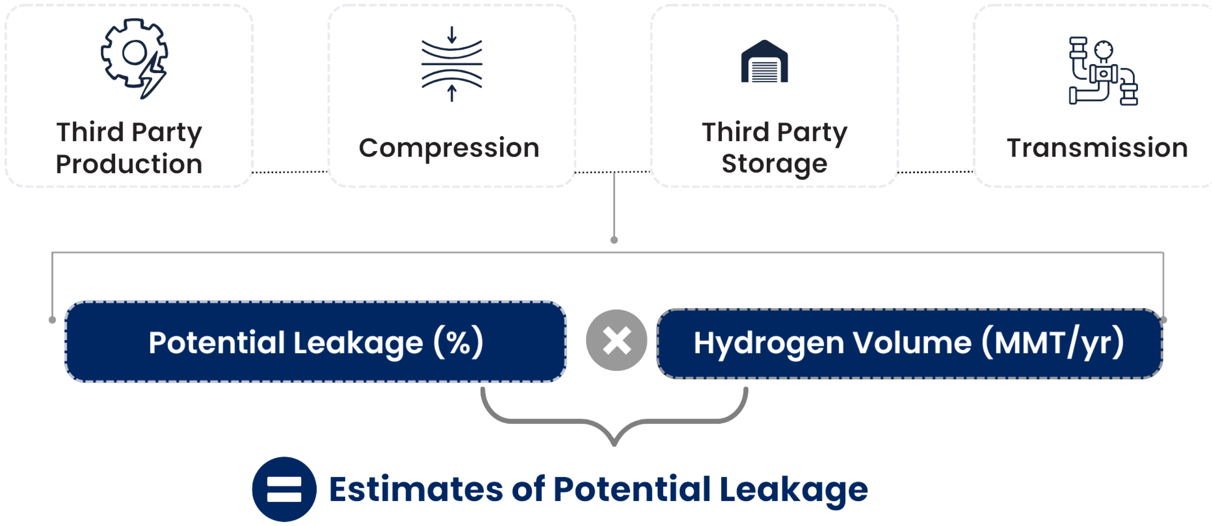

Figure 2 Top-Down Value Chain Leakage Calculation Approach

Figure 2 provides a graphic illustration of the top-down value chain estimation approach. The potential for leakage is provided in the literature as estimated percentages for each of the value chain components (i.e., production, compression, storage, and transmission). These percentages would need to be multiplied by the quantity of hydrogen passing through each value chain component to obtain the estimated leakage for hydrogen. The estimates reviewed in the literature were based on calculations via proxies such as natural gas, laboratory experiments, and theory-based models or simulations. At the time of this Study, project design and engineering of the proposed infrastructure had not been developed to the level of detail needed to prepare a meaningful estimate. This total value chain approach calculation methodology could be performed in the future once additional detail is available.

3.0 BACKGROUND INFORMATION

This section provides background information relating to the properties of hydrogen, leakage in the natural gas industry, the regulatory requirements relevant to the potential for leakage and mitigation of leakage, as well as information regarding types of equipment related to the anticipated Angeles Link infrastructure, as well as third party production and storage.

3.1 PROPERTIES OF HYDROGEN

The physical and chemical properties of hydrogen are relevant to its leakage potential. Physical properties such as weight and density can affect the amount of leakage and its dispersion characteristics. Chemical properties can affect how the gas interacts with its surrounding materials.

Hydrogen is a colorless, odorless, tasteless, flammable gas. A molecule of hydrogen in its common molecular form consists of two hydrogen atoms. It is the smallest existing molecule. Under ordinary ambient conditions, hydrogen is a gas. Common hydrogen has a molecular weight of about 2 grams per mole. As a gas, it has a density of 0.071 grams per liter at 0°C and 1 atmosphere (atm). Its relative density, compared with that of the air, is 0.0695. Hydrogen being lighter than air causes the gas to quickly flow upward if a release occurs. The viscosity, or resistance to flow, of hydrogen is lower than methane, which can contribute to the potential for higher leakage through orifices when compared to natural gas based on fluid dynamics theory. Experimental studies show that hydrogen may leak at the same rate or faster compared to methane and more research is needed to understand hydrogen leakage behavior under various conditions.[7] Hydrogen is slightly more soluble in organic solvents than in water. Many metals absorb hydrogen which is important for designing hydrogen gas enclosures.[8]

3.2 LEAKAGE IN NATURAL GAS INDUSTRY

There is the potential for natural gas leakage from natural gas infrastructure. Sources include compressor rod packing and pipeline connection points such as valves and fittings. Leaks may occur during normal operations or during maintenance activities. Potential leaks may occur during normal operations or resulting from improper equipment installation or equipment malfunction. Leaks may also occur during routine maintenance.

Leak Detection and Repair (LDAR) regulations typically provide a classification, or grade, for leak size, and outline a timeframe for repair. The U.S. EPA estimated in 2016 that 37% of natural gas supply chain leakage was attributable to production, 27% to gathering, 16% to transmission and

[7] National Petroleum Council, April 2024, “Harnessing Hydrogen: A Key Element of the U.S. Energy Future https://harnessinghydrogen.npc.org/downloads.php

[8] Jolly, W. Lee, August 7, 2023, Hydrogen, Encyclopedia Britannica, https://www.britannica.com/science/hydrogen/Production-and-applications-of-hydrogen

storage, 13% to processing, and 7% to distribution.[9] The EPA estimates that the nationwide average leak rate is approximately 2% of natural gas produced whereas other studies estimate a weighted average of 2.95% across several basins and global regions.[10]

In California, CARB issued the Greenhouse Gas Emission Standards for Crude Oil and Natural Gas Facilities that became effective January 1, 2018. This regulation requires quarterly LDAR inspections amongst other requirements to minimize methane emissions to the atmosphere. The latest amendments, which include reduced leak repair times, were effective April 1, 2024. The most recent 2020 Annual LDAR Summary report by CARB, published November 2023, states that the average leakage rates within the regulated natural gas industry (natural gas production, storage, transmission, gathering and boosting, and processing) under this program ranged from 0.4% to 1.66% (number of leaks compared to unique components surveyed).[11] Valves and connectors were observed to contribute more than 70% of the components found to be leaking in 2020.

Senate Bill (SB) 1371 in California requires the implementation of best management practices to minimize methane to the atmosphere. Compliance plans are prepared and annual reports of methane reductions are provided to CARB. With these requirements, measures have been evaluated and are being implemented that can potentially be adopted and applied for future hydrogen infrastructure projects.

3.3 REGULATORY REQUIREMENTS

Regulatory requirements may limit the potential for leakage associated with hydrogen infrastructure. A review of regulations was conducted to understand the potential drivers and requirements for potential mitigation measures to minimize leakage.

The US Department of Transportation (DOT) has regulated the safety of hydrogen pipelines since 1970 via Pipeline and Hazardous Materials Safety Administration (PHMSA) regulations, codified in Title 49 Code of Federal Regulations (CFR) Part 192, Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards. PHMSA regulations covers pipeline design, construction, operation, maintenance, and spill response.[12]

In May 2023, PHMSA proposed LDAR regulatory amendments to implement congressional mandates in the Protecting Infrastructure of Pipelines and Enhancing Safety Act of 2020 to reduce emissions from new and existing gas transmission pipelines, distribution pipelines, and regulated

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[9] PBS NewsHour, 2018, The U.S. natural gas industry is leaking way more methane than previously thought, July 4, https://www.pbs.org/newshour/science/the-u-s-natural-gas-industry-is-leaking-way-more-methane-than-previously-thought

[10] National Petroleum Council, April 2024, Ibid.

[11] CARB, 2023, CARB's Oil and Gas Methane Regulation 2020 Annual LDAR Summary, https://ww2.arb.ca.gov/sites/default/files/2023-11/CARBOilandGasMethaneRegulation2020AnnualLDARSummary.pdf

[12] Congressional Research Service, 2021, *Pipeline Transportation of Hydrogen: Regulation, Research, and Policy*, March 2, CRS Report R46700, https://crsreports.congress.gov/product/pdf/R/R46700

(Types A, B, C and offshore) gas gathering pipelines.[13] This includes the approximately 1,600 miles of hydrogen pipelines in operation today and the proposed amendments apply to both natural gas and hydrogen pipelines. This recent LDAR proposal outlines grading and repair of leaks based on a classification, or grade, for leak size or specified percentages of lower explosive limit (LEL), and outlines a timeframe for repair. An LEL for hydrogen gas is given as 4% gas by volume.[14]

PHMSA is participating with the DOT, Research and Innovation Technology Administration (RITA), the U.S. DOE, U.S. Department of Commerce (DOC), National Institute of Standards and Technology (NIST) and others towards establishing a National Hydrogen Energy Roadmap. The goal of this roadmap is to expedite the production, processing, delivery, storage, and use of clean hydrogen to help meet the federal goal of 100% carbon pollution-free electricity by 2035.[15]

Regulations can impact the potential for leakage via design requirements and mitigation measures. The inclusion of hydrogen pipelines within PHMSA's proposed LDAR regulation may increase the speed at which leaks are detected and repaired, and minimize the total volume of gas leaked, by requiring regular leak detection monitoring and by providing structured requirements around how quickly repairs are required.

[13] Federal Register, 2023, *Pipeline Safety: Gas Pipeline Leak Detection and Repair*, 88 Fed. Reg. 31890 (May 18, 2023) (amending 40 CFR 191, 192, 193)

[14] US DOE, Office of Energy Efficiency and Renewable Energy (EERE), Hydrogen Safety – H1 fact sheet series, https://www1.eere.energy.gov/hydrogenandfuelcells/pdfs/h2_safety_fsheet.pdf

[15] U.S. State Department and Executive Office of the President, The Long-Term Strategy of the United States: Pathways to Net-Zero Greenhouse Gas Emissions by 2050, November 2021, available at: https://www.whitehouse.gov/wp-content/uploads/2021/10/US-Long-Term-Strategy.pdf.

3.4 INFRASTRUCTURE COMPONENTS AND EQUIPMENT

Snapshot 1: Expected Components and Equipment for Hydrogen Infrastructure

Overview of Expected Components and Equipment for Hydrogen Infrastructure

THIRD PARTY PRODUCTION

- **Electrolysis:** A process that uses electricity to split water into hydrogen and oxygen, providing a clean source of hydrogen when powered by renewable energy.
- **Biomass Gasification:** Converts organic materials such as agricultural residues into hydrogen, carbon monoxide, and carbon dioxide through high-temperature processing in a controlled environment with limited oxygen.
- **Steam Methane Reforming (SMR):** A common method for producing hydrogen by reacting methane with steam over a catalyst to produce hydrogen and carbon dioxide.

COMPRESSION

- **Reciprocating Compressor:** Uses a piston within a cylinder to compress and transport hydrogen at high pressures, commonly used for small to medium-scale operations.
- **Centrifugal Compressor:** Employs a rotating disk or impeller to accelerate and then decelerate captured air or gas to pressurize and transport it, suitable for large-scale hydrogen movement.

THIRD PARTY STORAGE

- **Aboveground Tanks/Vessels:** Storage units located above the earth's surface for holding compressed or liquefied hydrogen, designed to handle various pressure levels.
- **Underground Storage:** Caverns or reservoirs used for large-scale underground storage of hydrogen

TRANSMISSION

- **Pipelines:** Specially designed conduits made from materials compatible with hydrogen to safely transport hydrogen gas from production sites to points of use, considering hydrogen's specific properties like its small molecular size and reactivity.

Production (Third Party)

Clean Renewable Hydrogen Production Methods

Three primary methods for generating clean renewable hydrogen were evaluated:

- **Electrolysis:** This process employs electricity to dissociate water into hydrogen and oxygen, with the electrical power sourced exclusively from renewable energies.
- **Steam Methane Reforming with Renewable Natural Gas:** In this catalytic process, renewable biogas reacts with steam, producing hydrogen and carbon dioxide.
- **Biomass Gasification:** Organic materials, including agricultural and forest residues, energy-specific crops, and organic municipal solid waste, undergo thermochemical conversion in low-oxygen or anaerobic conditions at temperatures above 1,300°F. This conversion process yields hydrogen, carbon monoxide, and carbon dioxide.

Compression, Thid Party Storage, and Transmission of Clean Renewable Hydrogen

Compression

The process of compression involves increasing the pressure of hydrogen gas to facilitate its storage and transmission. This is typically accomplished using specialized compressors such as reciprocating or centrifugal compressors. Each type is selected based on specific system requirements, including the required pressure levels and flow rates. Compressors should be efficient and designed and operated to minimize leaks.

Storage (Third Party)[16]

- **Above Ground Storage:** Above Ground Hydrogen Storage offers a flexible, scalable option for hydrogen containment, utilizing advanced vessel technologies to store gaseous hydrogen under high pressure. This method capitalizes on the properties of materials such as high-strength steel and composite structures for safety and durability. Above ground tanks are particularly beneficial for their accessibility and ease of integration into existing hydrogen infrastructure, making them ideal for dynamic systems with variable demand. This storage solution is well-suited for short-term and medium-term energy storage needs, providing an important buffer to accommodate fluctuations in supply and demand.
- **Underground Storage:** Underground storage solutions can offer a large-scale option for hydrogen storage, utilizing natural geological formations to contain vast amounts of hydrogen under high pressure. Storage can play a particularly important role for long-term energy storage, providing a buffer against supply and demand fluctuations. Storage

[16] Various storage technologies are discussed and explored in greater detail within the Pipeline Sizing & Design Report.

technologies such as salt cavern storage or hydrocarbon reservoirs are discussed in further detail within the Storage Chapter of the Pipeline Sizing & Design Report.

Transmission

Approximately 1,600 miles of hydrogen pipelines are currently operating in the United States.[17] Owned by merchant hydrogen producers, these pipelines are typically located where large hydrogen users, such as petroleum refineries and chemical plants, are concentrated, such as in the Gulf Coast region. As of the year 2021, there are 14 miles of hydrogen pipelines in California.

[17] U.S. DOE, Office of Efficiency & Renewable Energy, *Hydrogen Pipelines*, 2023, available at: https://www.energy.gov/eere/fuelcells/hydrogen-pipelines

4.0 POTENTIAL FOR LEAKAGE

As measurement technology is further developed over time, and more data is available, more specific estimates of potential for leakage may be developed. It should be noted that consistent with the Decision, Angeles Link is intended to transport only 100% clean renewable hydrogen, and any analysis of hydrogen blending refers strictly to potential end users' "behind-the-meter" operations, and not hydrogen use within SoCalGas's control.

4.1 SOURCES OF POTENTIAL LEAKAGE

To identify sources of potential hydrogen leakage, this Study evaluated the potential for hydrogen leakage from anticipated equipment and systems that would be associated with Angeles Link, as well as third party production and storage. The following potential hydrogen value chain leakage sources were identified in the consulted literature and are evaluated in this Study: production, compression, storage (above ground & underground), and transmission through pipelines. Table 1 was developed to represent the subset of potential sources of leakage that may be applicable to the Angeles Link infrastructure (e.g. transmission and compression) identified based on the evaluation of the general hydrogen value chain (e.g. includes transmission, compression, and third party production and storage) considered by EDF and UCI in their research and specifically in their recent publication, "Wide range in estimates of hydrogen emissions from infrastructure."[18] This information is also referenced in another recent article from EDF.[19] This publication summarizes the more relevant studies over the past two decades, to estimate total value chain and component-level hydrogen leaks, in order to assess the potential risk of large-scale hydrogen use on the climate. The estimation methods in the background studies referenced in the publication are dependent on assumptions, calculations via proxies, laboratory experiments, as well as theoretical models or simulations.

Table 1: Potential Sources of Leakage from Hydrogen Infrastructure

[18] Esquivel-Elizondo, Sofia, Alejandra Hormaza Mejia, Tianyi Sun, Eriko Shrestha, Steven P. Hamburg and Ilissa B. Ocko, 2023, *Wide Range in Estimates of Hydrogen Emissions from Infrastructure*, Frontiers in Energy Research Vol. 11: 1207208, https://www.frontiersin.org/articles/10.3389/fenrg.2023.1207208/full

[19] Sun, T., E. Shrestha, S. Hamburg, R. Kupers, I. Ocko, *Climate Impacts of Hydrogen and Methane Emissions Can Considerably Reduce the Climate Benefits across Key Hydrogen Use Cases and Time Scales*, Environ. Sci. Technol., February 21, 2024, available at: https://pubs.acs.org/doi/10.1021/acs.est.3c09030.

PRODUCTION	COMPRESSION	STORAGE	TRANSMISSION
• Piping and equipment • Residual H2 • Venting • Purging	• Piping and equipment • Venting • Purging	• Aboveground: Equipment • Underground: Venting, Purging	• Pipelines • Venting

Hydrogen Production: SoCalGas will utilize hydrogen production conducted by third-party producers. The primary pathways for potential hydrogen leakage related to production of clean renewable hydrogen are via operation of the production equipment and associated piping such as during purging and the process of removing impurities. Leakage may also occur from piping components such as valves and connections.

Information regarding electrolyzer and steam methane reformer production options available in the literature was reviewed. In electrolyzers, the vented oxygen stream may also carry residual hydrogen due to hydrogen crossover through the membrane between the electrodes. Leakage of hydrogen through the casing of the electrolyzer is assumed to be negligible and mitigated through laminated gaskets and welded joints.[20]

In steam methane reformers, the hydrogen purification process removes CO2 and other impurities from the primary syngas stream. Depending on the calorific value of the rejected stream, it could be used as fuel or combusted. In either case, hydrogen could be captured and minimized by following proper design and operational procedures.

Hydrogen Compression: Hydrogen compression is a subcategory of both storage and transmission since both may use compressors. Seals and packing vents of compressors have the potential to release hydrogen. Blowdowns, purging, and other venting processes may result in

[20] Frazer-Nash Consultancy, 2022, Fugitive Hydrogen Emissions in a Future Hydrogen Economy, prepared for the U.K. Department for Business, Energy & Industrial Strategy (BEIS), https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1067137/fugitive-hydrogen-emissions-future-hydrogen-economy.pdf

hydrogen releases during maintenance activities. These sources of potential leakage can be mitigated by, for example, routing the hydrogen for recompression into the process stream. Potential leaks may also occur from pipeline components, including valves and connectors. Current research related to compression focuses on the need for lower cost, more reliable, and more durable hydrogen compression technology.

Hydrogen Storage: Third-party operated hydrogen storage facilities may connect to Angeles Link. For the purpose of this evaluation, hydrogen storage may occur above ground or below ground. This Study focused on leakage as it pertains to storage of hydrogen in gaseous form. Liquid storage was not evaluated for this Study. Both aboveground and underground storage technologies are discussed in detail within the Pipeline Sizing and Design Study. These include, and are not limited to, compressed gas cylinders, pressure vessels, and tanks for aboveground storage; and salt caverns and depleted oil and gas reservoirs for underground storage.

Aboveground storage technologies pose a potential for leakage from components such as during equipment maintenance activities. Underground storage technologies for hydrogen such as salt caverns, depleted oil and gas reservoirs, and engineered cavities present a potential for leakage associated with maintenance operations and geologic migration/diffusion. At the surface level, underground facilities have maintenance plants from which there is potential for leakage during maintenance activities. The potential for underground hydrogen leakage in salt caverns is considered to be low since the hydrogen gas is within the salt that is effectively impermeable.[21] This highlights the intrinsic feature of salt formations in preventing hydrogen escape (because of their natural impermeability).

Development of assumptions regarding above ground and underground storage volumes and pressures can support refinement of leakage estimates. The sealing potential of a caprock to hydrogen gas depends on the caprock ability to withstand mechanical and hydraulic gas infiltration.[22]

Geochemical reactions that may take place during hydrogen injection in underground hydrogen storage include oxidation-reduction reactions with iron minerals such as iron bearing clays, micas, hematite, and goethite impacting rock strength as well as formation of leakage pathways in the caprock. Hydrogen can diffuse easily and can, therefore, begin to move through fractures and across faults in the caprock, potentially leading to leakage.[23] The low solubility of hydrogen in water may minimize the losses of hydrogen due to diffusion as the water saturated caprock acts as a permeability barrier to hydrogen.[24]

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[21] Gaffney Cline Consultancy Company, 2022, Underground Hydrogen Storage, https://www.gaffneycline.com/sites/g/files/cozyhq681/files/2022-07/gaffneycline_underground_hydrogen_storage_article.pdf
[22] Derouin, Sarah, 2023, Materials Highlight: What makes a salt cavern useful for hydrogen storage? | ASCE
[23] Gaffney Cline Consultancy Company, 2022, Underground Hydrogen Storage, https://www.gaffneycline.com/sites/g/files/cozyhq681/files/2022-07/gaffneycline_underground_hydrogen_storage_article.pdf
[24] Panfilov, 2016, Underground and pipeline hydrogen storage - ScienceDirect

Recent research and studies have evaluated the technical aspects of hydrogen storage in various types of reservoirs and the initial conclusions are that salt caverns are currently being used for storage and successfully minimizing leakage; and that depleted oil and gas reservoirs are currently being piloted and researched.[25]

Hydrogen Transmission: Hydrogen is anticipated to be transmitted via pipelines to operational assets and end users. Traditional operations and maintenance activities that require pipelines to be cleared of gas such as blowdowns, purging, and/or other venting processes may result in hydrogen releases unless controlled through capture and control practices. These sources of potential leakage can be mitigated such as by routing the hydrogen for recompression into the process stream. Potential leaks may also occur from pipelines components, including valves and connectors, and other equipment handling hydrogen, however material selection and gas specific design considerations coupled with best management practices can mitigate or greatly reduce potential leaks. Material properties and recommendation information is available in the parallel Pipeline Sizing & Design Criteria Study.

Current research focuses on overcoming technical issues that can potentially lead to leaks related to pipeline transmission, including:

- Embrittlement: the potential for hydrogen to embrittle steel and welds used to fabricate the pipelines (hydrogen embrittlement is mechanical damage of a metal due to the penetration of hydrogen into the metal causing loss in ductility and tensile strength).
- Permeation: the potential for hydrogen permeation and leaks (hydrogen permeation is the diffusion of hydrogen ions through the thin metal isolation diaphragms used in pressure transmitters).

4.2 LEAK ESTIMATION METHODOLOGIES

Leakage estimation methodologies include direct measurements, as well as wide-ranging estimation methodologies comprised of calculations via proxies such as natural gas, laboratory experiments, and theory-based models or simulations as discussed in studies evaluated in the literature. These methodologies are important in identifying and quantifying potential hydrogen leaks, offering a nuanced understanding that informs mitigation strategies.

- **Detection Sensors:** Instrumental in the early detection of hydrogen leaks, these technologies include semiconductor sensors, electrochemical cell sensors, and ultrasonic detectors. Deployed at junctures within the infrastructure, their function could be pivotal in enhancing leak mitigation by providing timely notifications upon detecting hydrogen presence, thus enabling swift initiation of containment procedures.

[25] Gaffney Cline Consultancy Company, 2022, Underground Hydrogen Storage, https://www.gaffneycline.com/sites/g/files/cozyhq681/files/2022-07/gaffneycline_underground_hydrogen_storage_article.pdf

- **Measurement Tools:** Post-detection, accurately quantifying the leak's magnitude is imperative for assessing its severity and deciding on appropriate remedial measures. Measurement tools are employed to determine the concentration of hydrogen, enabling precise calculation of leak rates. This quantification is helpful for impact assessments, informing repair strategies, and ensuring regulatory compliance.

Information regarding hydrogen sensors as leak detection instruments, which are crucial for conducting direct measurements, is elaborated upon in Section 4.2.1. Additionally, estimates of potential leakage, derived from a review of existing literature and encompassing both direct measurement data and theoretical estimations, are detailed in Section 4.2.2. This comprehensive approach to leakage estimation leverages both advanced detection technologies and sophisticated measurement tools, ensuring a robust framework for identifying, quantifying, and mitigating the potential for hydrogen leakage associated with the infrastructure.

4.2.1 Hydrogen Detection Sensors and Direct Measurement Tools

The direct measurement of hydrogen leakage is pivotal for refining leakage estimation methodologies, such as the development of leakage factors for both top-down and bottom-up assessments across the hydrogen value chain or its specific components. The infancy of direct hydrogen measurement is primarily due to the existing lack of instruments capable of accurately measuring hydrogen at very low concentrations.[26] The measurement tools for monitoring hydrogen leakage have historically been focused on safety and economics measuring at the ppm levels and have not been capable of quantifying hydrogen at the facility level.[27]

Current commercially available sensors for industrial applications have detection levels down to parts per million,[28] and research is underway regarding part per billion levels. Measurement tools with more accuracy may also be used to quantify leakage concentrations, such as with sensitivity at the parts per billion level, as well as the ability to respond in seconds and correctly identify hydrogen amongst other compounds. Direct measurement used to estimate leakage is dependent on the sensitivity and accuracy of the instruments used. Emerging detection technologies provide opportunities to further enhance leak detection and measurement. For example, semiconductor sensors and electrochemical sensors have high sensitivity and can accurately detect concentrations of hydrogen less than 10 parts per million (ppm) with potential for operational integration into regulatory frameworks, which could substantially enhance both

[26] Esquivel-Elizondo, Sofia, Alejandra Hormaza Mejia, Tianyi Sun, Eriko Shrestha, Steven P. Hamburg and Ilissa B. Ocko, 2023, Wide Range in Estimates of Hydrogen Emissions from Infrastructure, Frontiers in Energy Research Vol. 11: 1207208, https://www.frontiersin.org/articles/10.3389/fenrg.2023.1207208/full

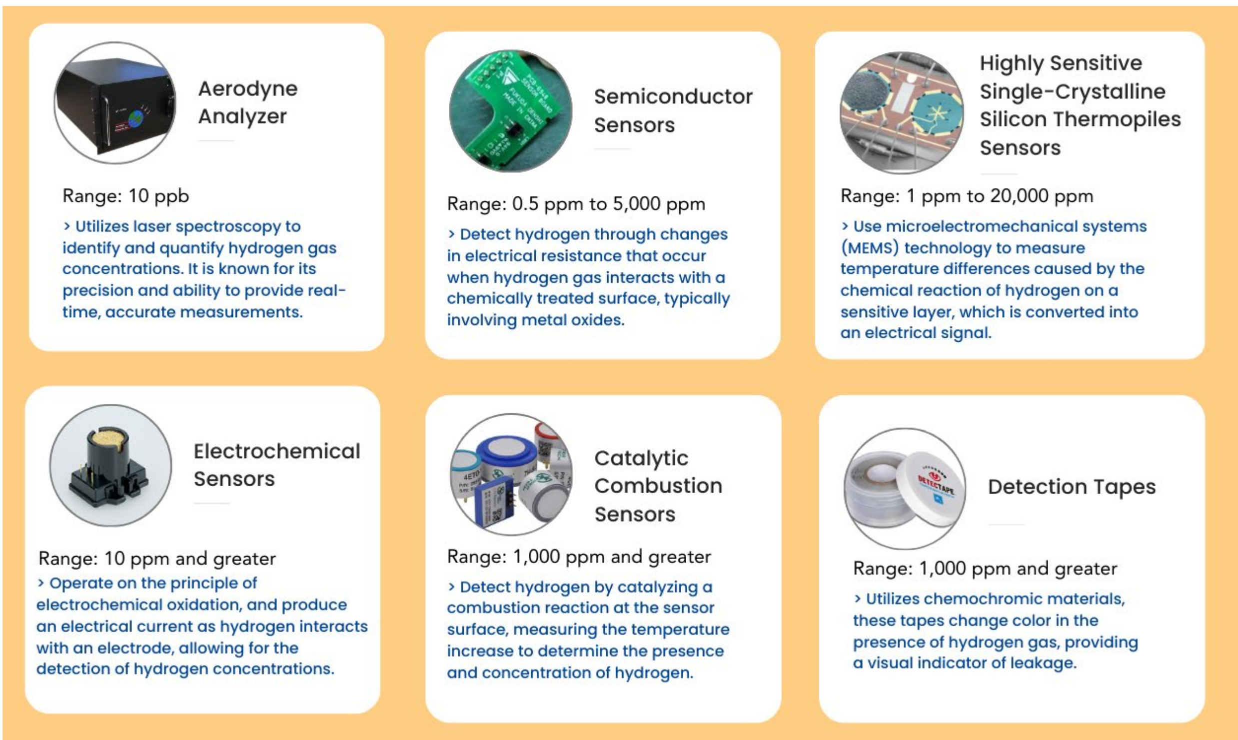
[27] National Petroleum Council, April 2024, Ibid.

[28] Najjar, Y.SH. and Mashareh S, 2019, Hydrogen Leakage Sensing and Control: (Review), Biomedical Journal of Scientific and Technical Research 21(5), https://biomedres.us/pdfs/BJSTR.MS.ID.003670.pdf

proactive and reactive responses to hydrogen leak scenarios. [29] [30] Additional details are available in the Future Considerations section of the Draft Pipeline Sizing and Design Study Report.

This Study reviewed several types of leak detection equipment and evaluated anticipated advancements in sensor technology. Specific existing and emerging hydrogen leakage detection and measurement technologies reviewed are summarized in snapshot 2 below. Information regarding other hydrogen detection equipment is provided in the parallel "Plan for Applicability Safety Requirements" document based on a literature review, manufacturer's specifications, and vendor inquiries. Additional details regarding each technology follow the snapshot.

Snapshot 2: Summary of Leak Detection Sensor and Measurement Technologies



<u>Aerodyne Analyzer</u>

Aerodyne Research, Inc., in collaboration with EDF and funded through the DOE, developed an analyzer[31] that uses laser spectroscopy to detect and quantify hydrogen concentrations down to 10 parts per billion (ppb). The objective is to be able to quantify hydrogen emissions at the facility level. During testing in January 2023 at Colorado State University, precision measurements were

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[29] Wang, Chao, Jiaxuan Yang, Jiale Li, Chenglin Luo, Xiaowei Xu, and Feng Qian, 2023, Solid-state electrochemical hydrogen sensors: A review, International Journal of Hydrogen Energy: 48 (80) pgs 31377-31391, https://doi.org/10.1016/j.ijhydene.2023.04.167

[30] Zhang, Haozhi, Hao Jia, Zao Ni, Ming Li, Ying Chen, Pengcheng Xu and Xinxin Li, 2023, *1ppm-detectable hydrogen gas sensors by using highly sensitive P+/N+ single-crystalline silicon thermopiles*, Microsystems & Nanoengineering: 9(29), https://doi.org/10.1038/s41378-023-00506-2

[31] As Climate Concerns About Hydrogen Energy Grow, New Tech Unveiled at CERAWeek Delivers Unprecedented Results Measuring Leaks, Other Emissions | Environmental Defense Fund (edf.org)

collected every second with 98% accuracy. The Aerodyne Analyzer's portability allows it to be utilized in a variety of settings, including vehicles and small aircraft.

Semiconductor Sensors

A key example of a sensor used for hydrogen leak detection is the semiconductor type, which features a sintered structure where tin oxide is vitrified. At normal room temperature, this type of sensor does not allow electricity to flow. However, when operating in ambient air conditions, oxygen in air is adsorbed to the sensor surface of the detector. The adsorbed oxygen inhibits the flow of electrons, causing high electric resistance and a condition where electricity is difficult to flow (with no oxygen, electricity starts to flow when the sensor is exposed to a high temperature of approximately 752°F). When hydrogen gas is pulled in during the measurement, hydrogen molecules attach to oxygen (oxidation reaction) and oxygen attached to tin oxide decreases. Since the amount of oxygen on the sensor surface decreases, the electric resistance value decreases and electricity starts to flow easily. Leakage of hydrogen gas and gas concentrations are detected through this change of electric current. Figure 3 depicts these principles of a hydrogen leak test using semiconductor sensors.

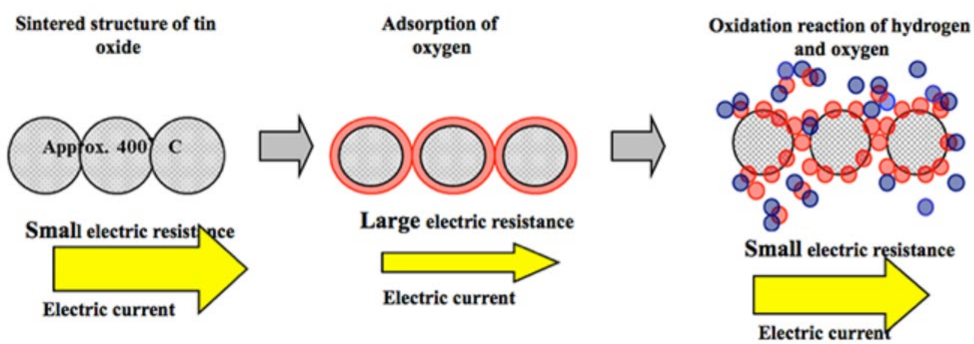

Figure 3 Semiconductor Sensors

For example, the Fukuda portable hydrogen leak detector HDA-0100 is an example of one of these detectors, with a sensitivity range of 0.5 to 5,000 ppm. It can detect relatively low levels of hydrogen (gas volume: 1×10^{-6} Pa・m3 /s) emitted from capillaries.[32] According to the variation of electrical and optical properties of semiconductor oxide (SMO) sensors under a hydrogen-containing atmosphere, the SMO hydrogen sensors can be divided into four types: resistance based, work function based, optical, and acoustic.[33]

Resistance Based: These sensors operate on the principle that the resistance of a semiconductor metal oxide layer changes upon exposure to hydrogen. Typically constructed with an SMO layer on an insulating substrate, flanked by two electrodes, and a heater beneath the sensitive layer, these sensors are engineered for optimal

[32] FUKUDA, 2024, *Measurement Principle of Hydrogen Leak Test*, industry webpage Portable Hydrogen Leak Detector / FUKUDA CO., LTD. (fukuda-jp.com)
[33] https://www.mdpi.com/1424-8220/12/5/5517

performance at elevated temperatures—often several hundred degrees Celsius. This thermal management enhances the adsorption and reaction kinetics of hydrogen on the sensor surface, resulting in a measurable change in electrical resistance directly correlated to hydrogen concentration levels. The linear response within a specified concentration range provides a reliable method for detecting hydrogen leaks, offering a balance between sensitivity and operational stability.

Work Function Based: Employing a change in work function as the primary detection mechanism, these sensors manifest in various configurations: the Schottky diode type, metal/oxide/semiconductor (MOS) capacitor type and the MOS field-effect transistor (MOSFET) type. Field-effect transistor (FET) and Schottky diode hydrogen sensors are two different types of work function sensors. The interaction between hydrogen and the sensor's surface alters the work function, modulating the sensor's electrical properties in a manner that can be quantitatively related to the hydrogen concentration. These devices highlight the intricate interplay between materials and sensor technology, offering nuanced detection capabilities that extend beyond simple resistance changes, potentially enabling more precise and selective hydrogen sensing solutions.

Optical: Optical hydrogen sensors utilize a variety of light-based techniques to detect hydrogen, among which, Raman scattering stands out for its specificity and feasibility for hydrogen detection. Unlike other optical methods that may lack the specificity for hydrogen gas, Raman scattering exploits inelastic light scattering to produce a spectral fingerprint unique to hydrogen.[34] This specificity is further enhanced in optical SMO hydrogen sensors, which detect changes in the optical properties of semiconductor materials upon exposure to a hydrogen-containing environment. Typically configured with thin films applied to the tips or sides of optical fibers, these sensors—known as optrodes or optodes—transform optical property variations into detectable optical signals, offering a unique approach to hydrogen detection.

Acoustic: Acoustic hydrogen sensors operate by detecting changes in the acoustic wave properties (e.g., resonance frequency) of piezoelectric materials, which occur due to the adsorption of hydrogen onto the sensing layers. This method relies on the principle that the resonance frequency of both bulk and surface acoustic wave (BAW, SAW) devices is sensitive to the accumulation of mass on the surface of the piezoelectric materials. The adsorption of hydrogen molecules leads to a measurable change in mass, thus altering the resonance frequency. With its high sensitivity and capability of detecting minute concentrations of hydrogen in various conditions, these devices could be invaluable for monitoring.

[34] Arrigoni, Alessandro and Laura Bravo Diaz, 2022, Hydrogen Emissions from a Hydrogen Economy and their Potential Global Warming Impact, Publications Office of the European Union EUR 31188 EN, ISBN 978-92-76-55848-4, doi:10.2760/065589, JRC130362. https://publications.jrc.ec.europa.eu/repository/handle/JRC130362

Highly Sensitive Single-Crystalline Silicon Thermopiles Sensors

The Single-Crystalline Silicon Thermopile technology, leveraging Micro Electro-Mechanical Systems (MEMS) to create differential thermopile gas sensors, represents a promising avenue in the sensitive and rapid detection of trace hydrogen gas in the air. Integrating two identical temperature-controlled thermopiles, these sensors can detect minute temperature changes resulting from the catalytic reaction of hydrogen on a sensing thermopile. The use of single-crystalline silicon, chosen for its significant Seebeck coefficient (*the Seebeck effect is a phenomenon in which a temperature difference between two dissimilar electrical conductors or semiconductors produces a voltage difference between the two substances*), along with high-density thermocouples, endows the thermopiles with a temperature sensitivity of 28 millivolt per °C and sub-millikelvin level temperature resolution. This technology provides a detection limit of 1 ppm, spanning a broad linear detection range from 1 ppm to 20,000 ppm, coupled with swift response and recovery times of 1 to 2 seconds. Additionally, these sensors are distinguished by their selectivity towards hydrogen, which supports reliable repeatability and long-term stability, making them indispensable for applications demanding high precision and reliability in hydrogen detection.[35]

Electrochemical Sensors

Electrochemical hydrogen sensors utilize electrochemical reactions at the sensing electrode to delineate hydrogen concentrations, with the sensor's output signal changing proportionally to the hydrogen levels at the electrode surface. The advantages of such sensors include their ability to operate at room temperature with relatively low power requirements, marking them as energy-efficient solutions for continuous hydrogen monitoring. The underlying principle of these sensors is that hydrogen reacts with the sensing electrode material to produce electron transfer, hydrogen is oxidized at the anode, oxygen is reduced at the cathode, and the concentration of hydrogen is obtained by detecting the change of electrical signal.[36] This reaction mechanism allows for the accurate quantification of hydrogen concentration, providing relevant data for ensuring efficiency in hydrogen-fueled systems.

Catalytic Combustion Sensors

These sensors incorporate sensing elements alongside catalytic metals like Palladium, Platinum, and Ruthenium to facilitate the detection of hydrogen through spontaneous oxidation reactions. Hydrogen is spontaneously oxidized at a temperature above its ignition point (1,085°F) when the environment does not contain a catalyst or ignition source. However, hydrogen's ignition point decreases to 572 to 932°F in the presence of a catalytic metal such as Platinum. When the

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[35] Zhang, Haozhi, Hao Jia, Zao Ni, Ming Li, Ying Chen, Pengcheng Xu and Xinxin Li, 2023, 1ppm-detectable hydrogen gas sensors by using highly sensitive P+/N+ single-crystalline silicon thermopiles, Microsystems & Nanoengineering: 9(29), https://doi.org/10.1038/s41378-023-00506-2

[36] Wang, Chao, Jiaxuan Yang, Jiale Li, Chenglin Luo, Xiaowei Xu, and Feng Qian, 2023, *Solid-state electrochemical hydrogen sensors: A review*, International Journal of Hydrogen Energy: 48 (80) pgs 31377-31391, https://doi.org/10.1016/j.ijhydene.2023.04.167

temperature of the sensing element increases during an exothermic reaction between hydrogen and oxygen on the surface of the catalytic metal, the resistance value of the sensing element changes, and the hydrogen concentration is measured in terms of the change in the resistance value. Despite their effectiveness, the high operating temperatures and power consumption of catalytic combustion sensors limit their utility in portable applications, highlighting the need for innovations that balance efficacy with operational efficiency.[37]

Detection Tapes

Detection tapes, developed through extensive collaboration between research institutions and supported by agencies such as the U.S. DOE Hydrogen and Fuel Cell Technologies Office and NREL, offer a simple yet effective approach to hydrogen detection. These tapes, made from a silicone base impregnated with transition metal oxides, exhibit a visible color change upon exposure to hydrogen, facilitating rapid detection at concentrations as low as 1,000 ppm. The tape can be readily used on flanges, welded seams and joints, rigid pipelines, and flexible tubing.38 Their ease of use, coupled with the ability to provide immediate visual indications of hydrogen presence, makes them a valuable tool for initial leak detection and safety inspections across a variety of settings, including industrial sites, laboratories, and fuel cell installations. The integration of chemochromic materials into the tape design represents a novel approach to gas detection, combining chemical sensitivity with physical durability to provide effective monitoring over extended periods. [39]

4.2.2 Published Studies Regarding Hydrogen Leakage

The estimates of potential for leakage from components of new hydrogen infrastructure (e.g., production, compression, storage, and transmission) in available literature were reviewed to gather information for potential future implementation of the total value chain approach estimate. The total value chain approach is a top-down methodology and considers the leaks for a complete system such as hydrogen production assets, compression, storage systems, and transmission. In some cases, the systems are analyzed to consider a large group of facilities and in some cases, across an entire country.[40] This approach uses generalized datasets and leads to a wide range of emissions estimates. Many of the estimated leakage rates found in the literature are based on hydrogen leak assumptions and estimates from natural gas systems. Estimates of leakage rates are uncertain due to the lack of empirical data regarding real-world infrastructure and facilities.[41] The publications reviewed appear to generally agree on the need of performing

[37] Leea, Jun-Seo, Jin Woo Ana, Sukang Baeb, and Seoung-Ki Leea, 2022, *Review of Hydrogen Gas Sensors for Future Hydrogen Mobility Infrastructure*, Applied Science and Convergence Technology 31(4) pgs 79-84, https://doi.org/10.5757/ASCT.2022.31.4.79

[38] Fan, Zhiyuan, Hadia Sheerazi, Amar Bhardwaj, Anne-Sophie Corbeau, Kathryn Longobardi, Adalberto Castañeda Vidal, Ann-Kathrin Merz, Dr. Caleb M. Woodall, Mahak Agrawal, Sebastian Orozco-Sanchez, Dr. Julio Friedmann, 2022, Hydrogen Leakage: A Potential Risk for the Hydrogen Economy, report from Colombia Center on Global Energy Policy, July, https://www.energypolicy.columbia.edu/publications/hydrogen-leakage-potential-risk-hydrogen-economy/

[39] Zhang, Haozhi, et al., 2023, Ibid

[40] Arrigoni, Alessandro and Laura Bravo Diaz, 2022, Ibid.

[41] Esquivel-Elizondo, Sofia, et al., 2023, Ibid.

additional research and investigation to generate more refined estimates of the potential for leakage.

This Study leaned heavily on an articlethat was prepared by EDF and the National Fuel Cell Research Center at UCI in 2023 that compiled information gathered from several articles published over the past two decades to estimate total value chain and component-level hydrogen leaks, in order to assess the potential risk of large-scale hydrogen use on the climate.[42] The estimation methods in the background studies referenced in the publication used various methods to develop the potential for leakage estimates which included assumptions, calculations via proxies such as natural gas, laboratory experiments, and theory-based models or simulations.

Another article prepared by EDF was also reviewed for this Study report.[43] Key findings from this research highlighted the substantial variability in hydrogen leakage rates across different system components. The insights into the disparate sources and scales of potential leaks are instrumental for developing targeted mitigation strategies, supporting the environmental integrity of clean renewable hydrogen. Additionally, highlighting the variability and potential sources of hydrogen leaks spurs innovation in detection, measurement, and mitigation technologies, which are helpful for harnessing hydrogen's full potential as an energy resource.

A summary of unmitigated estimates for the total value chain approach that may be applicable to new hydrogen infrastructure, such as Angeles Link and the associated production and storage infrastructure of third parties, is provided in the snapshots 3, 4, 5, and 6 below. These estimates range significantly, reflecting the variability in methodologies, assumptions, and technological efficiencies considered in the literature. These values may be reduced by applying the opportunities to minimize and mitigate leakage discussed in Section 4.3 of this document.

As shown below, there is considerable variability in the values. The background studies were evaluated more closely to determine the assumptions that were used to develop these estimates. This information is provided below.

[42] Esquivel-Elizondo, Sofia, et al., 2023, Ibid.

[43] Sun, Tianyi, et al. "Climate Impacts of Hydrogen and Methane Emissions Can Considerably Reduce the Climate Benefits across Key Hydrogen Use Cases and Time Scales." Environmental Science & Technology, American Chemical Society, Feb. 2024, https://doi.org/10.1021/acs.est.3c09030

Snapshot 3: Overview of Potential Sources of Leakage for Third Party Production

Production

0.0001% to 4%

[Namely: 0.0001%, 0.03%, 0.1%, 0.2%, 0.24%, 0.25%, 0.5%, 0.52%, 4%, 4%]
Contributions from Harrison & Peters (2013), Frazer-Nash (2022), Arrigoni and Diaz (2022), and Cooper et al. (2022).

Causes of Leakage during Production Phase

- Piping and equipment
- Venting
- Purging
- Residual H20

Broad range from **0.0001%** (notably low for steam methane reformers) to **4%** for some electrolyzer technologies, emphasizing the variability dependent on technology and operational efficiency.

Research Insights on Leakage Rates during Production

Steam Methane Reforming (SMR) Leakage Rate at **0.0001%** reflects the highest containment efficiency, primarily due to flaring practices that mitigate hydrogen release.

Electrolyzer Technologies show a wide range of leakage rates **(0.03% to 4%)**, underscoring the influence of technological maturity and specific operational challenges.

Rates of **0.1% and 0.2%** represent current variability in electrolysis efficiency, with losses due to hydrogen and oxygen crossover and dryer process inefficiencies.

A significant **4%** rate in **PEM electrolyzers** points to substantial losses in the dryer phase, indicating specific areas for technological enhancements.

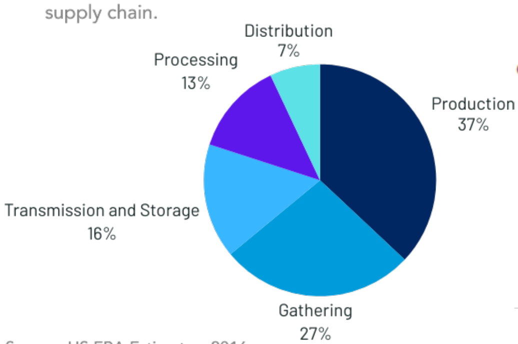
Leakage rates of **0.24% to 0.52%** reflect both expected and upper-threshold leakage under various scenarios, including electrolytic production with full recombination and CCUS-enabled production.

- These rates highlight the challenges in achieving complete containment and the importance of optimizing operational practices and technology to minimize leakage.
- Expected improvements by 2030 could reduce leakage to as low as **0.03%**, highlighting the role of advancements in reducing membrane crossover.

Table 2: Natural Gas Supply Chain Leakage

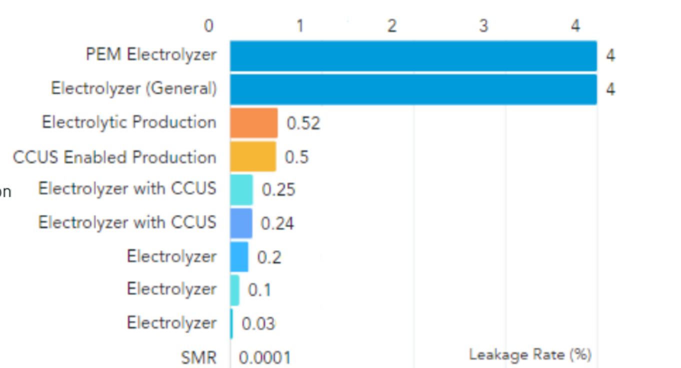
US EPA Estimates, 2016.

This pie chart illustrates the percentage breakdown of natural gas leakage across the supply chain.



Source: US EPA Estimates, 2016.

Table 3: Leakage Rates by Infrastructure Components



Source: Harrison & Peters (2013), Frazer-Nash (2022), Arrigoni and Diaz (2022), and Cooper et al. (2022).

Steam Methane Reforming (SMR)

Leakage Rate: 0.0001%[44]is associated with SMR technology. This low rate signifies the efficiency and containment capabilities of SMR technology in hydrogen production.

Electrolyzer Technologies

Leakage Rates: 0.03%[45], 0.1%[46] 0.2% [47], and 4%[48], with another 4%[49] rate specifically tied to PEM electrolyzers.

- The **0.03%** rate is based on the expectation that hydrogen losses in production will drop by 2030 due to maturing technologies, expected to minimize hydrogen loss, particularly through reduced membrane crossover.
- The **0.1%** rate is derived from a comprehensive analysis of various electrolyzer technologies, representing the lower end of estimated losses for hydrogen production for domestic and international supply chains evaluated.
- The **0.2%** estimate was presented as the current understanding of losses during electrolysis. In addition to inadvertent leakage, the losses are generally due to hydrogen and oxygen crossover through the membrane and to the dryer's regeneration process.
- The first **4%** leakage rate, associated with PEM electrolyzers, emerges from laboratory examinations highlighting that the bulk of hydrogen losses can occur in the dryer phase (3.4%).
- The other **4%** reflects the upper end of a calculation performed to estimate losses for a variety of electrolyzer technologies for green hydrogen production for domestic and international supply chains that were evaluated.

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[44] Arrigoni, Alessandro and Laura Bravo Diaz, 2022, Ibid.
[45] Arrigoni, Alessandro and Laura Bravo Diaz, 2022, Ibid.
[46] Cooper, Jasmin, Luke Dubey, Semra Bakkaloglu, Adam Hawkes, 2022, Hydrogen Emissions from the Hydrogen Value Chain -Emissions Profile and Impact to Global Warming, Science of the Total Environment Vol. 380: 154624, July 15, https://www.sciencedirect.com/science/article/pii/S004896972201717X#s0070
[47] Arrigoni, Alessandro and Laura Bravo Diaz, 2022, Ibid.
[48] Harrison, Peters, 2013, National Renewable Energy Laboratory, 2013 DOE Hydrogen and Fuel Cells Program Review, Renewable Electrolysis Integrated System Development & Testing, Project ID PD031. https://www.hydrogen.energy.gov/docs/hydrogenprogramlibraries/pdfs/review13/pd031_harrison_2013_o.pdf
[49] Cooper, Jasmin, Luke Dubey, Semra Bakkaloglu, Adam Hawkes, 2022, Ibid.

Conventional Fluid Mechanics-Based Modeling

Leakage rates: 0.24%[50] 0.25%[51], 0.50%[52], and 0.52%[53]

0.24% and 0.25% Leakage Rates: These rates were predicted with a 50% confidence level, representing expected leakage under standard conditions. The **0.24%** rate is applied to electrolytic production scenarios where there is full recombination of hydrogen from purging and crossover venting. The **0.25%** rate is associated with Carbon Capture, Utilization, and Storage (CCUS) enabled production, indicating an average projection of leakage based on current technological practices and operational efficiencies.

0.50% and 0.52% Leakage Rates: These higher rates were derived using models with a 99% confidence level, indicating the upper threshold of potential leakage in less optimized scenarios. Specifically:

- The **0.50%** rate applies to CCUS enabled production, highlighting the potential for increased leakage in these systems despite the utilization of CCUS technologies. This projection accounts for the inherent variability in operational practices and the efficiency of technology in minimizing hydrogen loss.
- The **0.52%** rate is attributed to electrolytic production scenarios that incorporate full recombination of hydrogen from purging and crossover venting. This rate underscores the potential for higher leakage even in electrolytic processes designed to minimize loss, reflecting the challenges in achieving complete containment.

[50] Frazer-Nash Consultancy, 2022, Ibid.
[51] Frazer-Nash Consultancy, 2022, Ibid.
[52] Frazer-Nash Consultancy, 2022, Ibid.
[53] Frazer-Nash Consultancy, 2022, Ibid.

Compression

Snapshot 4: Overview of Potential Sources of Leakage for Compression

Compression

0.14% and 0.27%

[Representing the lower and upper limits. Estimated using natural gas as a proxy, where leakage rates are adjusted based on the differences in physical properties between natural gas and hydrogen.] Contributions from Cooper et al. (2022).

Causes of Leakage during Compression

- Piping and equipment
- Venting
- Purging

Relatively narrow range from **0.14%** and **0.27%**, suggesting a more consistent leakage profile across different compression technologies or setups.

Research Insights on Leakage Rates during Compression

Compression Leakage Rates: Identified at **0.14% and 0.27%.** Based on modeling, these rates established the lower and upper bounds for hydrogen leakage during compression. **Methodology:** Utilized natural gas leakage data as a proxy, based on its documented properties and leakage rates, to estimate hydrogen leakage, informed by a study on natural gas leakage in reciprocating compressors, Cooper et al. (2022).

- These estimates are derived using natural gas as a proxy, with adjustments based on the relative physical property differences between natural gas and hydrogen. This approach leverages the substantial body of knowledge on natural gas to infer hydrogen behavior, acknowledging the limitations and potential discrepancies in directly translating these rates due to hydrogen's unique properties.

The leakage rates of **0.14% and 0.27%**[54] represent the modeled lower and upper bounds for potential hydrogen leakage during the compression process. This range was determined through modeling due to the lack of specific data on hydrogen. In these estimations, natural gas served as a proxy, leveraging its well-documented physical properties and leakage rates to infer those of hydrogen. The rationale behind this approach is anchored in a 2015 study[55] that examined natural gas leakage rates in reciprocating compressors, which then informed the model's assumptions about hydrogen leakage.

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[54] Cooper, Jasmin, Luke Dubey, Semra Bakkaloglu, Adam Hawkes, 2022, Ibid.

[55] Subramanian, R., Williams, L.L., Vaughn, T.L., Zimmerle, D., Roscioli, J.R., Herndon, S.C., Yacovitch, T.I., Floerchinger, C., Tkacik, D.S., Mitchell, A.L., Sullivan, M.R., Dallmann, T.R., Robinson, A.L., 2015. Methane emissions from natural gas compressor stations in the transmission and storage sector: measurements and comparisons with the EPA greenhouse gas reporting program protocol. Environ. Sci. Technol. 49, 3252–3261. https://doi. org/10.1021/es5060258

Snapshot 5: Overview of Potential Sources of Leakage for Third Party Storage

Storage

Aboveground Storage

2.77% to 6.52%

2.77% corresponds to a 50% confidence level over a 2-day storage period. 6.52% corresponds to a 99% confidence level over a 30-day storage period.

Potential leakage ranging from 2.77% to 6.52%, showcasing substantial variability and higher risk associated.

Causes of Leakage during Storage Phase

Aboveground: Equipment

Underground: Venting, Purging

Underground Storage

0.02% and 0.06%

Salt cavern storage leakage rates are predicted to be very low, with primary concerns around surface plant maintenance or venting.

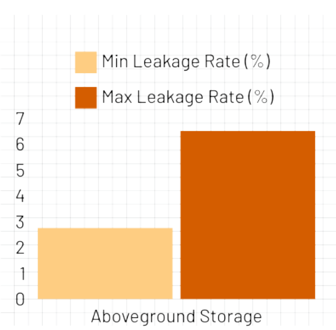
Minimal leakage rates from 0.02% to 0.06%, emphasizing the effectiveness of underground storage in mitigating leakage risks.

Research Insights on Aboveground Storage and Underground Storage

The comparison starkly highlights that aboveground storage faces much higher leakage rates **(2.77% to 6.52%)** compared to underground storage **(0.02% to 0.06%)**, indicating the inherent advantage of geological barriers in minimizing leakage.

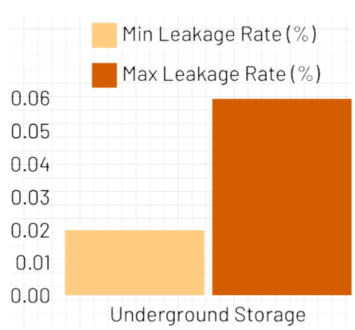
- **Aboveground Storage:** These rates are derived from probabilistic modeling, incorporating a range of variables to simulate storage conditions. The confidence intervals (**50% for 2.77% and 99% for 6.52%**) reflect the statistical likelihood of these rates occurring under specified conditions, with storage duration being a critical factor. The wide range in confidence levels suggests that duration of storage is a critical factor in environmental risk management strategies. Frazer-Nash (2022) utilized probabilistic modeling to estimate these rates, reflecting the impact of storage duration on leakage.
- **Underground Storage:** The low leakage rates anticipated for salt cavern storage **(0.02% to 0.06%)** suggest geological advantages that minimize environmental risks, albeit with operational challenges. The insights highlight the comparative safety and efficiency of underground hydrogen storage, particularly in salt caverns, while also pointing out the importance of vigilant maintenance and response strategies to minimize leakage risks. Cooper et al. (2022) and Frazer-Nash (2022) highlight the dual approach of theoretical modeling and empirical understanding of geological storage mechanisms.

Table 4: Aboveground Storage Leakage Rates



Source: Frazer-Nash (2022)

Table 5: Underground Storage Leakage Rates



Source: Cooper et al. (2022) Frazer-Nash, (2022)

Aboveground Storage

- The **2.77%**[56] leakage estimate originates from an uncertainty model designed to calculate probabilistic leakage outcomes for hydrogen in compressed tanks, assuming a 50% confidence level. Input data for the model included leakage rates from compressed gas cylinders, specifically 0.005% to 0.01% per hour[57], acknowledging the impact of storage duration on leakage, with a two-day period being the basis for this rate.
- The **6.52%**[58] is derived using a similar uncertainty model but at a 99% confidence level, this rate also examines hydrogen stored in compressed tanks. The model uses the same hourly leakage inputs as the 2.77% estimate but extends the assumed storage duration to thirty days, emphasizing the role of time influencing leakage outcomes.
- Stakeholder comment identified that the potential for leakage from aboveground storage should be less than **1%.**

Underground Storage

- Underground storage of hydrogen is envisaged in various geological formations, including depleted oil and gas reservoirs, aquifers, and specifically engineered caverns in salt, coal, igneous, and metamorphic rocks.[59]
- The expected leakage rates from such underground storage, particularly in salt caverns, are projected to be low, as values of **0.02% and 0.06%**[60]. This low potential for leakage primarily arises from the structural integrity of the storage sites and the controlled environment. However, it's noted that the main areas where leakage could potentially occur are at the surface facility, particularly during maintenance operations or instances of emergency venting. The Study suggests that with further technological advancements, it may be possible to significantly reduce these leakage risks. The quantity of caverns is highlighted as a significant factor influencing the overall potential for leakage, underscoring the importance of cavern management in mitigating risk.

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[56] Frazer-Nash Consultancy, 2022, Ibid.
[57] DOE, "Conformable Hydrogen Storage Pressure Vessel."
[58] Frazer-Nash Consultancy, 2022, Ibid.
[59] Zivar, Davood, Sunil Kumar, and Jalal Foroozesh, 2021, *Underground hydrogen storage: A comprehensive review*, International Journal of Hydrogen Energy 46(45) pg 23436-23462, https://doi.org/10.1016/j.ijhydene.2020.08.138
[60] Frazer-Nash Consultancy, 2022, Ibid.

Snapshot 6: Overview of Potential Sources of Leakage for Transmission

Transmission

0.02% to 1%.

[Namely: 0.02%, 0.04%, 0.06%, 0.1%, 0.2%, 0.4%, 0.48% , 1%.] Contributions from Panfilov (2016), US DOE targets (2022), Frazer-Nash (2022), Cooper et al. (2022), Arrigoni & Diaz (2022), and Van Ruijven et al. (2011).

Causes of Leakage during Transmisssion

- Pipeline
- Venting

A range from 0.02% to 1%, underlining the importance of pipeline integrity and advanced monitoring technologies in minimizing leakage during hydrogen transmission.

Research Insights on Leakage Rates during Transmission

0.1% is the estimated leakage rate for new pipelines dedicated to hydrogen transport, based on simulations integrating a global energy system model (TIMER) to develop a set of diverging scenarios.

Modeled Leakage Rates (0.02% and 0.06%): These rates are derived from modeling that uses natural gas data as a proxy, reflecting an analytical approach to approximate hydrogen leakage in transmission pipelines, informed by empirical studies on natural gas leakage.

Conservative Leakage Estimates (0.04% to 1%): Ranging from conservative benchmarks (0.04%) to higher estimates (up to 1%), these rates underscore the variability in leakage potential based on pipeline material, construction, and operational parameters. The anticipated improvement in international transport leakage rates by 2030 to below 0.7% showcases the expected advancements in pipeline technologies and management practices.

- This range encompasses a variety of transmission scenarios, from new, dedicated pipelines to retrofitted existing infrastructure. The reliance on models, such as the global energy system simulation model TIMER, provides a comprehensive framework for understanding the interactions between hydrogen transport, atmospheric chemistry, and potential leakage
- The recommendation of using materials like PVC and polyethylene highlights the role of material science in addressing leakage and embrittlement challenges, supporting the integrity and efficiency of hydrogen transmission networks.
- Various studies from Panfilov (2016), US DOE targets (2022), Frazer-Nash (2022), Cooper et al. (2022), Arrigoni & Diaz (2022), and Van Ruijven et al. (2011), illustrate the complex dynamics of hydrogen transmission and the potential for leakage across different pipeline infrastructures and technologies.

- **Leakage Rates of 0.02% and 0.06%**[61]: These values represent the modeled lower and upper bounds for hydrogen transmission leakage, respectively. The use of natural gas as a proxy was essential in this estimation process, informed by a 2015 study[62] that provided data on natural gas leakage rates in pipelines. This approach acknowledges the similarities and differences between hydrogen and natural gas, aiming to provide a reasoned approximation of potential hydrogen leakages.

- **0.04%[63] Estimate**: This rate, established with a 50% confidence level, is derived from the Digest of U.K. Energy Statistics concerning natural gas transmission. It provides a conservative benchmark for hydrogen leakage within transmission systems, reflecting an integration of empirical data into the estimation process.

- **0.1%[64] Rate for New Pipelines:** Specifically focusing on pipelines constructed for hydrogen transmission, this estimate incorporates findings from both a global energy system model and a global atmospheric model. It explores the environmental implications of hydrogen as a key component of the global energy matrix, using the TIMER model to assess various application scenarios and their consequent leakage rates. **Estimates of 0.2% and 0.4%[65]**: These figures are inferred from data on natural gas leakage within local distribution systems, utilizing in-field activity data—including miles of pipeline and leaks per mile—collected from six locations along the U.S. East Coast.[66] This methodology emphasizes the role of empirical evidence in shaping our understanding of leakage dynamics in hydrogen distribution.

- **0.48%[67] Rate**: With a 99% confidence level, this estimate is based on comprehensive data from the Digest of U.K. Energy Statistics for natural gas transmission, serving as a high-confidence marker for potential leakage in hydrogen transmission systems.

- **1%[68] Rate for Transmission:** Reflecting the current understanding of hydrogen leakage in European pipeline transmission, this rate is anticipated to improve to below 0.7% by 2030, indicative of ongoing advancements in pipeline technology and management aimed at enhancing efficiency and reducing leakage.

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[61] Cooper, Jasmin, Luke Dubey, Semra Bakkaloglu, Adam Hawkes, 2022, Ibid.
[62] Subramanian, R., Williams, L.L., Vaughn, T.L., Zimmerle, D., Roscioli, J.R., Herndon, S.C., Yacovitch, T.I., Floerchinger, C., Tkacik, D.S., Mitchell, A.L., Sullivan, M.R., Dallmann, T.R., Robinson, A.L., 2015. Methane emissions from natural gas compressor stations in the transmission and storage sector: measurements and comparisons with the EPA greenhouse gas reporting program protocol. Environ. Sci. Technol. 49, 3252–3261. https://doi. org/10.1021/es5060258
[63] Frazer-Nash Consultancy, 2022, Ibid.
[64] van Ruijven, B., J.F. Lamarque, D.P. van Vuuren, T. Kram, and H. Eerens, 2011, Emission scenarios for a global hydrogen economy and the consequences for global air pollution. Glob. Environ. Change 21, 983–994. doi:10.1016/j.gloenvcha.2011.03.013
[65] Fan, Zhiyuan, et. al., 2022, Ibid.
[66] Weller, Zachary D., Steven P. Hamburg, and Joseph C. von Fischer. 2020. "A National Estimate of Methane Leakage from Pipeline Mains in Natural Gas Local Distribution Systems." Environmental Science and Technology 54, no. 14 (July 21): 8958–67. https://doi.org/10.1021/ acs.est.0c00437
[67] Frazer-Nash Consultancy, 2022, Ibid.
[68] Arrigoni, Alessandro and Laura Bravo Diaz, 2022, Ibid.

4.3 HIGH LEVEL PRELIMINARY LEAKAGE ESTIMATE

In response to stakeholder comments requesting that the Study quantify potential leakage for Angeles Link, a high-level range of estimated potential for leakage has been developed for both general hydrogen infrastructure and Angeles Link infrastructure even though detailed design and engineering information is not available for the Angeles Link project. General infrastructure is comprised of production, compression, storage, and transmission. The estimates for Angeles Link infrastructure include the compression and transmission categories.

To prepare a preliminary high-level estimate of the potential for leakage associated with general hydrogen infrastructure, the leakage estimates provided in the literature for production, compression, aboveground storage, underground storage, and transmission, as shown in snapshots 3, 4, 5, and 6, were compiled. Additionally, the value of 1% leakage rate provided by stakeholder comment for aboveground storage was utilized. The median and mean of these 25 values were calculated and determined to be 0.24% and 0.92%, respectively. Then these values were applied to the low, medium, and high throughput scenarios for Angeles Link using equation 2 below.

Estimated Hydrogen Leakage = Throughput * Leakage Rate (%) (equation 2)

The low throughput scenario is 0.5 million metric tonnes of hydrogen per year (MMT/yr); the medium throughput scenario is 1.0 MMT/yr; and the high throughput scenario is 1.5 MMT/yr. These values are the same as 500,000 metric tonnes per year (MT/yr); 1,000,000 MT/yr; and 1,500,000 MT/yr. This estimation methodology and results are shown in Table 2A below. As shown in Table 2A, the high-level estimate of potential for leakage ranges from 1,200 MT/yr for the low throughput scenario with the median of the leakage estimates to 13,800 MT/yr for the high throughput scenario with the mean of the leakage estimates found in the literature.

To prepare a preliminary high-level estimate of the potential for leakage associated with anticipated Angeles Link hydrogen infrastructure, the leakage estimates provided in the literature for compression and transmission as shown in snapshots 4 and 6 were compiled. The median and mean of these 10 values were calculated and determined to be 0.17% and 0.27%, respectively. Then these values were applied to the low, medium, and high throughput scenarios for Angeles Link using equation 2. The estimation methodology and results are shown in Table 2B below. As shown in Table 2B, the high-level estimate of potential for leakage ranges from 850 MT/yr for the low throughput scenario with the median of the leakage estimates to 4,065 MT/yr for the high throughput scenario with the mean of the leakage estimates found in the literature.

Table 2A: Preliminary Leakage Estimate for General Infrastructure

SCENARIO	CATEGORY	LOW THROUGHPUT	MEDIUM THROUGHPUT	HIGH THROUGHPUT
--	Hydrogen Throughput (MT/yr)	500,000 MT/yr	1,000,000 MT/yr	1,500,000 MT/yr
A	Median of Compiled Leakage Rates (%)	0.24%	0.24%	0.24%
	Estimated Hydrogen Leakage (MT/yr)	1,200 MT/yr	2,400 MT/yr	3,600 MT/yr
B	Mean of Compiled Leakage Rates (%)	0.92%	0.92%	0.92%
	Estimated Hydrogen Leakage (MT/yr)	4,600 MT/yr	9,200 MT/yr	13,800 MT/yr

Table 2B: Preliminary Leakage Estiamte for Angeles Link Infrastructure

SCENARIO	CATEGORY	LOW THROUGHPUT	MEDIUM THROUGHPUT	HIGH THROUGHPUT
--	Hydrogen Throughput (MT/yr)	500,000 MT/yr	1,000,000 MT/yr	1,500,000 MT/yr
A	Median of Compiled Leakage Rates (%)	0.17%	0.17%	0.17%
	Estimated Hydrogen Leakage (MT/yr)	850 MT/yr	1,700 MT/yr	2,550 MT/yr
B	Mean of Compiled Leakage Rates (%)	0.27%	0.27%	0.27%
	Estimated Hydrogen Leakage (MT/yr)	1,355 MT/yr	2,710 MT/yr	4,065 MT/yr

The Advanced Research Projects Agency – Energy (ARPA-E) has indicated that there is a need to develop a large-area quantitative hydrogen estimation methodology to assess the rate of hydrogen leakage associated with production, transportation, and storage infrastructure.[69] The ARPA-E is a United States government agency tasked with promoting and funding research and development of advanced energy technologies. The proposal is to use sensor measurements of hydrogen concentrations in parts per billion on representative sites identified as 100 meters by 100 meters that would be used as input into an emissions model to determine the estimated hydrogen emission rate in kilograms per hour associated with the infrastructure. The components of the emissions model would include site data, sensor data, weather data, a transport model, and a predictive model.

4.4 OPPORTUNITIES TO MINIMIZE LEAKAGE

The Study evaluated three primary types of mitigation opportunities: 1) Design and Engineering; 2) Operation; and 3) Maintenance & Repair. This includes manufacturer's improvements to design including incorporation of technological advancements, such as use of equipment and components less prone to leaks, as well as operational and maintenance improvements to minimize the quantity and duration of leaks. Table 3 summarizes these opportunities and provides an estimated range of mitigation as a percentage that may be achieved. Although detailed reduction estimates have not been provided for each mitigation opportunity described, based on the potential mitigation measures identified, the overall reductions could be more than 90%. Detailed information regarding each of these opportunities follows Table 3.

Table 3: Opportunities to Minimize Leakage

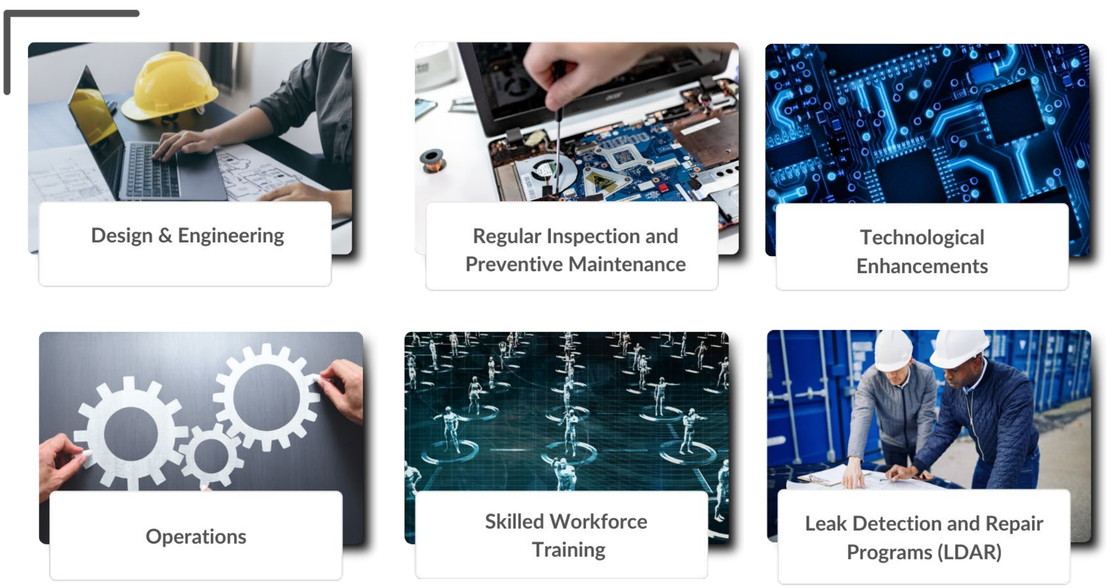
CATEGORY	COMPONENT AFFECTED	ESTIMATED REDUCTION POTENTIAL	NOTES
Design and Engineering	• Compressors	**95% or greater**	Involves leakage capture and return mechanisms with vapor control systems
	• Pipelines: Welded connections and leak tight valves	**Up to 100%**	Utilizes welded connections and leak-tight valves
Operations	*Not quantified at this time*		
Maintenance and Repair	Connections and valves	**89% to 96%**	Part of a leak detection and repair program

[69] ARPA-E Webinar: Hydrogen Sensing, April 18, 2024, https://arpa-e.energy.gov/about

The NPC's Report[70] includes Recommendation 20 "Technology – Detecting, Quantifying, and Mitigating Environmental Impact" suggesting that the DOE direct the national labs jointly with other researchers to develop and improve leak detection, prevention, and mitigation technologies, as well as the accuracy of the technologies; and to use these tools to measure and quantify hydrogen leak rates. The recommendation mentions that EPA can use this information to develop guidance regarding monitoring and repair of hydrogen leakage.

Additional opportunities to minimize the potential for leakage provided in the NPC Report[71] include: 1) encouraging RD&D investments to develop more robust measurement, monitoring, and verification of hydrogen leakage; 2) eliminating venting of hydrogen as much as possible and applying oxidation for vented hydrogen when possible; 3) proper treatment of hydrogen leakage during electrolysis such as recombination of hydrogen with oxygen; 4) strong insulation of pipes and storage vessels and use of proper materials such as plastic lining; 5) minimizing transport of hydrogen by co-locating facilities; 6) minimizing points of pressurization and depressurization; and 7) conducting regular, timely facility inspections.

Snapshot 7: Overview of Leakage Minimization/Mitigation Strategies



[70] National Petroleum Council, April 2024, Ibid.
[71] National Petroleum Council, April 2024, Ibid.

4.4.1 Design and Engineering

The incorporation of leakage minimization within the initial design and engineering for new infrastructure projects provides lifetime benefits for both the project and interconnection facilities. This includes consideration with respect to the processes, equipment, systems, and materials that could be used in the project. Engineering systems and processes that, do not normally vent hydrogen to the atmosphere, minimizes leakage.[72]

Codes, regulations, and standards applicable to hydrogen value chain systems and equipment provide guidance for the design, construction, and operation of systems to minimize leakage. Design-based mitigation measures may result in up to zero, near-zero leakage or significant potential to minimize leakage and should be implemented during the design and engineering phases as much as possible. Opportunities to minimize leakage include, but are not limited to, the following.

Leak detection system on diaphragm compressors: Each compressor could also include a leak detection system that monitors the integrity of the diaphragms and static O-rings. Breaches in these components can signal an alarm and or automatically shut down the compressor.[73]

Leakage capture and return mechanism for compressors and electrolyzers: A collection and recompression system can be used to capture leakage and route it to another portion of the process, such as the compressor suction, thereby eliminating leakage. These re-compression systems can be used for any leakage source that can be captured and routed to a closed system. In the case of the compressors, gas leakage through seals could in many cases be captured and directed to the suction of the unit for reprocessing. For example, reciprocating compressors used for natural gas compression vent natural gas from piston rod packing systems during normal operations, which could also occur for hydrogen compression. The rod packing systems are designed to have a sufficient fit around the piston rod to reduce leakage, but not so tight as to bind the rod and cause faster wear.[74] Since the packing cannot eliminate leakage from the inboard side of the cylinder, the leakage could be captured and returned to the system. Potential leakage reductions from implementing designs to capture and reroute process gas, using vapor control systems, can be estimated to be at least 95%, using data from natural gas operations as a proxy.[75] In the case of electrolyzers, venting and purging is considered one of the main causes of leakage, and when captured, leakage could be reduced significantly.

Purge system for compressors: Potential leaks from compressor seals can be mitigated by using a purge system to contain the leakage and prevent it from escaping the seal system.

Dry seals on compressors: A similar scenario that occurs in natural gas centrifugal compressors may happen in hydrogen compressors as well. These compressors contain rotating shafts that

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[72] Ocko I., S. Hamburg, July 19, 2023, EDF Blog: New research reaffirms hydrogen's impact on the climate, provides consensus. https://blogs.edf.org/energyexchange/2023/07/19/new-research-reaffirms-hydrogens-impact-on-the-climate-provides-consensus/

[73] PDC Machine, 2023, *Diaphragm Compressors*, industry brochure, https://www.pdcmachines.com/wp-content/uploads/2023/02/PDC_Brochure_V21_USA_SM.pdf

[74] US EPA, 2023a, Natural Gas STAR Program - Reciprocating Compressors, Agency website, https://www.epa.gov/natural-gas-star-program/reciprocating-compressors

[75] US EPA, 2023b, Natural Gas STAR Program: Vapor Recovery Units, webpage, https://www.epa.gov/natural-gas-star-program/vapor-recovery-units

require seals to prevent high-pressure natural gas from escaping the compressor casing. Traditionally, these seals used high pressure oil as a barrier against escaping gas; these seals are referred to as “wet seals.” Alternatively, centrifugal compressors can be equipped with mechanical seals, called “dry seals,” which have substantially lower potential for leakage.[76]

Diaphragm compressors: Diaphragm compressors are designed for zero leakage through the sealing. A diaphragm compressor is a positive displacement machine, which consists of a hydraulic system and a gas compression system. Most compressors used today for gaseous hydrogen compression are either positive displacement compressors or centrifugal compressors. Triple metal diaphragm compressors are unique because they are leak-free and non-contaminating since they do not utilize dynamic seals and the diaphragm set completely isolates the process gas from the hydraulic system. Diaphragm compressors are an option for high pressure, low volume situations such as filling aboveground storage tanks. Each compressor could also include a leak detection system that monitors the integrity of the diaphragms and static O-rings. Breaches in these components can signal an alarm and or automatically shut down the compressor[77].

Storage Vessels: A compressed hydrogen gas storage system has two main components: the aboveground storage vessel or underground reservoir and the compressors that may be needed to achieve the storage pressure. For aboveground storage, minimizing the number of connections, which are dependent of the number of vessels used and the operating conditions of the vessels (pressure, storage time, cycles) will directly impact the potential for leakage. Engineering and design considerations include: 1) optimize/reduce the total surface storage to meet system operational needs; 2) use the combination commercial vessel size and design pressure that decreases the number of total required vessels; 3) minimize the number of connections and valves; and 4) evaluate alternate gas storage technologies being developed, which could be commercial in the near future, such as multi-vessel aboveground storage modules.[78]

Transmission via Pipeline: Design to minimize potential for leakage by reducing the number of pipe connections, by using welded connections rather than flanges, and by checking the valves and tightening them to prevent leaks. Welded pipes are continuous, minimizing leak points, whereas flanged connections can leak at the flanged connection. Leak tight valves have additional packing in the valve to minimize the leaks for the valve stem. Welded joints in place of flanged joints can also reduce the potential for leaks.

4.4.2 Operations

Operations of the infrastructure to enhance leakage minimization opportunities are associated with operators’ knowledge, which is linked to having staff with the proper level of experience and training and detailed written operations procedures. Operational staff with the knowledge

[76] US EPA, 2023c, Natural Gas STAR Program - Centrifugal Compressors, Agency website, https://www.epa.gov/natural-gas-star-program/centrifugal-compressors

[77] PDC Machine, 2023, Diaphragm Compressors, industry brochure, https://www.pdcmachines.com/wp-content/uploads/2023/02/PDC_Brochure_V21_USA_SM.pdf

[78] FIBA Technologies, INC, 2023, Seamless Pressure Vessels, industry webpage, https://www.fibatech.com/products/seamless-pressure-vessels/ https://www.fibatech.com/products/seamless-pressure-vessels/

and expertise for efficient operation of hydrogen infrastructure requires training. The hydrogen economy will require the development of a new work force or/and the retraining of existing workers to operate future hydrogen facilities. In reference to training, there are several organizations that provide operator training services,[79] [80] and it is expected that when the market grows, more organizations will be added to the list. Operations manuals detailing procedures should contain the information regarding the operation of the systems and facilities. The manual could include day-to-day activities necessary for the facility, its systems, equipment, and occupants/users to perform their intended functions. These functions may include required environmental protection protocols, as well as opportunities to minimize potential for hydrogen leakage. Refer to the "Workforce Planning & Training Evaluation" study for additional considerations for a workforce trained and qualified with appropriate skills to operate and maintain hydrogen infrastructure.

4.4.3 Maintenance and Repair

Studies have shown that many different mechanisms can affect the need for maintenance or contribute to the failure of an equipment part, such as packing wear on a valve in place.[81] Having a regular maintenance program offers opportunities to minimize the potential for leakage from infrastructure. For example, a predictive or condition-based maintenance approach is one in which operating conditions are monitored and maintenance decisions are based on either performance or defined conditions. Leak detection and repair programs are used across the natural gas industry and result in reductions in overall system leakage. These same practices can be adopted by the hydrogen industry to increase the likelihood that valves and other components are maintained and tightened to prevent leaks. Plans for Integrity Management are discussed in the Future Considerations section of the Draft Pipeline Sizing and Design Study Report.

- Timely repair in conjunction with timely leak detection can minimize leakage by reducing the leak duration. Traditional leak detection methodologies include conducting regular screening of components using sensors or optical imaging instruments. Sensors can be used for regular/frequent/continuous screening of potential sources of leakage.
- High-performance hydrogen gas sensors with low-concentration detection limits, wide measurement ranges, and fast responses can be used to monitor potential for leakage and facilitate timely repairs to minimize potential for leakage to the atmosphere. The reductions potential is estimated to range from 89%[82] to 96%[83].

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[79] US DOE, 2023f, Education, Office of EERE webpage, https://www.hydrogen.energy.gov/program-areas/education
[80] GTI Energy, 2024, Hydrogen Training, webpage, https://www.gti.energy/training-events/training-overview/hydrogen-training/
[81] INGAA, 2018, Improving Methane Emissions from Natural Gas Transmission and Storage, August, https://ingaa.org/wp-content/uploads/2018/08/34990.pdf
[82] California State University, Fullerton. 2012. Estimation of Methane Emissions from the California Natural Gas System (California Energy Commission), website: http://www.energy.ca.gov/2014publications/CEC-500-2014- 072/CEC-500-2014-072.pdf
[83] Pacific Gas and Electric Company's Comments on the Revised Draft Regulation Proposal for Greenhouse Gas Emission Standards for Crude Oil and Natural Gas Facilities, https://ww2.arb.ca.gov/sites/default/files/classic/isd/cc/oil-gas/meetings/pge_02262016.pdf

5.0 RESULTS

This Study summarizes potential sources of leakage, leakage estimation methodologies, and opportunities to mitigate and minimize the potential for leakage. Data reported in literature that was reviewed from the last two decades shows significant variation in estimates for potential hydrogen leakage. This indicates that additional research and investigation of hydrogen leakage is required for more detailed predictions.

With further development of leakage sensor detection and direct measurement technologies, more accurate measurements of hydrogen leakage and more refined evaluation of the effectiveness of implementation of mitigation strategies can be performed. Mitigation measures to minimize leakage may include design parameters, operating and maintenance procedures, and leak detection and repair processes. With successful implementation of mitigation strategies, the likelihood of infrastructure with the potential for leakage can be minimized.[84] [85] [86] Based on the potential mitigation measures identified, the overall reductions can be more than 90%.

This Study found that there is not enough available data to prepare a detailed estimate of the volumetric potential for leakage associated with Angeles Link, in addition to third party production and storage, using the value chain or component-level approaches. However, a high-level preliminary estimate was prepared and with more refined leakage estimates and more detailed information regarding the anticipated Angeles Link infrastructure, the top-down value chain approach can be applied in more detail in the future. Significantly more data and information based on detailed design and engineering of the infrastructure would be needed to use the bottom-up component-level methodology. We recognize comments from stakeholders, such as EDF, CBE, Food and Water Watch, Protect Playa Now, and Physicians for Social Responsibility – Los Angeles, that have expressed concerns that the Preliminary Data and Findings document for the this Study did not include detailed estimates of the volumetric potential for leakage and have incorporated a preliminary high-level estimate using a methodology that was based on the values available in the literature.

Limitations

The limitations related to the results presented is primarily due to the limitations of the quantity and quality of information currently available regarding actual leak measurement data for hydrogen. With infrastructure design development, project refinements, and detailed

[84] Hauglustaine, D., F. Paulot, W. Collins, R. Derwent, M. Sand and O. Boucher, 2022, Climate benefit of a future hydrogen economy, Comm. in Earth & Environment, 3 Article 295, https://doi.org/10.1038/s43247-022-00626-z

[85] Ocko, I. and S. Hamburg, 2022, For hydrogen to be a climate solution, leaks must be tackled, Environmental Defense Fund blog, March, https://www.edf.org/blog/2022/03/07/hydrogen-climate-solution-leaks-must-be-tackled

[86] Warwick, N.J., A.T. Archibald, P.T. Griffiths, J. Keeble, F.M. O'Connor, J.A. Pyle, and K.P. Shine, 2023, Atmospheric composition and climate impacts of a future hydrogen economy, Atmospheric Chemistry and Physics 23(20) 12451-13467, https://doi.org/10.5194/acp-23-13451-2023

information from technological data measurement and collection advancements, the estimates of the potential for hydrogen leakage could be further refined.

6.0 CONCLUSION

Results regarding the potential for leakage and mitigation opportunities related to the Angeles Link project, as well as third party production and storage, as set forth in this Study are for informative purposes for Phase 1 of Angeles Link. Information from parallel studies related to hydrogen infrastructure is still evolving. These results may be further refined in response to feedback from the PAG and CBOSG.

As described in the literature reviewed for this Study, potential sources of leakage associated with Angeles Link infrastructure include production equipment such as electrolyzers, compression equipment such as reciprocating and centrifugal compressors, storage equipment such as aboveground vessels and underground salt caverns, and transmission infrastructure such as pipelines. Based on the information gathered, the total value chain approach (top-down) leakage estimation methodology was selected as the preferred approach given that insufficient data was available regarding direct measurements of hydrogen leaks to perform accurate leak estimates. The component-level approach could be evaluated in the future with more detailed Angeles Link information and development of hydrogen leakage factors.

Some studies consulted provided preliminary leak estimates using the total value chain approach.[87] Leakage estimation methodologies include direct measurement such as leak detection sensors, as well as published estimates based on a variety of methodologies including calculations via proxies such as natural gas, laboratory experiments, and theory-based models or simulations. The reviewed publications show agreement on the necessity of performing additional research and investigation on hydrogen leakage to generate more accurate data.

The magnitude of the potential for hydrogen leakage depends on the quantity and type of equipment that is used for production, compression, and storage, how the infrastructure is designed and engineered, whether the pipelines are above ground or below ground, the sizing and routing of the pipelines, and how the infrastructure is operated and maintained, amongst other factors.

A preliminary high-level estimate of the potential for leakage associated with the infrastructure of Angeles Link was prepared as described in Section 4.3. As shown in Table 2, the high-level estimate of potential for leakage ranges from 1,200 MT/yr for the low throughput scenario (using the median of the leakage estimates) to 13,800 MT/yr for the high throughput scenario, based on the mean or the average of the leakage estimates found in the literature.

Mitigations and opportunities to minimize the potential for leakage from various processes are available in design and engineering of new infrastructure, operation of equipment and systems, as well as maintenance procedures. In addition to design and engineering, the use of existing and emerging sensor technologies support early identification of leaks and facilitate timely repairs,

[87] Arrigoni, Alessandro and Laura Bravo Diaz, 2022, Ibid.

thereby mitigating leaks. The selection of available mitigation measures for equipment and systems that comprise Angeles Link infrastructure will determine the overall reductions. Based on the potential mitigation measures identified, the overall reductions can be more than 90%.

This Study acknowledges that while limited data exists in the literature for actual measurements of hydrogen for production, compression, storage, and transmission of clean renewable hydrogen, measurement technologies and calculation methodologies related to hydrogen are anticipated to develop further over time. As significant enhancements have been made for natural gas leak detection and mitigation over the past decades, it is anticipated that those measures to reduce gas leakage in general will be employed and new developments will similarly be made for hydrogen to minimize the potential for leakage. The design details of the Angeles Link infrastructure, as well as further project refinements, will allow future refinements of the evaluation of the potential for leakage and opportunities to minimize leakage of hydrogen.

7.0 STAKEHOLDER COMMENTS

The input and feedback from stakeholders including the PAG and CBOSG has been essential to the development of this draft Leakage Study Report. Some of the feedback that has been received related to this Study is summarized below. All feedback received is included, in its original form, in the quarterly reports submitted to the CPUC and published on SoCalGas' website.[88] Feedback topics that were not addressed are also identified.

Quarter 1 to Quarter 4 2023 Reports:

- **EDF Comments**
  - Examine all possible research and literature around hydrogen leakage including listed articles. Examine all possible sources of hydrogen including venting and purging of hydrogen and include in study calculations. Studies have shown that leak detection and prevention at parts per billion level is needed to evaluate climate benefits from use of hydrogen.
- **SCAQMD Feedback**
  - The overview of the hydrogen leakage assessment should clarify whether it will primarily involve modeling or also include assessments of leakage detection methods. Different leakage rates for liquid and gaseous storage should be considered when assessing potential environmental impacts.
- **Food & Water Watch Comments**
  - Evaluate leakage and risks for repurposed gas pipelines. Evaluate leakage and risks for underground and aboveground storage. It is crucial that leakage be measured accurately.
- **CBOSG Feedback Themes**
  - Questions regarding whether study will consider research on existing hydrogen pipelines, research at existing hydrogen facilities, and how the study will identify how the leakage will be determined. Suggesting leakage at end users be evaluated. Concerns regarding the difficulty of capturing hydrogen leakage rate at low levels. Identify potential mitigation opportunities including available sensors and emerging leak detection methodologies.

[88] https://www.socalgas.com/sustainability/hydrogen/angeles-link

Preliminary Data & Findings Document:

- Six comment letters received from Environmental Defense Fund, Communities for a Better Environment, Food and Water Watch, Protect Playa Now, and Physicians for Social Responsibility – Los Angeles, and Air Products
  - First five letters requested volumetric leakage estimates and associated impacts to climate change be discussed and a volumetric analysis be included in the leakage and GHG study reports.
  - Sixth letter shared that leakage rates included for aboveground storage vessels are considered to be too high.

Summary of How Comments were Addressed

- A literature review was conducted for all elements of infrastructure. Estimated leakage rates were evaluated for the anticipated Angeles Link infrastructure, in addition to third party production and storage, as described in Section 4.2.1.

- The potential for leakage at end users was not incorporated since equipment specific details for end users was not available and end users were considered out of scope for this assessment.

- The above ground storage estimated leakage rates were based on the values available in the literature as described in Section 4.2.1 below. The Study notes that a stakeholder has commented that they assume a lower value for leakage rates than the rates presented here.

- Potential leakage from gaseous storage was evaluated whereas liquid storage was not.

- Potential mitigation opportunities including available sensors and emerging leak detection methodologies was included. Information regarding available and emerging direct measurement tools and leakage sensors was incorporated. Existing and emerging technologies regarding hydrogen leak detection sensors and direct measurement tools are presented in Section 4.2 below. These may be used to support mitigation of leakage as discussed in Section 4.4.

- Sources of potential hydrogen leakage including venting and purging are anticipated to be mitigated via leakage capture mechanisms.

- A range of preliminary high-level volumetric estimates of the potential for leakage were developed based on the range of values derived from the literature review. This analysis was developed using the low, medium, and high Angeles Link throughput scenarios. This range of high-level estimates will be used in the parallel Greenhouse Gas (GHG) Study to estimate a range of potential impacts associated with potential leakage that is accounted for when considering the overall expected GHG reductions associated with Angeles Link. This second step of taking the volumetric estimates from potential leakage and using it to estimate the range of potential GHG impacts in the GHG Study, is important and responsive to several stakeholder comments asking for an analysis of the role hydrogen leakage may play as an indirect GHG.

- Specific literature provided by PAG/CBOSG stakeholders has been evaluated and relevant information has been incorporated, as appropriate, including, but not limited to:
    - Environmental Defense Fund, March 2023, As Climate Concerns About Hydrogen Energy Grow, New Tech Unveiled at CERAWeek Delivers Unprecedented Results Measuring Leaks, Other Emissions. https://www.edf.org/media/climate-concerns-about-hydrogen-energy-grow-new-tech-unveiled-ceraweek-delivers-unprecedented
    - Esquivel-Elizondo, Sofia, Alejandra Hormaza Mejia, Tianyi Sun, Eriko Shrestha, Steven P. Hamburg and Ilissa B. Ocko, 2023, Wide Range in Estimates of Hydrogen Emissions from Infrastructure, Frontiers in Energy Research Vol. 11: 1207208, https://www.frontiersin.org/articles/10.3389/fenrg.2023.1207208/full
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8.0 GLOSSARY

Biomass Gasification - Biomass is a renewable organic resource that includes agriculture crop residues (such as corn stover or wheat straw), forest residues, special crops grown specifically for energy use (such as switchgrass or willow trees), organic municipal solid waste, and animal wastes. This renewable resource can be used to produce hydrogen, along with other byproducts, by gasification.

Caprock - Caprock or cap rock is a more resistant rock type overlying a less resistant rock type, analogous to an upper crust on a cake that is harder than the underlying layer.

Centrifugal Compressors - These are the compressors of choice for pipeline applications due to their high flowrate and moderate compression ratio. Centrifugal compressors rotate a turbine at very high speeds to compress the gas. Hydrogen centrifugal compressors must operate at top speeds three times faster than that of natural gas compressors to achieve the same compression ratio because of the low molecular weight of hydrogen.

Clean renewable hydrogen - hydrogen that does not exceed 4 kilograms of carbon dioxide equivalent (CO2e) produced on a lifecycle basis per kilogram of hydrogen produced and does not use fossil fuel in the hydrogen production process where fossil fuel is defined as a mixture of hydrocarbons including coal, petroleum, or natural gas, occurring in and extracted from underground deposits.[89]

Component-level leaks - A component-level leak is a leak in a component of the overall transmission system, such as a valve. A leak in a valve is characterized by a leak rate, which is often given as a volumetric flow rate at a standard temperature and pressure (e.g., standard cubic meters per minute; scm).

Diaphragm compressors - A diaphragm compressor is a variant of the classic reciprocating compressor with backup and piston rings and rod seal. The compression of gas occurs by means of a flexible membrane, instead of an intake element. The back and forth moving membrane is driven by a rod and a crankshaft mechanism. Only the membrane and the compressor box come in contact with compressed gas. Diaphragm compressors are an option for high pressure, low volume situations such as filling aboveground storage tanks.

Electrochemical Sensors - Electrochemical gas sensors are gas detectors that measure the concentration of a target gas by oxidizing or reducing the target gas at an electrode and measuring the resulting current.

Electrolysis - Electrolysis is the process of using electricity to split water into hydrogen and oxygen. This reaction takes place in a unit called an electrolyzer that can range in size from small, appliance-sized equipment that is well-suited for small-scale distributed hydrogen production to

[89] California Public Utilities Commission (CPUC) adopted Decision 22-12-055, Ibid.

large-scale, central production facilities that could be tied directly to renewable or other non-greenhouse-gas-emitting forms of electricity production.

Embrittlement – Embrittlement is a decrease of ductility of a material, which makes the material brittle. Embrittlement happens when the environment compromises a stressed material's mechanical performance, such as temperature or environmental composition. Various materials have different mechanisms of embrittlement; therefore, it can manifest in a variety of ways, from slow crack growth to a reduction of ductility and toughness.

Emissions – Emissions are substances that are released into the air, water, or soil by various sources, such as vehicles, factories, or animals.

Emission/Leakage source types – Emission/Leakage source types are sources of emissions from the activities or processes that release greenhouse gases into the atmosphere.

End User – An end user uses the good or service provided by a producer or distributor.

Feasibility study – A feasibility study is an assessment of the practicality of a proposed project plan or method. For example, asking “Is this feasible?” by analyzing factors such as technical, economic, legal, and operational feasibility.

Hydrocarbons – Hydrocarbons are organic compounds that contain carbon and hydrogen atoms, forming the backbone of fossil fuels and many other substances. Hydrocarbons can have different shapes and structures, depending on how the carbon atoms bond with each other and with the hydrogen atoms.

Impermeability - Impermeability is a measure of the difficulty of passage for liquids, gases, or specific chemicals through a material.

Infrastructure – Infrastructure is the resources (such as personnel, buildings, or equipment) required for an activity.

Leak or leakage – Leak or leakage means any unexpected, accidental, and/or unintended gas or liquid flows through and object because of anthropogenic activities through an imperfection or production defect such as a hole, crack, or weak seal.

Methodology – A methodology is a system of methods and principles for doing something, for example for teaching or for carrying out research.

Mitigation/Mitigating factors – Mitigation means implementing actions to reduce impacts.

Processing systems – Processing systems within the Angeles Link are main industrial processes and include production, compression, storage, and transmission (pipelines) process systems.

Raman scattering – Raman scattering is inelastic light scattering, is the only common optical technique suitable for hydrogen, as it is specific to hydrogen and accessible. (Inelastic scattering from different molecules gives each component a spectral fingerprint).

Reciprocating Compressors - A reciprocating compressor uses a motor with a linear drive to move a piston back and forth. This motion compresses the hydrogen by reducing the volume it occupies. Reciprocating compressors are the most used compressors for applications that require a very high compression ratio (compression ratio is the ratio of the pressure at the outlet of the compressor over the pressure at the inlet of the compressor).

Renewable fuels – Renewable fuels are energy sources from renewable resources that provide clean and sustainable alternatives to non-renewable resources. Renewable fuel uses natural resources, such as wind, solar, geothermal, and biomass (plant and animal life), for natural replenishment.

Rotary Compressors - This equipment compresses by the rotation of gears, lobes, screws, vanes, or rollers. Hydrogen compression is a challenging application for positive displacement compressors due to the tight tolerances needed to prevent leakage.

Scalability – Scalability is the capacity to be changed in size or scale taking advantage of economies of scale.

Sensors - A sensor is a device that detects and responds to some type of input from the physical environment. The input can be light, heat, motion, moisture, pressure, or any number of other environmental phenomena.

Steam methane reforming – Steam methane reforming (SMR) is a process that commercial hydrogen producers and petroleum refineries use to separate hydrogen atoms from carbon atoms in methane and primarily use natural gas as the methane source.

Underground hydrogen storage – Underground hydrogen storage is the practice of hydrogen storage in caverns, salt domes and depleted oil/gas fields.

Value chain – A value chain is a series of consecutive steps that go into the creation of a finished product, from its initial design to its arrival at a customer's domicile or place of use.

Van der Waals bonds –Van der Waals bonds are weak intermolecular forces that are dependent on the distance between atoms or molecules. These forces arise from the interactions between uncharged atoms/molecules.

Viscosity – Viscosity is the resistance of a fluid (liquid or gas) to a change in shape, or movement of neighboring portions relative to one another. Viscosity denotes opposition to flow.

Work Function-Based Sensors - This type of hydrogen sensor is based on the variation of work function induced by hydrogen. Features of these gas sensors' operation and the various materials, such as metallic films, inorganic and organic layers, which can be used in these devices as a sensing element.

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ANGELES LINK PHASE 1

PLAN FOR APPLICABLE SAFETY REQUIREMENTS

DRAFT – June 2024

SoCalGas commissioned this analysis from Burns & McDonnell. The analysis was conducted, and this report was prepared, collaboratively.

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1.0 LIST OF ABBREVIATIONS AND ACRONYMS

ABET	Accreditation Board for Engineering and Technology
AICHE	American Institute of Chemical Engineers
ANSI	American National Standards Institute
API	American Petroleum Institute
API RP	American Petroleum Institute Recommended Practice
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
BVPC	Boiler and Pressure Vessel Code
BTU	British Thermal Units
CBO	Community Based Organizations
CBOSG	Community Based Organizations Stakeholder Group
CCM	Control Center Modernization
CFR	Code of Federal Regulations
CGA	Compressed Gas Association
CHS	Center for Hydrogen Safety
CISA	Cybersecurity and Infrastructure Security Agency
CPUC	California Public Utilities Commission
DOT	Department of Transportation
EERE	U.S. Department of Energy’s Office of Energy Efficiency and Renewable Energy
ERM	Enterprise Risk Management
ESD	Emergency Shutdown Devices
FEMA	Federal Emergency Management Agency

GIS	Geographic Information System
GO	General Order
GTI	Gas Technology Institute
HCA	High Consequence Areas
HySafe	International Association for Hydrogen Safety
ILI	Inline Inspection
ISO	International Organization for Standardization
LNG	Liquified Natural Gas
MAOP	Maximum Allowable Operating Pressure
MJ	Megajoule
mol	Mole
MSP	Material Specification
NFPA	National Fire Protection Association
NPS	Nominal Pipe Size
O&M	Operations and Maintenance
OPM	Optical Pipeline Monitoring
OQ	Operator Qualifications
OSHA	Occupational Safety and Health Administration
PAG	Planning Advisory Group
PDCA	Plan-Do-Check-Act
PHMSA	Pipeline and Hazardous Materials Safety Administration
PIR	Potential Impact Radius
ppb	Parts per billion

PPE	Personal Protective Equipment
ppm	Parts per million
RAMP	Risk Assessment Mitigation Phase
SCC	Standards Council of Canada
scf	Standard Cubic Foot
SIF	Serious Injuries and Fatalities
SMS	Safety Management System
SMYS	Specified Minimum Yield Strength
SoCalGas	Southern California Gas Company
THT	Tetrahydrothiophene
TSA	Transportation Security Administration

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2.0 EXECUTIVE SUMMARY

Southern California Gas Company (SoCalGas) is proposing the Angeles Link Project (Angeles Link) to develop a clean renewable hydrogen[1] pipeline system to facilitate transportation of clean renewable hydrogen from multiple potential regional third-party production sources to various delivery points and end users in Central and Southern California, including in the Los Angeles Basin. The CPUC Phase 1 Decision[2] requires SoCalGas to, among other things, evaluate safety concerns involved in the pipeline transmission, storage, and transportation of clean renewable hydrogen.

As detailed herein, this study demonstrates that Angeles Link can be safely designed, constructed, operated, and maintained in accordance with existing regulations and industry standards and best practices pertaining to hydrogen; adapting corollary safety regulations and industry standards and best practices to suit the specific properties and characteristics of hydrogen; and developing new standards and practices specific to the transport of hydrogen.

Key Findings

- **Existing Hydrogen-Specific Requirements, Codes, and Industry Standards Will Help Promote Safety.**

  Regulatory requirements and industry-standard codes exist for the transportation of hydrogen gas by pipeline, primarily anchored by Title 49 Code of Federal Regulations (CFR) Part 192 Subparts A through P and the CPUC's General Order (GO) 112-F governing natural gas transmission and distribution and addressing flammable gases such as hydrogen. Current federal minimum safety standards for pipelines transporting natural and other gases include hydrogen and do not specify differences and considerations for hydrogen specifically versus natural gas (and other gases). Other hydrogen-specific standards and specifications also exist and are applied in the industry (e.g., American Society of Mechanical Engineers (ASME) B31.12 or National Fire Protection Association (NFPA 2)), although they are not specifically incorporated into 49 CFR Part 192 or CPUC GO 112-F by direct reference. There are approximately 1,600 miles of hydrogen pipelines operating in the United States today that are regulated via industry standards.

- **Existing Requirements Applicable to the Natural Gas System Can Be Leveraged and Tailored to Promote the Safe Transportation of Hydrogen for the Benefit of the Public, Our Employees, Contractors, and Our Infrastructure.**

  A clean renewable hydrogen system (gaseous hydrogen) can leverage many of the existing requirements of an analogous natural gas system. Where hydrogen's physical and chemical

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[1] In the California Public Utilities Commission (CPUC) Angeles Link Phase 1 Decision (D).22-12-055 (Phase 1 Decision), clean renewable hydrogen refers to hydrogen that does not exceed 4 kilograms of carbon dioxide equivalent (CO2e) produced on a lifecycle basis per kilogram of hydrogen produced and does not use fossil fuels in the hydrogen production process, where fossil fuels are defined as a mixture of hydrocarbons including coal, petroleum, or natural gas, occurring in and extracted from underground deposits.

[2] CPUC Decision 22-12-055.

properties differ from natural gas, influence from SoCalGas's existing natural gas system plans including safety systems, specifications, procedures, and training will provide a basis for designing, constructing, and operating Angeles Link. SoCalGas's catalog of specifications and standards for its existing natural gas pipeline system (as of August 2023) implements federal and state pipeline safety requirements, industry standards, and best practices across the required aspects of design, material sourcing, construction, operation, maintenance, inspection, and reporting for a natural gas transmission and distribution system. In consideration of Angeles Link, SoCalGas will leverage existing specifications and develop new specifications (as appropriate), including but not limited to material specifications, fabrication and welding requirements, safety plans, quality management plans, approved manufacturer's lists, operator qualification procedures, fire protection and prevention strategies, corrosion control requirements, inspection requirements, and reporting requirements.

- **Safety Will Be Foundational and Factored into All Aspects of System Design, from Material Selection to Sizing and Compression Requirements and Control Room Operations, and Risk Mitigation, from Personal Protective Equipment to Odorization, Cybersecurity, Etc.**

  Transmission pipeline construction, operations, and maintenance safety considerations for a clean renewable hydrogen system can take into account the various existing SoCalGas safety systems that promote safety for the public, infrastructure, SoCalGas employees, and contractors. Major topics reviewed in this assessment include safety considerations with respect to material, design, construction requirements, operations, inspections and maintenance activities, Personal Protection Equipment (PPE), security (both physical and cyber), and odorization of 100% clean renewable hydrogen.

  A preliminary design basis will include the identification of key factors such as the operating and design characteristics of clean renewable hydrogen for Angeles Link, which will be used in the determination of preliminary pipeline sizing, compression requirements, and pipeline material selection. Subsequently, construction, operation, and maintenance requirements, such as 49 CFR Part 192, will contribute to that basis. In addition to the federal regulations, there are applicable and/or hydrogen-specific industry codes and standards that are already in existence and will be considered, such as API 5L, API 1104 and ASME B31.12[3]. New rules or changes to existing rules would go through the rulemaking process as described by the Federal Register (Office of the Federal Register).[4] This process includes stages for development, rule proposal, soliciting comments from the public and those directly affected by the proposed rule, finalizing the rule, integration of the rule, and providing interpretation (if necessary).

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[3] API 5L pipe specifications. American Piping Products. (2024, January 4). https://amerpipe.com/products/api-5l-pipe-specifications/API standard 1104, 22nd edition. Energy API. (n.d.). https://www.api.org/products-and-services/standards/important-standards-announcements/1104, B31.12 - Hydrogen Piping & Pipelines: Digital Book. ASME. (n.d.). https://www.asme.org/codes-standards/find-codes-standards/b31-12-hydrogen-piping-pipelines.

[4] The Federal Register. Federal Register: Request Access. (n.d.). https://www.federalregister.gov/.

In general, PPE used by SoCalGas employees, contractors, or any other personnel accessing a SoCalGas facility (or as otherwise required by SoCalGas at a project or work site), is covered by California Occupational Safety and Health Administration (OSHA) and addressed within NFPA 2112. Special considerations must be made for hydrogen service, due to its low ignition energy, flame temperature, and flame speed. Anti-static and flame-resistant clothing or coveralls and non-metallic (or non-sparking materials) should be considered. SoCalGas should review its procedures to determine if changes should be made regarding PPE for employees working on hydrogen pipelines.

Hydrogen, like natural gas, is odorless. Assessing odorizing the 100% clean renewable hydrogen transported through the proposed Angeles Link infrastructure to indicate the presence of hydrogen is an important consideration in the development of applicable safety protocols. The selection of the appropriate odorizing agent is important to avoid impacts on downstream customers that require relatively pure hydrogen for their uses and may require downstream customers to "scrub" the odorant from the received hydrogen. Industry research on the implications of odorant in a pure hydrogen system is ongoing and should be monitored during the development of Angeles Link to identify industry best practices.

Control room operations are critical elements to safely and efficiently operate hydrogen pipeline infrastructure and can provide early opportunities to mitigate risk. The control room operators monitor the pressure and flow of gas in the system utilizing a supervisory control and data acquisition (SCADA) system 24 hours a day, 365 days a year. SCADA provides live data which is used to quickly detect potential abnormalities in pipeline operation, including potential leaks and changes in pressure and flow. In addition, SoCalGas's monitoring, and installations of rupture-mitigation valves and automated valves are consistent with PHMSA's valve rules in case of rupture. SoCalGas uses a SCADA system today to monitor the gas-transmission system including associated pipelines, line compressor stations, and underground storage facilities. A hydrogen system may require a separate SCADA system to monitor the pipeline and compressor station operations.

Physical and cyber security requirements are primarily addressed by the Transportation Security Administration (TSA) as part of Homeland Security.[5] It is envisioned that a clean renewable hydrogen pipeline system could follow the same philosophy SoCalGas currently uses for the physical and cyber security of its existing natural gas system. Physical and cyber security requirements should be addressed with third-party clean hydrogen producers and third-party hydrogen storage providers if applicable.

- **Existing Emergency Response and Public Awareness Plans Can Be Leveraged and Tailored for Hydrogen's Specific Properties and Characteristics.**

[5] 49 of the United States Code, Transportation Security Administration, section 114(s); https://www.dhs.gov/publication/2023-biennial-national-strategy-transportation-security

Emergency response plans and procedures promote effective emergency incident management and are designed to address unanticipated or emergency situations. This includes employees who are trained and equipped to respond promptly to protect the public, maintain system reliability, and restore the affected system and Company operations to normal status. The emergency response plan should contain hydrogen-specific details and provide the framework for the emergency response protocol, including dispatch of personnel to a potential hydrogen leak site. SoCalGas can leverage its existing Operating and Maintenace Procedures (O&M Plan) which include comprehensive safety and emergency response procedures and protocols that address safety of the public and employees, during emergencies, and comply with all applicable state and federal safety requirements.

SoCalGas should continue compliance with Public Awareness Plans requirements pursuant to 49 CFR § 192.616 that would specify the hydrogen infrastructure to have markers indicating the transported fuel, hydrogen, and an emergency phone number which should be monitored 24/7 by the control room or a separate emergency response desk. Hydrogen control room and emergency response personnel will require hydrogen-specific training in the physical and chemical properties and the execution of the emergency plans. First responder awareness level training can be provided by multiple organizations and provides an overview on hydrogen for fire, law enforcement, emergency medical personnel and others.[6] SoCalGas may also consider separate gas controllers and emergency response teams for the natural and hydrogen gas systems since natural gas and hydrogen are different fuels with different physical and chemical properties. Gas controllers' training will require operator qualifications unique to the hydrogen system, including knowledge of the abnormal operating conditions associated with hydrogen compressor and pipeline operations.

- **Hydrogen-Specific Training for Employees and Contractors that Incorporate Industry Lessons Learned Can Be Collaboratively Developed.**

Training on the operational considerations and key risks of hydrogen for SoCalGas employees and contractors can be developed. Additionally, the public should be provided access to information about the risks and safety measures associated with hydrogen, supporting public outreach and long-term project input considerations, similar to the training materials and programs for the public that SoCalGas offers on natural gas. Several organizations and consultants currently offer training specific to the risks associated with designing, constructing, operating, and maintaining a hydrogen system. As the hydrogen energy market continues to grow, additional training and certifications may become available.

As the Angeles Link Project progresses, safety will remain foundational. Collaboration amongst industry stakeholders, regulatory bodies, research institutions, first responders and the communities,

[6] This introduction to Hydrogen Safety for First Responders is a Web-based course that provides an "awareness level" overview of hydrogen for fire, law enforcement, and emergency medical personnel. American Institute of Chemical Engineers: Center for Hydrogen Safety, https://www.aiche.org/ili/academy/courses/ela253/introduction-hydrogen-safety-first-responders.

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will play a key role in the continued development of regulations, specifications, standards, and other requirements to safely design, construct, operate and maintain a clean renewable hydrogen pipeline transportation system. SoCalGas is well positioned to build, operate, and maintain a clean renewable hydrogen pipeline system due to its long-standing experience operating and maintaining a highly developed gas transmission and distribution system, existing highly trained and qualified workforce, and comprehensive established integrity management and emergency response procedures.

Stakeholder Input Summary

The input and feedback from stakeholders including the Planning Advisory Group (PAG) and Community Based Organization Stakeholder Group (CBOSG) has been helpful to the development of this draft Safety Study. SoCalGas has also routinely met with the California Public Utilities Commission's (CPUC)'s Safety Enforcement Division to provide updates and to collaborate on the project. As further detailed in Section 13 below, in response to stakeholder comments received thus far, the Center for Hydrogen Safety, Hydrogen Safety Panel is conducting a third-party review of this safety study, with results of their review expected to be incorporated into the final report. Additionally, the following topics for: Safety Management Systems (SMS) framework, odorant feasibility, Emergency Response protocols, and Public Awareness plans, are described in Sections 4, 6, 7, 8, respectively.

3.0 INTRODUCTION

The transmission of clean renewable hydrogen across the value chain must prioritize safety and leverage applicable industry experience and best practices, regulations, codes, and standards. Hydrogen has been used for decades across the globe, including for heavy industries (e.g., oil refineries and chemical plants) and transportation (e.g., vehicle fueling stations). In addition, there are over 1,600 miles of hydrogen pipelines currently operating in the U.S. today, owned by merchant hydrogen producers.[7] This industry experience makes the properties and risks associated with hydrogen well known. Additionally, many rules and regulations for natural gas transportation in transmission and distribution pipelines are applicable or can be used to draw sufficiently accurate parallels to transmission and distribution pipelines for clean renewable hydrogen.

SoCalGas is regulated by the California Public Utilities Commission (CPUC) and has over 150 years of experience transporting natural gas via pipeline. Safety is foundational to all aspects of SoCalGas's business[8] and is reflected in the safety plans, programs, policies, standards, and procedures that are designed to support a strong safety culture, as well as the company's comprehensive Safety Management System (SMS) framework, which is implemented consistent with American Petroleum Institute Recommended Practice (API RP) 1173.[9]

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[7] Hydrogen pipelines | Department of Energy. (n.d.-b). https://www.energy.gov/eere/fuelcells/hydrogen-pipelines.

[8] Additional information regarding SoCalGas's commitments to safety can be found in Section II of SoCalGas's 2023 Gas Safety Plan, available at https://www.socalgas.com/sites/default/files/2023-Gas-Safety-Plan.pdf.

[9] API 1173 is a "pipeline" safety management system, designed to support the safe delivery of energy with safe pipeline operations by helping pipeline operators understand, manage, and continuously improve safety.

SoCalGas defines safety as the presence of controls for known hazards, actions to anticipate and guard against unknown hazards, and the commitment to continuously improve the ability to recognize and mitigate hazards. SoCalGas's safety focus is comprehensive and systemic and includes all activities – from the office to the field – to advance public safety, infrastructure safety, employee safety, and contractor safety.

Safety is embedded throughout Angeles Link's planning, engineering, and design process as well as through the execution of construction and long-term operation and maintenance. The objective of this Plan for Applicable Safety Requirements (Safety Study) is to evaluate federal, state, and industry codes, standards, and best practices for their application to pipeline transmission, storage, and transportation of clean renewable hydrogen as applicable to Angeles Link. This evaluation includes providing an assessment of applicable safety requirements for employee, contractor, system, and public safety. This Safety Study identifies potential updates or modifications to SoCalGas's standards, specifications, and procedures (covering construction, operations, and maintenance) to address hydrogen-specific considerations, as applicable. This Safety Study also outlines the unique considerations associated with hydrogen while outlining actively documented mitigations, standards, and procedures.

4.0 SOCALGAS SAFETY MANAGEMENT SYSTEM

SoCalGas has implemented a comprehensive safety management system,[5] consistent with API 1173, to promote the safe and reliable delivery of service to its customers and integrate public safety, infrastructure safety, employee safety, and contractor safety systems. SoCalGas's SMS documents and connects SoCalGas's comprehensive set of safety plans, programs, and procedures in place that address specific infrastructure or activity areas. The SMS encompasses all aspects of safety relevant to SoCalGas' business, including employee safety, contractor safety, public safety, and infrastructure safety. It applies to all SoCalGas assets and operations as well as to all employees, from senior management to those on the frontline.

SoCalGas designed its SMS to be consistent with American Petroleum Institute (API) Recommended Practice 1173. API 1173 provides a framework for managing safety holistically through the integration of various activities including risk and asset management, formal processes and procedures, systematic decision making, monitoring of program effectiveness, safety culture, audits, and increased communications. While API 1173 is designed to address recommended practices around Pipeline Safety Management Systems, SoCalGas has developed its SMS to apply comprehensively to safety at SoCalGas.

SoCalGas acknowledges that assessment, learning, and continuous improvement are essential to a strong safety management system. Accordingly, in 2021, SoCalGas engaged the American Petroleum Institute to perform a maturity assessment of SoCalGas's SMS. At that time, SoCalGas's SMS scored a 3.06, which indicates SoCalGas's SMS is "Implemented: Organizational structures are in place, processes are fully developed, and procedures and programs documented and functional." Since that assessment, SoCalGas has and is implementing improvements to continue maturing its SMS.

The ten essential elements of API 1173 are detailed below as well as how relevant activities at SoCalGas and the information within this study can be leveraged together for application in the development of Angeles Link.

1. Leadership and Management Commitment is demonstrated through organizational goals, objectives, and a company culture that encourages openness and prioritizes learning from incidents and events. SoCalGas plans to begin integrating hydrogen safety goals into its programs and plans such as including hydrogen safety awareness in employee and contractor safety dialogues and forums. To lead these efforts, SoCalGas created a Senior Vice President of Engineering & Major Projects and Chief Clean Fuels Officer position that leads Angeles Link and other hydrogen projects. This position reports directly to SoCalGas's President and integrates core engineering and construction functions that are vital to current safe work practices and clean fuels projects of the future.

2. Risk Management is advanced by developing a systemic and systematic way to evaluate risks to safety and then develop strategies on how to manage them through preventive controls, monitoring, and mitigation measures. SoCalGas advances its structured enterprise risk management efforts through a Chief Risk Officer and Enterprise Risk Management (ERM) organization. Two key components of SoCalGas's approach to enterprise risk management are (1) the development and filing of a Risk Assessment Mitigation Phase (RAMP) Report to the CPUC every three years and (2) the ongoing maintenance of an enterprise risk registry. SoCalGas plans to integrate hydrogen and hydrogen assets into this existing risk management process. Initial Risk Management considerations are detailed in Section 4: Risk Management.

3. Stakeholder Engagement is promoted through structured processes and plans for communication and engagement with internal and external stakeholders regarding risk and safety. SoCalGas maintains robust processes for stakeholder engagement as noted in Section 8: Awareness, Education, and Training and is implementing additional stakeholder engagement for Angeles Link.[10]

4. Operational Controls are addressed through procedures for safe work practices to promote operations, maintenance, control of materials, and emergency response activities. As detailed in this study, SoCalGas recognizes that existing practices, policies, and procedures will need to be evaluated and evolve to transport hydrogen. SoCalGas is in the process of reviewing and updating existing operational controls to provide for the safe transportation of hydrogen (See Appendix

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[10] SoCalGas established a Planning Advisory Group (PAG) to receive technical advice and to collaborate on Project design and development. The stakeholders include government entities, environmental justice nonprofits, environmental nonprofits, labor groups, industry, academia, and ratepayer advocates. Through the PAG, SoCalGas coordinates with stakeholders on hydrogen market issues, technical issues, environmental impacts, and environmental justice issues. SoCalGas also established a separate and parallel Community Based Organization Stakeholder Group (CBOSG) engagement process. The CBO stakeholder group is composed of 25 organizations that represent disadvantaged communities (DACs), social justice and environmental justice groups, faith-based organizations, school groups, and tribal organizations. It was established to preliminarily provide these members a better understanding of Angeles Link and engage in a collaborative process where the needs and concerns of represented communities are heard.

A).[11] These updates will further enhance its capacity to systematically review a change, including the assessment and mitigation of risks associated with the change. Management of Change is a continuously expanding component of the Operational Controls, a structured process for identifying potential risks associated with changes. Management of Change is an important, enterprise-wide process to safely integrate changes related to hydrogen transportation.

5. Incident Investigation, Evaluation, and Lessons Learned details practices for investigating, evaluating, and learning from incidents and near-misses. SoCalGas has established incident investigation procedures for analyzing natural gas related accidents and failures for the purpose of determining the causes of the failure and identifying learnings to minimize the possibility of recurrence, consistent with federal Pipeline and Hazardous Materials Safety Administration (PHMSA) and Department of Transportation (DOT) regulations (see 49 CFR §192.617, Investigation of Failures), which provide a foundation for application to hydrogen pipelines. SoCalGas has also integrated new and emerging practices related to Human and Organizational Performance by developing a Learning Team framework to assess and improve practices and activities while partnering with employees closest to the work. SoCalGas routinely references lessons learned published by the Pacific Northwest National Laboratories H2Tool website as noted in Section 10: Lessons Learned.

6. Safety Assurance is advanced by regularly assessing whether expected progress toward effective risk management and improved safety performance are being achieved. SoCalGas gathers and maintains data related to its activities and safety performance. Key safety performance metrics (e.g., third party dig ins, Serious Injuries and Fatalities [SIFs], Gas In-line Inspection [ILI] mileage) are reported publicly to the Commission as part of the Commission's Safety Performance Metric Reporting process. Furthermore, SoCalGas's Quality Management Department performs quality assurance on major pipeline and infrastructure projects and maintenance activities such as leak survey, leak detection, and locate and mark of infrastructure on both its distribution and transmission system. Many of SoCalGas's existing metrics and measures would be similarly applicable to hydrogen safety (for example, Job Safety Observations, Near Miss / Stop the Job Reporting) and SoCalGas plans to develop additional safety performance metrics specifically related to hydrogen.

7. Management Review and Continuous Improvement is demonstrated through the review of performance to determine the extent to which goals and objectives have been met. SoCalGas engages in external benchmarking efforts through trade organizations; relationships with peer companies; and through its Advisory Safety Council, which provides feedback on SoCalGas's

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[11] For example, SoCalGas has developed and collaborated with manufacturers to support operation of hydrogen assets; uses company operations standards to guide system-wide consistency in daily operations or event-driven operation; uses material specification (MSP) sheets to specify SoCalGas's requirements for material(s) used in pipeline construction and company operations; uses line classes to specify the allowable piping components for a given service and define the governing code(s). Standards, MSPs, and line classes are also shared with contractors when appropriate to provide transparency and information in regard to safely operating SoCalGas assets.

approach to safety through independent members with deep experience and proven leadership in the areas of safety management systems, public safety, community relations, regulatory oversight and industry safety. In addition to existing internal processes for performance and goal review and continuous improvement, with respect to Angeles Link specifically, SoCalGas's review process for the Angeles Link Phase 1 studies includes subject matter expert reviews internally and externally. This also includes the review and feedback coordinated through the PAG and CBOSG engagement process, and third-party review of this Plan for Applicable Safety Requirements by the Hydrogen Safety Panel (HSP), which was founded by the U.S. Department of Energy to develop and implement guidance, procedures, and best practices that would ensure safety in the operation, handling, and use of hydrogen and hydrogen systems.

8. Emergency Preparedness and Response is promoted through procedures that detail plans to address potential types of emergencies, notification requirements, identification of response resources, use of Incident Command Structure, communication plans, training and drill requirements, and improvement processes. SoCalGas's Emergency Management department is a centralized and dedicated department that supports business operations with first responder outreach and emergency response, preparedness, and recovery. Furthermore, Emergency Management maintains SoCalGas's business continuity (BC) program that addresses continuity of operations and essential functions in the event of a business disruption. The BC program contains multiple BC plans that contain the assessment of potential impacts, mitigations of risks, and processes and procedures to continue operations and essential functions in the event of a business disruption. SoCalGas utilizes the Federal Emergency Management Agency (FEMA) Incident Command System (ICS), which allows for a multi-level emergency response, and is a nationally recognized standardized approach to incident management. SoCalGas regularly conducts outreach to first responders in accordance with 49 CFR § 192.615(c), California Public Utilities Code § 956.5 and API 1162 as noted in Section 7: Control Room and Emergency Response. SoCalGas has already met with first responders such as local fire departments to coordinate and share knowledge on hydrogen safety-related preparedness and response.

9. Competence, Awareness, and Training is demonstrated through processes to evaluate, determine, and enable the appropriate level of competence, including education, training, and experience. SoCalGas has administered hydrogen safety education facilitated by third parties for employees supporting hydrogen projects. SoCalGas has proactively joined with supporting organizations to present hydrogen awareness information to CBOSGs as well as strengthen the connections within academia. SoCalGas has also collaborated with other industry partners to develop pathways to acquire hydrogen training for various levels of personnel. For additional information see Section 8: Awareness, Education, and Training.

10. Documentation and Recordkeeping is advanced through procedures for the identification, distribution, and control of required documents. SoCalGas maintains a comprehensive Information Management Policy, detailed Record Retention Schedule(s), and every employee is responsible to review, evaluate, and manage Company-related information (records and non-records) within their possession or control in accordance with these policies. These same processes will be used in maintaining documentation and recordkeeping related to Angeles Link.

5.0 PHYSICAL AND CHEMICAL PROPERTIES OF HYDROGEN

The safe transmission, compression, storage, and transportation of hydrogen must account for physical and chemical properties associated with pure hydrogen. To illustrate the properties of hydrogen, Table 1 *Properties of Hydrogen Compared to Natural Gas*, compares hydrogen's properties and characteristics to natural gas.

Table 1 - Properties of Hydrogen Compared to Natural Gas

Property / Characteristic	Hydrogen Gas	Natural Gas	Comparison / Comment	Management
Visibility	Colorless	Colorless	Both natural gas and hydrogen are colorless	N/A
Odor	Odorless	Odorless	Both natural gas and hydrogen are odorless	Addition of an odorant, such as mercaptans, which are currently used to odorize natural gas
Toxicity	No toxicity risk when inhaled in small quantities.	No toxicity risk when inhaled in small quantities.	Neither hydrogen nor natural gas are toxic in their pure forms. Both gases can potentially displace oxygen in an enclosed space, resulting in an asphyxiant hazard.	Leak detection, hydrogen gas detectors, addition of odorant
Flammability Range	4% to 75% in air	5% to 15% in air	With hydrogen's wider flammability range, it can combust in a broader set of circumstances than natural gas.	Leak detection, hydrogen gas detectors, and addressing hazards in an electrical area
Combustion Byproduct	Water Nitrous Oxides (NO_X)*	Carbon Dioxide, Carbon Monoxide, NO_X, Sulfur Oxides (SO_X)*	Combustion temperatures and fuel quality and composition influence combustion byproducts	See the discussion below regarding adiabatic flame temperatures

Property / Characteristic	Hydrogen Gas	Natural Gas	Comparison / Comment	Management
Molecular Weight/Size	H_2 Very light/small (2.02 g/mol)	CH_4 (Methane) Heavier/larger chains (16.04 g/mol)	The hydrogen (H_2) molecules are relatively much smaller than methane (CH_4) and can permeate into the base materials containing the hydrogen. Permeation into base materials may result in increased embrittlement in steel pipes, resulting in cracking/fracturing. While methane and hydrogen are lighter than air, hydrogen will rise and disperse more quickly than methane when released into the atmosphere.	Material selection and internal coating (pipelines/tanks) considerations to reduce the potential for cracking/fracturing and embrittlement
Corrosivity	Inherently non-corrosive	Inherently non-corrosive	While both hydrogen and natural gas are non-corrosive, they can impact materials in certain conditions. As indicated previously, hydrogen can act to embrittle steel in certain conditions. Additionally, hydrogen can interact with metals to form metal hydrides. For hydrogen and natural gas, impurities (like water) can result in metal degradation and corrosion.	Commodity purity requirements Regular inspections

Property / Characteristic	Hydrogen Gas	Natural Gas	Comparison / Comment	Management
Ignition Energy	0.02 mJ (or lower)	0.25 mJ – 0.5 mJ (or higher)	Hydrogen and natural gas ignition energy can vary depending on the mixture, temperature, and pressure. Hydrogen's lower ignition energy indicates it is more easily ignited than natural gas, given an identical ignition energy source.	Precise hydrogen ignition control equipment; Non-spark personal protective equipment
Heating Value (lower/higher)	51,600 / 61,000 Btu/lb 290 / 340 Btu/scf	20,300 / 22,500 Btu/lb 980 / 1,100 Btu/scf	To match the energy content of natural gas, hydrogen must be provided at a greater volumetric flow rate.	Design the pipeline on a volumetric basis to meet desired energy needs.
Flame Speed	~200-300 cm/s	~30-40 cm/s	Hydrogen's flame speed is approximately ten times faster than that of natural gas. A hydrogen flame propagates more rapidly than natural gas, impacting combustion systems (e.g., an engine designed for a natural gas fuel source cannot run reliably on a hydrogen fuel source without modification).	Modifications to combustor design to manage flame speed

Property / Characteristic	**Hydrogen Gas**	**Natural Gas**	**Comparison / Comment**	**Management**
Adiabatic Flame Temperature	~4,000 °F	~3,565 °F	Hydrogen's adiabatic flame is approximately 500 °F hotter than that of natural gas, which requires considerations for proper materials and mitigating potential increases in oxides of nitrogen (NO_X) emissions.	Select materials that can withstand the increase in temperature, modify the combustion air/fuel ratios, control flame hot spots, and increase emission treatment. *See section on materials within the Pipeline Sizing and Design Study*

Property / Characteristic	**Hydrogen Gas**	**Natural Gas**	**Comparison / Comment**	**Management**
Compressibility	Additional compressor horsepower is required per unit of energy vs natural gas due to lower molecular weight.		Due to its low molecular weight relative to natural gas, hydrogen requires additional power to compress, given a consistent compression ratio. Due to hydrogen's low volumetric energy density compared to natural gas, additional hydrogen must be compressed to transmit an equivalent amount of energy. Natural gas typically increases in temperature when compressed and decreases when depressurized. Hydrogen has a negative Joule-Thomson coefficient, which has a slight cooling effect as hydrogen is compressed adiabatically, but the added energy from compression results in an overall temperature increase. The negative Joule-Thomson coefficient also causes an increase in temperature during depressurization.	Appropriate compression and hydrogen cooling/heating system design

In summary, there are many similarities between hydrogen and natural gas operations and gas handling. While there are some differences in their properties and characteristics, a variety of existing practices can be modified to manage these differences. Risk management of any gas system should be similar in prioritizing safety measures for materials, design, operation, and maintenance. Eliminating hazards and detecting leaks are a critical component of monitoring and mitigating risk.

6.0 RISK MANAGEMENT

SoCalGas's SMS establishes a unified systemic approach to managing safety across the enterprise, and includes the necessary organizational structures, accountability, policies, and procedures. The system is comprehensive and iterative in nature, and designed to identify, manage, and reduce risks and help prevent or mitigate the likelihood and consequences of safety incidents, including serious injuries to employees, contractors, or the public, as well as unintended releases or Abnormal Operating Conditions.

Risk management is an element of SoCalGas's SMS, and the existing risk management approach will be beneficial in incorporating and addressing hydrogen infrastructure. SoCalGas's enterprise risk management (ERM) is modeled after International Organization for Standardization (ISO) Standard 31000 and is a comprehensive framework to identify, assess, respond to and report on key risks. The SMS utilizes Plan-Do-Check-Act (PDCA), which serves as a core component of SoCalGas's SMS. The PDCA cycle is iterative and intended to continuously improve safety at SoCalGas. Furthermore, execution of the PDCA supports the ERM framework.

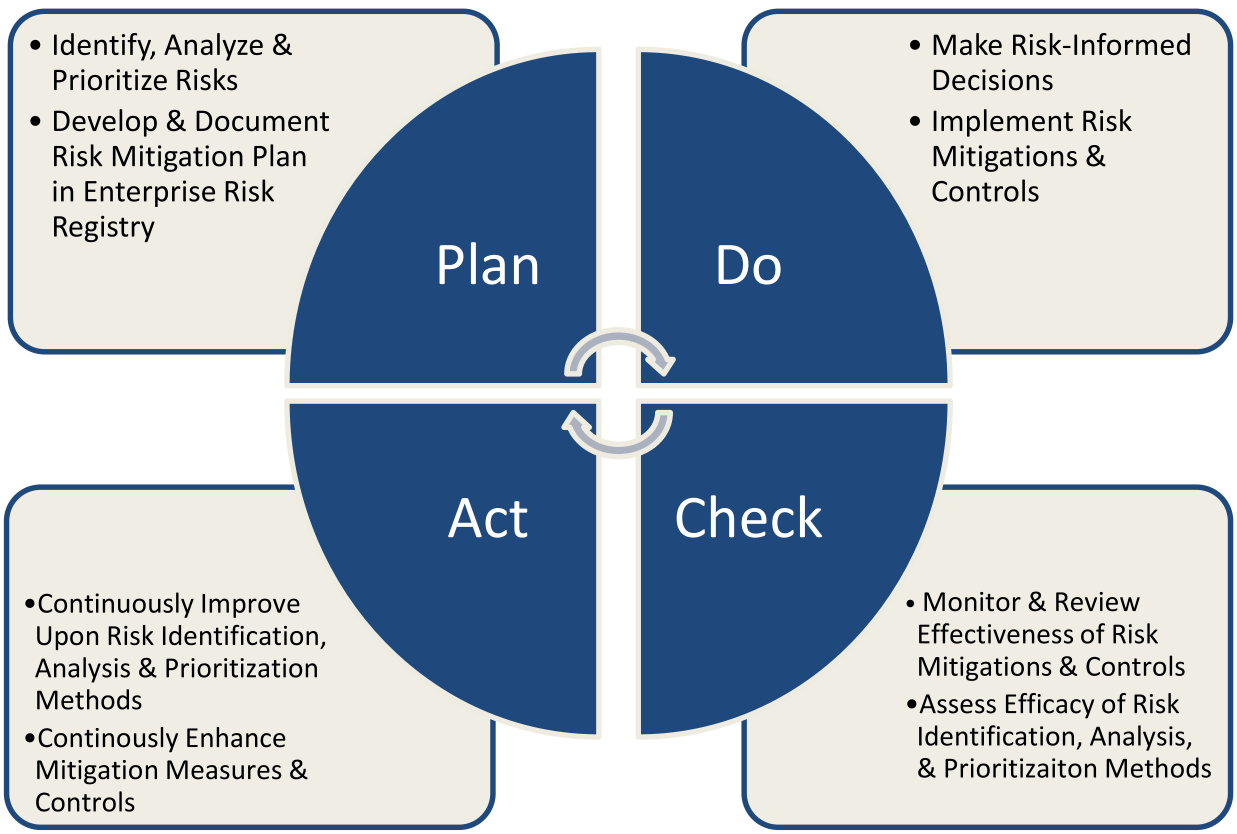

Figure 1 – Risk Management

Table 2, *Risk Management* below identifies potential considerations regarding the transportation of fuel by pipeline, as well as potential risk management. The management of risk would include considerations for internal integrity management processes, training, design, engineering, and implementation of regulatory requirements mandated by PHMSA and the CPUC. The following table outlines these considerations for transmission, compression, storage, and transportation and includes potential management. As with any installation, site and situation-specific mitigations must be considered.

Table 2 – Risk Management

Description of Risk	**Potential Consequences**	**Potential Management**
Stakeholder engagement and safety training	Public awareness plans and local first responder liaisons are not specific to hydrogen, leading to potentially inappropriate reactions to incidents.	Update Public Awareness Plan material for hydrogen infrastructure to inform the public and emergency responders on the fundamentals of hydrogen and differences versus natural gas (what may be familiar). For internal resources, widespread safety training from industry associations and organizations like GTI, AGA, and others.
Design, construction, operations & maintenance	Equipment failures, leaks/accidents could create a potential risk of fire or explosion. If a significant failure occurs, the shutdown could lead to fuel shortages and service disruptions, impacting areas adjacent to the failure location(s) and the end users.	Monitoring API and other organizations' research and development of hydrogen pipe specifications to incorporate current industry best practices.
	Properties of hydrogen that differ from natural gas are not appropriately accounted for in design and construction, leading to failures and impacting areas adjacent to the failure location(s) and the end users.	For purposes of this report, it is assumed that the Angeles Link infrastructure would be an entirely new system constructed with 100% hydrogen-compatible material, compatible welding specifications, and the latest industry best practice construction techniques, helping to minimize damage and leak events.
	Potential for ignition, which could create risk of fire or explosion.	Regular maintenance and compliance with all safety regulations, including leak detection, monitoring, and conducting regularly scheduled leakage surveys.

Description of Risk	Potential Consequences	Potential Management
Natural disasters and third-party damages	Higher populated areas increase the risk of threats like third-party damage and impacts on people and property affected.	The Angeles Link infrastructure would be an entirely new system constructed with hydrogen-compatible material, compatible welding specifications, and the latest industry best practice construction techniques, helping to minimize damage and leak events. Additionally, the pipeline will be buried with adequate cover and signage along the route in accordance with federal and state pipeline safety standards. The SoCalGas Public Awareness Plan will help inform the public about hydrogen, the specific pipeline route, emergency contacts, and additional relevant information.
	Damage to aboveground assets/equipment could create a potential risk of fire or explosion.	Upgrade physical security with technology designed to minimize occurrences of vehicles driving through gates or penetrating fences, such as bollards or concrete barriers.
	A seismic event could damage the pipeline if not appropriately designed. This damage could create a potential risk of fire, explosion, and potential fuel shortages and service disruptions.	Available seismic notifications systems and resulting system shutoffs, including actuated mainline valves with pressure monitoring for line break scenarios installed on either side of a major fault crossing. Installation of low-density backfill material (i.e., Geofoam) to account for pipeline displacement and reduce stresses. Other design considerations include minimizing pipeline changes across fault lines to reduce stress concentrations of an earth load applied to the pipeline due to a seismic event.
	Individuals could gain access to the pipeline infrastructure aboveground assets or equipment, intending to vandalize or do harm. This could result in infrastructure damage and lead to significant repairs and disruptions to service.	100% security camera coverage of all aboveground sites with real-time monitoring in a central security center or control room. All doors into buildings are locked and equipped with intrusion detection capabilities.

7.0 KEY SAFETY CODES

There are numerous existing codes, specifications, standards, and regulatory requirements applicable to transporting gas in a pipeline. SoCalGas is familiar with, and actively implements applicable codes and standards in connection with its existing natural gas transportation system. Certain codes and standards, including PHMSA's regulations contained in 49 CFR Part 192, also apply to the transportation of hydrogen.

In addition, there are a number of hydrogen-specific industry standards that provide best practices that should be considered for hydrogen pipelines.

Federal Regulations

1. 49 CFR Part 192, *Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards and Integrity Management*, is a comprehensive federal code covering design, materials, welding, testing, and topics in operations, maintenance, and operator qualifications (OQ). Under 49 CFR Part 192, code section 192.7 contains the documents incorporated by reference partly or wholly which include industry codes and standards, some of which may apply to hydrogen assets. Current federal minimum safety standards for pipelines transporting natural and other gases include hydrogen and do not specify differences and considerations for hydrogen specifically versus natural gas (and other gases).
2. 49 CFR Part 191, *Transportation of Natural and Other Gas by Pipeline; Annual, Incident, and Other Reporting* covers the requirements for reporting incidents, safety-related conditions, annual pipeline summary data, and other reporting. 49 CFR Part 191 would apply to hydrogen pipelines with potential changes to the format of the forms associated with reporting. 49 CFR Part 191 does not distinguish between natural gas, hydrogen, liquefied natural gas (LNG) or liquid pipelines. Part 191 is primarily a reporting section and requires establishing an Operator ID (OPID) before constructing new transportation assets.
3. 49 CFR Part 173, *Shippers – General Requirements for Shipments and Packaging* provides the requirements for transporting hazardous materials, including hydrogen, in mobile storage containers and pressure vessels. Part 173 covers the classification (hydrogen is classified as a Class 2.1 flammable gas), packaging, hazard communication, and the required transport driver training(s). Additionally, referencing 49 CFR 178, Part 173 covers the requirements for pressure vessels should hydrogen be transported as a compressed gas.[12]
4. Occupational Safety and Health Administration (OSHA), Code of Federal Regulations, Title 29, Part 1910, Subpart H. Hazardous Materials – This code addresses hydrogen as a hazardous material. 29 CFR Section 1910.103 is specific to hydrogen.

State Requirements

1. The CPUC is the agency authorized by PHMSA to oversee intrastate gas pipeline facilities in California. CPUC General Order (GO) No. 112-F, *State of California Rules Governing Design, Construction, Testing, Operation, and Maintenance of Gas Gathering, Transmission, and Distribution Piping Systems within the State of California*, is focused on many of the same regulatory requirements as 49 CFR Part 192. General Order No. 112-F incorporates by reference the current version of 49 CFR Part 192 and specifies additional rules and requirements to the Federal Pipeline Safety Regulations (49 CFR Parts 191, 192, 193, and 199).

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[12] This Safety Study references 49 CFR Part 173 for shipments and packaging for containers that may contain hydrogen gas as a potential consideration but does not imply it will be incorporated within Angeles Link, as Angeles Link is proposed as a pipeline infrastructure project.

2. The California Health and Safety Code contains requirements that govern the handling, storage, and transmission of hazardous materials:
    a. Division 20, Chapter 6.95, *Hazardous Materials Release Response Plans and Inventory* – This plan aims to prevent or minimize harm to public health and safety and the environment from a release or threatened release of a hazardous material.
    b. Sections 25531 - 25543.3, California Accidental Release Prevention (CalARP) program – The purpose of this program is to prevent accidental releases of those substances determined to potentially pose the greatest risk of immediate harm to the public and the environment.
3. Cal/OSHA Code of Regulations. Title 8, General Industry Safety Orders – This code establishes minimum workplace safety standards. Part 5473 includes language specific to hydrogen systems and storage (refer to Subchapter 7, Group 20, Article 138).

Industry Codes and Standards

1. NFPA 2, *Hydrogen Technologies Code* – This code provides fundamental safeguards for hydrogen generation, installation, storage, piping, use, and handling. It is backed by a knowledgeable technical committee and is a valuable resource as an industry best practice, although it is not incorporated by reference into 49 CFR Part 192.

2. API RP 1162, *Public Awareness Programs for Pipeline Operators* – This recommended practice, incorporated by reference into 49 CFR Part 192, addresses the development, implementation, evaluation, and documentation of pipeline public awareness programs. The content of an operator's public awareness program should be modified when referring to a hydrogen pipeline versus a natural gas pipeline even though API 1162 does not distinguish between natural gas and hydrogen from a procedural perspective. This recommended practice is focused on creating awareness with the affected public, excavators, and local governments on the location of gas infrastructure and steps that can prevent incidents/accidents and providing information on how to report emergencies.

3. California Government Code 4216, *Protection of Underground Infrastructure* – This code is related to damage prevention for underground infrastructure. 49 CFR § 192.614 also has specific requirements related to damage prevention, including the requirement to participate in a public service program, such as a one-call system. These requirements would also apply to hydrogen pipelines.

4. API RP 1173, *Pipeline Safety Management Systems* – This recommended practice relates to all pipeline systems and includes roles and responsibilities within the operator's company from the top down. This recommended practice will continue to guide the development and maintaining of a pipeline safety management system for hydrogen pipelines. This process standard is commodity/fuel agnostic and outlines the process for creating a safety management plan.

5. *ASME Boiler and Pressure Vessel Code (BPVC)* – BPVC is a set of codes and standards developed by ASME to regulate the design, construction, inspection, and maintenance of boilers and pressure vessels. Pressure vessels used for hydrogen storage would incorporate the requirements of BPVC, including, but not limited to:

a. BPVC Section VIII -Division 3 Article KD-10 provides special requirements for stationary pressure vessels in high-pressure hydrogen service.
b. BPVC Section XII provides the requirements for tanks and pressure vessels used for transportation up to 3,000 psig and volumes greater than 120 gallons.

6. ASME B31.8, *Gas Transmission & Distribution Piping Systems* – This code is applicable to the design, fabrication, installation, inspection, and testing of pipeline facilities used in the transportation of gas. Safety aspects of the operation and maintenance of those facilities, such as emergency plans, training programs, and prevention of accidental ignition are also covered. This code is considered an existing industry best practice, standard, and reference document although it is not wholly incorporated by reference into 49 CFR Part 192 (per §192.7).

7. ASME B31.12, *Hydrogen Piping and Pipelines* – This code is applicable to piping and pipelines in gaseous hydrogen service. Guidelines are provided for the design, construction, and operation of hydrogen piping and pipeline systems for the safety, integrity, and reliability of these systems. The code covers a wide range of system components, including pipes, fittings, valves, pressure vessels, and associated equipment and is one of the most reputable hydrogen codes adopted by regulatory authorities. ASME B31.12 is not currently incorporated by reference into 49 CFR Part 192.

8. *Compressed Gas Association (CGA) G-5, Hydrogen* – This specification is intended to provide background information and recommended practices covering the manufacture, distribution, and use of hydrogen. It summarizes the chemical and physical properties of hydrogen and provides guidance on critical aspects of hydrogen system design, including pressure relief and venting. This specification is referenced in NFPA 2 while it is not incorporated by reference into 49 CFR Part 192.

As the hydrogen economy further develops, additional industry best practices and technical specifications will likely emerge. [13] 49 CFR § 192.7 contains the list of documents incorporated by reference partly or wholly. The list will likely expand as more standards, best practices and technical specifications are developed for hydrogen pipelines. Existing codes and standards are not considered regulations or requirements unless incorporated by reference in the Code of Federal Regulations. Industry best practices may be beneficial as reference points in the development of hydrogen infrastructure, as well as to review, and potentially incorporate, as appropriate.

Finally, international codes can be used as a reference point or basis for development of standards in the United States. Access to these international codes may provide value in understanding certain best practices for similar systems as well as potential application(s) to enhance safety.

[13] Core objectives of the hydrogen industry are supported by SoCalGas's collaboration with and support of organizations such as: Pipeline Research Council International (PRCI), NYSEARCH (Natural Gas RD&D), and Low-Carbon Resources Initiative (LCRI).

8.0 SPECIFICATIONS, STANDARDS & PROCEDURES EVALUATION

In accordance with PHMSA and CPUC regulations, SoCalGas has an extensive set of specifications, standards, and procedures for its existing natural gas system, which can be modified for hydrogen as appropriate. The evaluation conducted as part of this work scope focused on the existing specifications, standards, and procedures provided by SoCalGas. The methodology applied is discussed in Appendix A, *SoCalGas Standards Review Summary*. The critical identifier is "Transportation," which places hydrogen pipeline infrastructure involved in transporting hydrogen from third-party production and third-party storage to end users under the jurisdiction of PHMSA. If new codes and standards are developed and released for incorporation into the federal safety standards, SoCalGas should update and revise the necessary specifications, standards, and procedures to comply with the requirements for safe hydrogen transportation. Currently, industry best-practice standards are available for hydrogen-specific pipelines. For example, until hydrogen-specific codes for pipe specifications and design, welding, weld flaw criteria and evaluation, and inspection and testing are developed, regulations and standards like ASME B31.12 could be used for guidance.

Recommendations for updates to procedures that will cover operations and maintenance of the hydrogen pipeline during normal operating conditions, abnormal operating conditions, leak investigation, repairs, and emergency response are contained in Appendix A, *SoCalGas Standards Review Summary*. Procedures to be developed will follow industry best practices to meet the requirements set out by PHMSA and the CPUC to include information and details such as the following:

1. Code specific language
2. Discussion of the requirements of the procedure
3. Methodology of "How To" execute the procedure
4. Records required and retention time

The following sub-sections discuss the existing specifications, standards, and procedures applicable to SoCalGas's natural gas system, and explain how these specifications, standards, and procedures should be reviewed by SoCalGas to determine whether they could apply to Angeles Link, whether modifications would be required for Angeles Link, or whether new specifications, standards, and procedures may be necessary for Angeles Link.

Pipeline Materials, Design, Construction, and Testing Evaluation

Transmission pipeline construction is identified in 49 CFR Part 192 Subpart B through Subpart G and Subpart J. Construction qualifications for hydrogen facilities will require pipe material specifications, welding specifications, and other typical construction activities specific to hydrogen and may overlap with existing qualifications. The following regulations listed below include many of the requirements that SoCalGas should consider for review.

- 49 CFR Part 192 Subpart B, requirements for pipeline material selections, as prescribed in 49 CFR § 192.51, the minimum requirements for the selection and qualification of pipe and components for use in pipelines. Further information regarding material selection can be found in the *Pipeline Sizing and Design Criteria Study (*Design Study*).*
- 49 CFR Part 192 Subpart C, requirements for new pipelines incorporates API Specification 5L "Specification for Line Pipe" by reference. Pipe manufacturers will seek API 5L certification that

the pipe manufactured and tested in accordance with API 5L will be acceptable for hydrogen service.

- 49 CFR Part 192 Subpart D lists the minimum requirements for design and qualification of pipeline components including prescribing minimum requirements for the design and installation of pipeline components and facilities, along with protection against accidental over pressuring.
- 49 CFR Part 192 Subpart E, *Welding of Steel in Pipelines*, addresses welding procedures, welding qualifications, and other issues. 49 CFR Part 192 also incorporates by reference other API Recommended Practices for transporting pipe, and API Standard 1104 "Welding of Pipelines and Related Facilities" is also incorporated by reference. These Standards and Recommended Practices must be updated to include specific hydrogen specifications.

Operations & Maintenance Procedures Evaluation

Existing SoCalGas natural gas operations and maintenance (O&M) procedures provide a basis for evaluations for hydrogen-specific requirements. O&M procedures were reviewed to provide guidance, including with respect to hydrogen safety, abnormal operating conditions, PPE required, and other topics. Specifically, procedures for leak survey/detection, fire prevention/detection, and purging hydrogen systems will be needed during pipeline, compressor, and other maintenance activities.

Typical O&M safety considerations for 100% hydrogen systems were reviewed to guide pipeline and facilities handling hydrogen; many of the O&M tasks will be structured similarly for hydrogen as they are for natural gas. 49 CFR Part 192 is the primary federal code for O&M of gas pipeline systems. GO 112-F contains additional requirements by the CPUC.

Potential for Future Odorization

Based on known factors and existing general management best practices, an odorant may be required under 49 CFR §192.625, *Odorization of gas*. For Angeles Link transmission pipeline infrastructure, the criteria in §192.625(b) will determine the requirements for odorization.

There have been several studies on the feasibility of odorizing hydrogen and the options for doing so. One such study, performed by DNV GL and SGS Nederland in 2020 for Gasunie Transport Services B.V. and Netbeheer Nederland (DNV GL and SGS Nederland, 2020), tested various types of odorants with various samples/mixtures of natural gas and hydrogen, including a 100% hydrogen sample. A panel was exposed to each sample, and several questions were asked regarding the odor and familiarity of the smell. The results of the study conclude that the mixtures of natural gas and hydrogen and pure hydrogen can be sufficiently odorized with existing odorants.

Another study conducted by MARCOGAZ in 2021 (MARCOGAZ, 2021) investigated odorization of hydrogen and hydrogen and natural gas blends. The report cites several studies from various countries, including the one performed by DNV GL/SGS Nederland. These studies concluded that all the odorants were judged suitable for use in a 100% hydrogen gas for combustion applications. Further research would be required if the intention is to supply hydrogen to stationery fuel cells or fuel cell vehicles. Experience in this matter is limited as most pure hydrogen pipelines to date are strictly for industrial purposes and are not odorized.

The MARCOGAZ report identifies potential areas for further study:

- Possible effects on odorization due to differences in physical properties of the mixture of gas and odorant (density, vapor pressure, etc.)
- Possible chemical reaction between hydrogen and odorant at high-pressure condition
- Possible effects of high concentrations of hydrogen on gas odorant
- Influences from possible impurities from hydrogen production

A discussion on odorants with Arkema Inc. was also conducted. Arkema is a global producer/manufacturer of chemicals, including odorants, for natural gas pipelines. They have also conducted tests similar to the DNV GL/SGS Nederland study and found that odorizing hydrogen will likely be feasible, and that the odorant will not interfere with leak detection technology or explosimeters. If the hydrogen is intended for fuel cells, injected odorant may need to be scrubbed out as it may impact fuel cell system performance. From the discussion with Arkema, hydrogen for use in fuel cells must be >99.97% pure; for more general use, such as combustion or blending, it can be >98% pure.

Per the studies and discussions conducted, the odorant known as tetrahydrothiophene (THT) has been identified to be compatible with a pure hydrogen system. Complementary to the studies discussed, another research study conducted by DNV GL in 2022 for Stedin and Gaz Reseau Distribution France (GRDF) (DNV GL 2022), identified three sulfur free odorants and their suitability for hydrogen in the gas grid. Due to the disadvantages of using THT in hydrogen such as for fuel cell systems, alternative sulfur-free odorants were investigated for hydrogen distribution. The odorant 2-hexyne was found not to have an adverse effect on the performance of fuel cells and was able to maintain stability in hydrogen, therefore appeared suitable for use as a sulfur-free odorant in hydrogen. As research on odorizing hydrogen gas continues, studies are revealing odorization of 100% hydrogen gas is likely to be feasible.

Leak Survey, Detection, Mitigation, and Repair

Leak management is a critical component of system operations and maintenance for several reasons including safety, environmental protection, resource conservation, and infrastructure integrity. SoCalGas has a record of successful application and continuous improvement of leak management, including the adoption of best practices such as aerial monitoring, electronic recordkeeping, use of artificial intelligence, and increased survey frequency. SoCalGas projects such as the Control Center Modernization (CCM) will utilize new field assets such as Optical Pipeline Monitoring (OPM) stations and above ground methane sensors in High Consequence Areas (HCAs).

As hydrogen pipelines are designed and installed, SoCalGas should evaluate inclusion of multiple methods of leak detection. This comprehensive leak detection system should leverage design and construction standards which may include the installation of fiber optic cables for the Angeles Link pipeline. Fiber optic technology may be used to detect and alert SoCalGas to potential events such as unauthorized digging, ground movement, heavy equipment mobilization, subsidence, and pipeline leakage/rupture. Identifying potential gas leaks and other indicators of potential leaks through continuous monitoring utilizing technologies suggested in Table 3, below, would enhance safety and operation of the pipeline. In addition, pipeline patrols performed by trained and qualified individuals within structured scheduled times that meet or exceed Federal and State requirements will provide further active monitoring and safety enhancement. Monitoring systems would alert SoCalGas to potential leaks or ruptures along the pipeline route and enable automatic response and deployment of the appropriate resources to respond and mitigate safely and efficiently.

SoCalGas's existing processes, technology, reporting, compliance, and safety notifications related to leak survey and leak detection would require certain modification for hydrogen leak consequences, but the framework from the natural gas system can be used as a starting point. The areas that will be focused on will be:

1. Leak survey and identifying "Abnormal Operating Conditions" for hydrogen.
2. Leak detection – using the appropriate equipment for detection, including confirmation of equipment calibration.
3. Leak mitigation and repair – requiring engineering and technical support.

Leak Survey

The existing SoCalGas leak survey processes, technology, reporting, compliance, and safety notifications provide a basis for applicability to the hydrogen pipeline and facilities. Current federal regulations (e.g., 49 CFR Part 192) in conjunction with stricter California GO112F regulations require Transmission pipeline leak surveys to be conducted:

- At least twice each calendar year, not exceeding 7.5 months
- Twice each calendar year, not exceeding 7.5 months, for non-odorized pipelines in a Class 3 location[14], and
- Four times each calendar year, not exceeding 4.5 months, for non-odorized pipelines in a Class 4 location[15].

Leak Detection

Leak detection equipment is available and can be utilized for hydrogen detection. Leak detection equipment can be categorized into the following uses:

- Permanently Mounted
- Mobile (Personal and Deployable)
- Aerial Leak Survey

Permanently Mounted Hydrogen Detectors

Per federal regulation 49 CFR §192.736, *Compressor stations: Gas detection*, each compressor building in a compressor station must have a fixed gas detection and alarm system, unless the building is constructed so that at least 50% of its upright side area is permanently open or is located in an unattended field compressor station of 1,000 horsepower or less.

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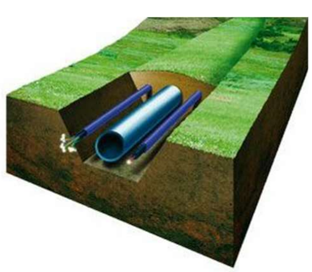
[14] A Class 3 location is: (i) Any class location unit that has 46 or more buildings intended for human occupancy; or (ii) An area where the pipeline lies within 100 yards (91 meters) of either a building or a small, well-defined outside area (such as a playground, recreation area, outdoor theater, or other place of public assembly) that is occupied by 20 or more persons on at least 5 days a week for 10 weeks in any 12-month period. (The days and weeks need not be consecutive.)

[15] A Class 4 location is any class location unit where buildings with four or more stories above ground are prevalent.

Permanently mounted detection equipment should be installed near all above ground assets, in compressor stations, and at underground storage locations. Table 3, *Permanently Mounted Hydrogen Detectors*, lists various equipment identified as options for SoCalGas to consider.

Table 3: Permanently Mounted Hydrogen Detectors

Equipment Name/Model	Specifications/Details
SBS-H2 Hydrogen Gas Detector (Exponential Power, n.d.) 	• Electronic spec sheet available (SBS) • Alarm at 1% and 2% hydrogen • Fail safe mode in event of loss of power
Nitto: Hydrogen Detection Tape (Nitto, Inc., n.d.) 	• Color changing tape that detects hydrogen • Can be used on welds, fittings, equipment • Mainly used at stations
OptaSense: Fiber optic pipeline detections: Real-time Pipeline Leak Detection System (Luna Innovations, 2023)	• Uses multimode leak detection (temp, pressure, ground strain, acoustic changes) • Detects 0.1% leak size
Omnisens Lynx: Pipeline - Securing asset integrity (Omnisens, n.d.) 	• External fiber optic cable used to detect leaks, ground movement, and 3rd party intrusion • Continuous, real-time monitoring • Leak detection based on temperature change along the line • Geohazard and 3rd party intrusions detected by strain and/or vibrations

Mobile Hydrogen Detection Equipment

Detection equipment to monitor and alarm for the presence of hydrogen should be worn or carried by operations personnel as appropriate during operations and maintenance activities. Table 4, *Mobile*

Hydrogen Detection Equipment, lists the available equipment for consideration by SoCalGas for personal wear.

Table 4: Mobile Hydrogen Detection Equipment

Equipment Name/Model	Specifications/Details

Industrial Scientific – Multi-sensor: MX6 iBrid® | Multi-Gas Detector (Industrial Scientific Corporation, n.d.)

 	
	• Electronic spec sheet available (Industrial Scientific Corporation, 2019)
	• Up to 6 gases monitored simultaneously
	• Optional integral sampling pump with strong 30.5 m (100 ft) sample draw; 20 hour run time with pump, 36 hours without pump
	• Operating temperatures range from -4°F to 131°F
	• Full-color graphic LCD is highly visible in a variety of lighting conditions
	• Powerful, 95 dB audible alarm
	• Hydrogen:
	  ○ Range 0-2,000 ppm range, 0.10 ppm resolution
	  ○ Response time: T50: 25 seconds, T95: 60 seconds
	  ○ Calibration gas: 100 ppm hydrogen
	  ○ Accuracy: +/-6%

Industrial Scientific – Single Gas: GasBadge® Pro | Single-Gas Detectors (Industrial Scientific Corporation, n.d.) 	• Electronic spec sheet available (Industrial Scientific Corporation, 2017) • Range: 0-2,000 ppm • Event logger for 15 alarm events • Replaceable battery with a 2,600-hour run time

Dräger: X-am 8000, 5000, 2500, 5600 all can be combined with Hydrogen sensors, Hydrogen H2 – Detectors & Protection Equipment (Dräger, n.d.)

	• Electronic spec sheet available (Dräger, 2022)
	• 1-5 gas sensors
	• 40-hour charge time
	• Normally 1 second measuring interval
	• Sensors range: 0-2,000 ppm
	  ○ DrägerSensor XXS CO/H2 Compensated
	  ○ DrägerSensor XXS H2

Grainger Industrial Supply (Various other hydrogen gas detectors)	• Combustible Gas Detectors

Equipment Name/Model	Specifications/Details

Industrial Scientific – Radius® BZ1 | Area Gas Monitor (Industrial Scientific Corporation, n.d.)

	• Electronic spec sheet available (Industrial Scientific Corporation, n.d.)
	  ○ Rechargeable battery
	  ○ Temp range: -4F to 131F
	  ○ 108 Decibel alarm @ 3.3ft away
	  ○ H2 range: 0-2,000 ppm
	  ○ Logs 60 events
	  ○ H2 sensor: 17156650-C Part #

Aerial Leak Survey Hydrogen Detection Equipment

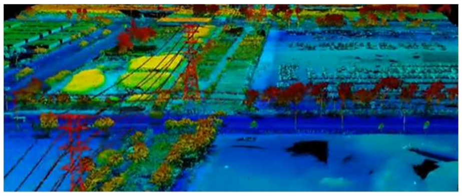
Equipment that could be mounted on drones or manned aircraft is presented in Table 5, *Aerial Leak Survey Equipment for Hydrogen Detection*, for SoCalGas's consideration. Drone options present advantages as they can fly at lower altitudes and slower speeds for more accurate hydrogen detection compared to manned aerial aircrafts.

Table 5: Aerial Leak Survey Equipment for Hydrogen Detection

Equipment Name/Model	Specifications/Details

Sniffer 4D – Mobile Air Pollutant Mapping System – Drone-based Air Pollutant Mapping System (TPI, n.d.)

	• Attachable to drones, planes, trucks/cars, and is wearable.
	• Wide-range H2 Sensing Module
	  ○ Detection method: electrochemistry
	  ○ Range: 0-5,000ppm
	  ○ Detection limit: 17ppm
	  ○ Repeatability: <5%FS
	  ○ Overall response time (t90): <55s (0-400ppm)
	  ○ Theoretical resolution: <0.7ppm
	  ○ On-chip proprietary individual difference compensation algorithms
	  ○ Support "Dormant Mode," warm-up time from a cold start: <10s
	  ○ Zero drift: <±20ppb/year (in laboratory environment)
	  ○ Est. service life: >24months
	  ○ Operating temperature: -30-50°C
	  ○ Operating humidity: 15-90%RH
	• Sniffer4D – Mobile Air Pollutant Mapping System (TPI, n.d.) comprises of various components that can be mounted on a moving platform.
	• Electronic spec sheet available (TPI, 2023)

Hawkeye Helicopter – Fixed wing airplane or rotor-wing aircraft (Hawkeye Helicopter, n.d.)   	• Variety of top technology partners nationwide • Detect leaks, encroachment, and/or erosion • Laser aerial leak detection capable of detecting minute PPM levels at ground level • Aerial video including GIS centerline data as well as a host of other references • Aerial photography to assist in right-of-way certification, project planning and maintenance, structure counts, and more • High-density LiDAR data • Infrared and Corona inspections

Furthermore, the *Supraparticles for Bare-Eye H2 Indication and Monitoring: Design, Working Principle, and Molecular Mobility* (Adv. Funct. Mater. 2022) research article recognizes sensors and indicators for hydrogen are essential in safely managing hydrogen by applying sensing agents to make hydrogen visible. This research introduces sensors with the capability to enable bare-eye detection of hydrogen leaks and can be applied as powders, inks, paints, or coatings. The research concluded the ability to synthesize and investigate a particulate additive for real-time monitoring and the presence of hydrogen gas, detectable by the bare eye for a wide variety of applications during hydrogen production, transport, and storage.

As summarized in this study, there are known leak detection options and equipment for hydrogen pipelines. Multiple vendors have been identified that can provide leak detection equipment specifications for hydrogen detection for permanently mounted, mobile detection equipment, fiber optics, and options for aerial leak detection. Information regarding other hydrogen detection equipment based on literature review is provided in the parallel "Leakage Report."

Leak Mitigation and Repair

Field workforce responsible for operating and maintaining Angeles Link must be trained appropriately to enable rapid leak response. The following actions may be required in response to an identified leak depending on the specific circumstances:

- Steps and measures to protect public and operator personnel per 49 CFR §192.711 – Requirements and techniques for temporary and permanent repairs on a hydrogen pipeline may differ from natural gas pipelines and would require operator qualifications specific to those tasks.
- Report the safety-related pipeline condition per 49 CFR §191.23 and SoCalGas procedures – These requirements and procedures would likely not require changes to operator's skill or tasks related to Angeles Link.
- Communicate emergency incidents per 49 CFR §192.615 and SoCalGas procedures.
- Pipeline section isolation – The Angeles Link pipeline infrastructure would be required to follow the PHMSA Valve Installation and Minimum Rupture Detection Standards, rupture mitigation valves and isolation criteria, which would align with SoCalGas's natural gas system requirements for new construction and certain replacement projects.
- Traffic diversion at road crossings.

- Compressor station sites placed in Fail-Safe Mode.

49 CFR §§ 191.15 and 191.17 contain the requirements for incident reporting and annual reports. 49 CFR §§ 191.23 and 191.25 contain the requirements for safety-related condition reporting. For repairing leaks, PHMSA has proposed a new addition to the 49 CFR Part 192 code to establish minimum criteria for leak grades and associated repair schedules to be prioritized by safety and environmental hazard (Pipeline and Hazardous Materials Safety Administration, 2023). This proposed rule aims to define the criteria and repair schedules to prioritize environmental risks along with the risks to persons and property.

Integrity Management

Transmission integrity management is governed by 49 CFR Part 192 Subpart O, which prescribes the requirements for an Integrity Management Program for covered segments along a gas transmission pipeline. This regulation requires pipeline operators to assess, identify, and address the safety of assets that are located in HCAs. The future framework for an integrity management program could likely continue to follow current requirements specified in 49 CFR Part 192 Subpart O. Certain processes/calculations and assessment technologies and/or intervals may change as outlined in the following integrity management activities. Damage prevention, Public Awareness Plans, and coordination with local responders increase the effectiveness of educating landowners and the general public about the presence of a new hydrogen pipeline, decreasing the likelihood of damage that can significantly impact the integrity of the pipeline infrastructure.

Class Location - The process for determining class location along a pipeline is to utilize a buffer of 660 feet on either side of the pipeline centerline and identify structures or well-defined outside areas along the pipeline that fall within a one-mile sliding segment (see 49 CFR § 192.5, Class locations).

The gas factor for hydrogen in the equation for calculating the potential impact radius (PIR), utilized for determining HCAs and moderate consequence areas (MCAs) along a pipeline route differs from the factor for natural gas. Per the final report issued by Michael Baker Jr., Inc., June 2005, "TTO Number 13, Potential Impact Radius Formulae for Flammable Gases Other Than Natural Gas Subject to 49 CFR 192", which can be found on PHMSA's website (PHMSA, n.d.), the factor for hydrogen is 0.47, which leads to the following formula for calculating the PIR:

$$r=0.47\sqrt{p \cdot d^2}$$

where:

r = the PIR in feet,

p = the pipeline maximum operating pressure in pounds per square inch, and

d = the nominal pipeline diameter in inches.

Once the PIR is calculated, the HCAs and MCAs can be determined for the hydrogen pipeline using the same methodology as for a natural gas pipeline.

To note, the factor for hydrogen (0.47) is lower than the factor for natural gas (0.69), which results in lower PIR than a similar pipeline carrying natural gas. This could result in fewer HCAs and MCAs identified for a hydrogen pipeline versus a natural gas pipeline, and potentially differing class locations along the pipeline route.

The process for determining class location, HCAs, and MCAs utilizes public data to evaluate structure counts and identified sites via class studies and/or field verification. A pipeline system can be modeled in a Geographic Information System (GIS) which allows for electronic data integration. Operations, integrity management, and technical services teams continually review and update (where needed) this information. Future Angeles Link infrastructure could be comprehensively evaluated using similar methods and processes in order to comprehensively determine the class location along the pipeline.

<u>Threat Identification/Evaluation</u> - Threats to a hydrogen pipeline are similar to threats for a natural gas pipeline while the degree of risk may vary. Data gathering and integration would likely be substantially similar as data sources and methodology would remain the same.

<u>Risk Assessment</u> - The risk algorithm should be adjusted to account for differences in the physical and chemical properties of hydrogen versus natural gas. Risk assessment is an annual process that is completed to support assessment types and scheduling, along with identifying appropriate preventive and mitigative measures.

<u>Pigging</u> – In-line inspection (ILI) of pipelines, such as through the use of smart pigs, may help to identify pipeline integrity issues that could result in pipeline failures. ILI of hydrogen pipelines is possible and can be utilized as one of the assessment methods identified by 49 CFR Part 192 Subpart O, *Gas Transmission Pipeline Integrity Management*, which requires regular assessment of pipeline segments that could affect a high consequence area. One such vendor, TD Williamson (TDW), has successfully inspected hydrogen pipelines via ILI using modifications to their existing tools. They concluded, "In terms of general pigging of new, converting, and operational pipelines carrying pure or blended hydrogen, existing tools can be modified or implemented with minimal engineering or cost. For ILI, combination tools and multiple mission runs can be used to establish needs to be addressed before hydrogen service with no changes required. When hydrogen pipelines are in service, especially those transporting highly pure hydrogen, a significant redesign of the ILI tools is required. However, it has been proven that successful inspection can be achieved under operational conditions." (Romney, Barker, Geren, & Kirkwood, 2021).

Rosen Group (Rosen) has also been researching and developing solutions for assessing hydrogen pipelines via ILI. (ROSEN Group, n.d.)

Pipeline operators also have an option of "batching" ILI tools, meaning the tool is loaded into the middle of two isolation pigs (one in front of the ILI tool and one behind) and the ILI tool is in a compatible pressurized gas, such as nitrogen (or a slug of diesel if the tool requires a liquid coupling). ILI inspections are one potential component of the overall Integrity Management Program governed by Subpart O of 49 CFR Part 192. Overall, the hydrogen industry is actively pursuing enhancing pigging solutions to proactively design, construct, or retrofit pipelines to incorporate the appropriate ILI tools to identify hydrogen pipeline integrity concerns. ILI vendors are currently developing and modifying ILI tools to perform assessments in pure hydrogen service.

Hydrostatic Testing – Hydrostatic testing (hydrotesting) of transmission pipelines is governed by 49 CFR Part 192 Subpart J, *Test Requirements*, which generally requires hydrotesting of new gas pipelines prior to placing into service. Testing will be dependent on pipe grade, pipe diameter, wall thickness, planned Maximum Allowable Operating Pressure (MAOP), hoop stress as a function of Specified Minimum Yield Strength (SMYS), and Class Location. The testing requirements remain applicable to hydrogen pipelines.

Cathodic Protection – Cathodic Protection is governed by 49 CFR Part 192 Subpart I, *Requirements for Corrosion Control*. This subpart contains all the requirements for cathodic protection and other external and internal corrosion control. Requirements for external corrosion control are expected to be the same between natural gas and hydrogen pipelines as they will be exposed to the same environments regardless of commodity transported; external coatings and other external protection mechanisms are effective for both pipeline systems. Internal corrosion control, such as internal tank coatings, will be specifically based on the physical and chemical properties of hydrogen.

Emergency Shutdowns

Emergency shutdown systems are a collection of devices that are primarily located at compressor stations and may also be located at other facilities. They are governed by 49 CFR §192.167, *Compressor Stations: Emergency Shutdown*, which contains all the requirements for emergency shutdown devices (ESD). ESD Systems must meet the following requirements listed in 49 CFR §192.167(a):

- ESD Systems must be able to block gas out of the compressor station and blow down the station piping.
- ESD Systems must discharge gas from the blowdown piping at a location where the gas will not create a hazard.
- ESD Systems must provide means for the shutdown of gas compressing equipment, gas fires, and electrical facilities in the vicinity of gas headers and in the compressor building, except that:
    - Electrical circuits that supply emergency lighting required to assist Station Personnel in evacuating the compressor building and the area in the vicinity of the gas headers must remain energized; and
    - Electrical circuits needed to protect equipment from damage may remain energized.
- ESD Systems must be operable from at least two locations, each of which is:
    - Outside the gas area of the compressor station;
    - Near the exit gates if the compressor station is fenced or near emergency exits if not fenced; and
    - Not more than 500 feet (153 meters) from the limits of the compressor station.

An ESD system is ultimately an engineered assembly of control devices. When activated during an emergency they will stop equipment that is part of a specific operating system, close certain valves to isolate that system, and may open other valves to cause the system to depressurize to atmosphere. The objective of an ESD is to get the system to a safe condition.

Other Safety Factors

Hydrogen PPE

Wearing PPE is a common practice in the pipeline industry to increase the personal safety of personnel in the work environment. By providing proper PPE to SoCalGas personnel, SoCalGas provides protective equipment in case an unanticipated event occurs during the performance of work on pipeline infrastructure or while responding to abnormal operating conditions or emergencies. SoCalGas will advise contractor personnel of the minimum PPE requirements. Contractors should be informed of the need to provide PPE to contractor personnel and the minimum standards for hydrogen PPE. Testing and performance of PPE should also account for any applicable changes in specifications for use for hydrogen systems. PPE may be grouped into the following two categories:

- PPE for routine O&M
- PPE worn for emergency events

Mobile leak detectors like those worn by operating personnel are also a form of PPE; there are available options for hydrogen detection, which are covered in the *Workforce Planning & Training Evaluation* study, under the *Leak Survey, Detection, Mitigation, and Repair* section. Research from Bulwark Protection, a leading industry PPE and flame-resistant clothing expert and supplier, is summarized in this section to present data on fire and heat rating capabilities of PPE clothing and gear in the event of a hydrogen fire.

The flame resistance of the PPE was reviewed, which is the property of a material/clothing whereby combustion is prevented, terminated, or inhibited following the application of a flaming or non-flaming source of ignition (i.e., a flame or electric arc), with or without subsequent removal of the ignition source.

Standards reviewed include NFPA 2112, NFPA 2113, and ASTM 1930 (Manikin Test). Table 6, *PPE Standards and Uses*, summarizes the standards related to PPE and how they are utilized.

Table 6 – PPE Standards and Uses

Standard	**Description**	**Use**

NFPA 2112, Standard on Flame-Resistant Clothing for Protection of Industrial Personnel Against Short-Duration Thermal Exposures from Fire	Specifies performance requirements and test methods for flame-resistant fabric and garments. (National Fire Protection Association, 2023)	Protects workers from flash fire exposure and injury through the specified requirements and test methods for constructing flame-resistant garments.
		
		Per Bulwark Protection;
		• Materials should be tested for a Heat Transfer Performance (HTP) of at least:
		  - Spaced (layered) 6 cal/cm²
		  - Base layer "skin contact" 3 cal/cm²
		• Test for thermal shrinkage
		• Emblems are placed on the exterior of the garment.
		  - Standard for all flame-resistant garments.
		• Standard against flammable dust, gas, and liquids.
		• Utilizes the Manikin test (ASTM F1930) for material testing.
		• Utilizes standard propane as the source gas for the flame test.
		• Exposure for 3 seconds to flame. (3 seconds is defined as the upper limit of flash fire).
		• Must have >50% 2nd and 3rd degree body burn combination to pass.

Standard	Description	Use
NFPA 2113, Standard on Selection, Care, Use, and Maintenance of Flame-Resistant Garments for Protection of Industrial Personnel Against Short-Duration Thermal Exposures from Fire	Specifies selection, care, use, and maintenance requirements for garments compliant with NFPA 2112. (National Fire Protection Association, 2020)	Reduce health and safety risks associated with incorrect selection, use, and maintenance, and contamination and damage of flame-resistant garments.
ASTM 1930, Standard Test Method for Evaluation of Flame-Resistant Clothing for Protection Against Fire Simulations Using an Instrumented Manikin	This test method predicts human skin burn injury for single-layer garments or protective clothing ensembles mounted on a stationary upright instrumented manikin, which is then exposed in a laboratory to a simulated fire environment with controlled heat flux, flame distribution, and duration. The average exposure heat flux is 84 kW/m2 (2 cal/s·cm^2), with durations up to 20 s. (American Society for Testing and Materials, 2023)	Measures the thermal protection provided by different materials, garments, clothing ensembles, and systems when exposed to a specified fire. Provides predicted skin burn injury for a specific garment or protective clothing ensemble when exposed to a laboratory simulation of a fire.

In summary, NFPA 2112, combined with ASTM F1930, is the material standard that dictates how materials should be tested and how results are accepted/recorded. NFPA 2112 is currently the only industry standard covering various fuels and is widely accepted by the oil & gas industry. Continued dialogue with PPE vendors is recommended to address anti-static issues and other specific concerns with materials used in coveralls, earmuffs, and other items.

Security (Physical and Cyber Security Procedures)

The TSA/Homeland Security define Critical Infrastructure in the Energy Sector to include assets, systems, or networks both physical and virtual, that are considered so vital to the United States that their incapacitation or destruction would have a debilitating effect on security, national economic security, national public health or safety, or any combination thereof.[16] This definition includes natural gas pipeline infrastructure currently owned and operated by SoCalGas. As such, existing SoCalGas security policies regarding both physical and cyber security should be reviewed and updated accordingly to include references to hydrogen infrastructure, as appropriate. SoCalGas may also consider a review with third-party owners/operators of hydrogen production sites and hydrogen storage that Angeles Link interfaces with to evaluate the compatibility of their physical and cybersecurity plans with that of SoCalGas. For

[16] Critical Infrastructure Sectors: CISA. Cybersecurity and Infrastructure Security Agency CISA. (n.d.). https://www.cisa.gov/topics/critical-infrastructure-security-and-resilience/critical-infrastructure-sectors.

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example, hydrogen production sites may be considered Critical Infrastructure if the loss of production negatively impacts downstream users as defined by TSA/Homeland Security Guidelines.

Physical Security

Physical security at Critical Infrastructure sites is a requirement of and is subject to audit by TSA/Homeland Security. These requirements include access controls such as: perimeter security fences, locked gates, and site security cameras for these sites. Site specific security measures are also required for facilities including valve sites, receipt meter stations, delivery meter stations, and compressor/regulator stations. Other physical concerns may be facility related such as gates, fence height, razor wire, electronic access to sites, door alarms, security cameras, and other physical access concerns.

SoCalGas's physical requirements for perimeter security at compressor stations, block valve sites, and meter/regulator stations are based on the TSA/Homeland Security Guidelines to prevent intrusion by non-SoCalGas personnel. SoCalGas should consider the same physical security procedures for all Angeles Link sites as specified by TSA/Homeland Security Guidelines for Critical Infrastructure. SoCalGas may also consider a review with third-party owners/operators of hydrogen production sites and hydrogen storage for their physical and cybersecurity plans and compatibility with SoCalGas's physical and cybersecurity plans.

Cyber Security

The threat environment in the cyber security realm is continuously changing, so security practices must also advance. The TSA/Homeland Security provides guidelines for security measures to protect Critical Infrastructure for natural gas and hazardous liquid transmission pipeline systems, natural gas distribution pipeline systems, and liquified natural gas facility operators within the TSA "Pipeline Security Guidelines" document.[17]

The Cybersecurity and Infrastructure Security Agency (CISA) conducts specialized security and resilience assessments on the nation's critical infrastructure.[18] Applicability of CISA's assessment requirements for Angeles Link has yet to be determined as it will depend on the completion of the final route selection and design of the pipeline system. If an assessment is required, the pipeline's SCADA system would be evaluated for compliance with TSA/Homeland Security Guidelines and may be based on the same activity for the natural gas system. Critical Infrastructure and the necessary Physical Security requirements are based on the location of pipeline assets; therefore, an assessment must be conducted on the hydrogen system once the detailed design is developed.

SoCalGas has hardened security measures implemented for its critical gas facilities and the alarm response protocols that have been established will support a Critical Infrastructure analysis. After the Critical Infrastructure analysis is completed and submitted to the TSA, SoCalGas's next steps would be to perform a security vulnerability assessment and inventory for cyber-sensitive assets, including SCADA

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[17] Pipeline security guidelines. (n.d.-c). https://www.tsa.gov/sites/default/files/pipeline_security_guidelines.pdf.

[18] Critical infrastructure assessments: CISA. Cybersecurity and Infrastructure Security Agency CISA. (n.d.-a). https://www.cisa.gov/critical-infrastructure-assessments.

system and control center/backup centers. After completing these steps, SoCalGas would determine the need to install cybersecurity protection systems.

Other DOT Requirements (Drug & Alcohol Testing)

DOT drug and alcohol testing requirements are specified by 49 CFR Part 199. Part 199 applies to the transportation of natural gas, hydrogen, LNG, and liquids pipelines rather than a specific fuel. Therefore, drug and alcohol testing pursuant to 49 CFR Part 199 is not dependent on the fuel being transported and would apply to the potential workforce personnel for the proposed Angeles Link as defined in the SoCalGas Drug & Alcohol Plan. The Drug & Alcohol Plans specifies testing pools and the number of drug/alcohol tests required yearly. In addition, all new employees joining SoCalGas for the hydrogen system that are in positions subject to drug and alcohol testing would require pre-employment drug/alcohol testing. SoCalGas's construction contractors would need to provide verification that construction personnel have followed testing procedures stated in the construction contractor's Drug & Alcohol Plan.

9.0 CONTROL ROOM AND EMERGENCY RESPONSE

SoCalGas operations are driven by safety and, accordingly, SoCalGas has an Emergency Management Preparedness and Response Policy, which illustrates SoCalGas's commitment to safety and strategies for preparedness. As hydrogen gets further integrated into SoCalGas's procedures and policies, certain aspects of the emergency response procedures may require modification and updates to apply more specifically to hydrogen assets.

Gas Control & Control Room Management

SoCalGas is an existing pipeline operator and, as such, has Control Rooms where Gas Control operations personnel monitor and/or control pipeline facilities in real-time, 24 hours a day, seven days a week. This monitoring covers both SoCalGas and San Diego Gas & Electric's combined gas-transmission systems, including associated pipelines, line compressor stations, and underground storage facilities. Therefore, SoCalGas has a comprehensive Control Room Management Plan which can be leveraged and subsequently tailored specifically to hydrogen operations.

Supervisory Control and Data Acquisition System

SCADA systems consist of both software and hardware components and enable remote and on-site monitoring of data gathered from various equipment and systems at different geographical locations. Pieces of data are continuously collected in real-time from multiple sources along the pipeline and at other related appurtenances or facilities and then displayed in the Control Room through a Human Machine Interface (HMI). Attributes can be assigned within the electronic system to automatically trigger alarms or notifications if conditions deviate from preassigned thresholds or parameters. These SCADA systems allow for the integration of a variety of different technologies in the field with an electronic management information system.

The hydrogen pipeline system is anticipated to require a SCADA system to allow for remote monitoring and operation of the pipeline and compressor station components. SoCalGas may elect to integrate this system as appropriate to their existing SCADA operations and/or train existing System Operators.

Control Center Modernization (CCM)

Independent of Angeles Link, SoCalGas is in the process of implementing the CCM project, which will further digitalize the existing natural gas transmission and distribution pipeline system with new field assets such as OPM stations and HCA methane sensors. The CCM project will drive the change or creation of new and existing business processes that will enhance the following:

- OPM stations and HCA methane sensors on the transmission system;
- Alarm response, planned/unplanned incidents, and maintenance activities related to the newly deployed distribution and transmission field assets;
- Coordination with Distribution Field Operations, Dispatch, Transmission, and Emergency Management and Preparedness organizations; and
- Data analysis through new situational awareness platforms being introduced via CCM technologies.

The system design, and new and enhanced processes developed for the CCM project may be beneficial and potentially leveraged in the planning and implementation of Angeles Link.

Emergency Response Procedures

The Emergency Management Preparedness and Response Policy documents how SoCalGas prepares and responds to emergencies by using the Plan-Do-Check-Act (PDCA) cycle for continuous improvement of its processes. This document provides an overall guide to SoCalGas's employees and contractors when responding to health and safety related incidents to protect employees, contractors, customers, the public, and property. SoCalGas Emergency Management Department is staffed with a Watch Office that provides 24/7 monitoring of its service territory and oversees an Emergency Operations Center (EOC) which may be activated when there are large impacts or a natural disaster event that may require coordination and communication with multiple internal and/or external organizations. The Watch Office provides real-time data monitoring, using tools such as Data Capable, to increase situational awareness and identify potential hazards, create executive notifications, convene situational awareness meetings, and timely regulatory reporting to external agencies. Based on the evaluation of the incident, the Watch Office will then recommend if an EOC activation is required. Once activated, one of the objectives of the EOC is to offer timely, accurate information to government officials, regulatory authorities, employees, customers, the public, and the media. Furthermore, SoCalGas Regional Public Affairs department provides courtesy notifications to local public officials when there is a leak on a transmission line or a reportable incident. Existing SoCalGas emergency response procedures, programs, technology, reporting, and safety plans should be updated for applicability to hydrogen pipeline and facilities. The existing emergency response procedures focus on the SoCalGas natural gas system, comprising transmission pipelines, storage fields, compressor stations, and extensive distribution systems – including residential, commercial, and industrial meters. Emergency Response personnel, including Control Room personnel and field personnel responding to indications of leaks or rupture incidents, require detailed training on hydrogen's physical and chemical properties.

Emergency response requirements are specified in 49 CFR § 192.615 and, in compliance with these requirements, SoCalGas has established written procedures to minimize hazards that result from a gas pipeline emergency. SoCalGas's existing emergency response procedures for the natural gas system provide a foundation and framework for emergency plans that are specific to hydrogen.

Notification of Leaks

SoCalGas receives notifications of potential leaks for its existing infrastructure through a variety of ways such as monitoring systems, leak surveys and patrols, as well as customer calls. Depending on odorization or equipment selections, leak notification procedures may need updates to address a 100% hydrogen system. The process by which leak notifications are received, and personnel are dispatched may need modification, and personnel receiving the notifications may need specific language to communicate to the person(s) making the notification and to first responders at the location of the reported leak.

Leak notifications may be received from compressor station sites and valves, meter, and regulator sites along the pipeline routes, as well as the third-party hydrogen production sites and third-party hydrogen storage sites. They can be received in several ways, including notifications from SoCalGas employees through regular monitoring, public notifications, gas-detecting equipment and instrumentation, and emergency response (fire, police, and other law enforcement). Leak notifications should be corroborated with leak detection equipment located at each site, with SoCalGas operations personnel dispatched for emergency response to confirm and mitigate leaks immediately.

Liaison with Local Emergency Response

Coordination with local emergency responders may include hydrogen-specific information and training, including proper equipment and awareness of the differences between hydrogen and natural gas. As hydrogen's physical and chemical properties differ from those of natural gas (refer to Section 2.0, *Physical and Chemical Properties of Hydrogen*, of this study), emergency response personnel should be trained to handle mitigating and preventing situations involving hydrogen. This may include hydrogen-specific training and changes to equipment utilized for emergencies.

To be prepared in the event of an emergency, it is important to liaise with the local emergency responders and appropriately communicate potential differences in their response, equipment, and resources for incidents involving hydrogen, as opposed to natural gas. SoCalGas's existing Emergency Management Preparedness and Response Policy has a robust external stakeholder engagement outreach program that can be leveraged for Angeles Link. The outreach program includes a First Responder Program developed to educate first responders (fire and police) on safely working with SoCalGas personnel when responding to natural gas-related incidents. The program also establishes local contact between SoCalGas field operations and first responders and provides information about SoCalGas's response capabilities and the level of participation during a unified command.

Damage Prevention

A damage prevention program to prevent damage to a pipeline from excavation activities is required pursuant to 49 CFR § 192.614. The One Call system, also known as 811,[19] is a critical tool for preventing accidental damage to underground utility assets during construction or excavation. Contractors and

[19] Pipeline Safety Stakeholder Communications. PHMSA. (n.d.). https://primis.phmsa.dot.gov/comm/cbyd.htm.

excavators use this system before digging to identify the location of utility assets such as natural gas, water, electricity, and telecommunications. Contractors or anyone digging can call the toll-free 811 number or submit an online request, providing details about the proposed excavation location. The One Call system then notifies all relevant utility owners in the vicinity. Utility personnel mark the exact location of their facilities on the ground, enabling safe excavation practices. While the system primarily covers existing utility assets, it is essential to include emerging hydrogen infrastructure. Overall, the One Call system enhances safety, protects critical infrastructure, and promotes responsible construction practices while mitigating damages before they occur.

10.0 AWARENESS, EDUCATION, AND TRAINING

Hydrogen has been used in various forms for decades across a variety of industries, but it is acknowledged that public awareness of the transmission and distribution of pure hydrogen as part of an energy utility delivery system is relatively new. SoCalGas employees and contractors will require appropriate documented and accredited training to construct, operate, and safely maintain hydrogen transmission and distribution systems. Furthermore, the public should be provided access to educational materials on hydrogen safety. Given the global interest in the implementation of hydrogen as a clean energy source, there are several organizations currently providing training to owners, operators, contractors, and other interested parties. As the adoption of hydrogen continues to accelerate, additional resources and new accreditations and certifications may become available and must be evaluated.

Public Awareness Plans

PHMSA requires pipeline operators to develop and implement public awareness plans and damage prevention programs (see 49 CFR § 192.616 and § 192.614). Public awareness plans must comply with the requirements of API RP 1162, first edition. API RP 1162 includes guidance for pipeline operators to develop and implement Public Awareness Programs to communicate safety and other relevant information to all stakeholders, emergency response agencies, and local government officials, and excavators. The existing SoCalGas Public Awareness Plan for natural gas infrastructure can serve as a template. SoCalGas's damage prevention program contains additional requirements that can also be incorporated and can follow closely with SoCalGas natural gas infrastructure language.

In addition to PHMSA's requirements, SoCalGas must comply with California Public Utilities Code Section 956.5, which requires that at least once per calendar year, owners and operators of intrastate transmission and distribution lines shall meet with each local fire department having fire suppression responsibilities in the area where those lines are located to discuss and review contingency plans for emergencies involving the intrastate transmission and distribution lines within the jurisdiction of the local fire department.

In compliance with 49 CFR § 192.616, SoCalGas implements an existing Public Awareness Program for its natural gas system, which includes the following:

- Enhance safety through increased public awareness and knowledge;
- Reduce third party damage to pipeline facilities; and
- Provide better understanding of pipeline emergency response.

These objectives are achieved by educating the public on:

- The existence and purpose of pipelines;
- Use of a one-call notification system prior to excavation and other damage prevention activities;
- Possible hazards associated with unintended releases from a pipeline facility;
- Physical indications that such a release may have occurred; and
- Steps that should be taken for safety in the event of a pipeline release and procedures to report such an event.

The current SoCalGas Public Awareness Plan follows the guidance provided in API RP 1162, *Public Awareness Programs for Pipeline Operators*. Specifically, the plan identifies the audiences to be considered for targeted communications, the frequency of messages, the messages to be delivered to each audience, and the methods and vehicles for delivering the messages. Furthermore, SoCalGas has specific measures to evaluate the effectiveness of its public awareness program and materials. The public awareness plan identifies communications for sharing pipeline safety risk information with those residing near the pipelines and defines a mechanism whereby the public can report safety risk issues to SoCalGas.

SoCalGas's public awareness program implements the public awareness plan to inform and educate customers, affected public, pertinent public officials and municipal staff, first responders/emergency officials, and persons engaged in excavation-related activities about the prevention and recognition of gas pipeline emergencies. This program also includes the process for reporting an incident to SoCalGas and the appropriate public officials including first responders. SoCalGas's First Responder Outreach program networks with over 200 agencies to acquaint first responders with gas pipeline emergencies response, types of gas pipeline emergencies and to engage in mutual assistance to minimize hazards to life or property. Accordingly, the specific details on what information is conveyed and the product descriptions will differ depending on the type of gas being transported. An example of a key difference is the use of pipeline markers/signage along a pipeline route. API RP 1162 has prescriptive language for the size, lettering, and marker information. The existing SoCalGas line markers indicate natural gas is being transported through the pipeline; therefore, for a dedicated clean renewable hydrogen pipeline, SoCalGas will need to create line markers to indicate hydrogen gas is being transported through the pipeline. Leveraging the SoCalGas existing public awareness program will lay the groundwork to make the necessary adjustments required to reflect the operations of a dedicated clean renewable hydrogen pipeline.

Education and Safety Training

SoCalGas is continually increasing its knowledge, education, and understanding of hydrogen through training materials and courses offered by outside accredited organizations. As SoCalGas's knowledge base and expertise continue to grow, and hydrogen-specific codes and regulations take shape, safety training requirements will be developed for inclusion into the Angeles Link O&M manual and OQ training program. Skillsets related specifically to hydrogen pipeline systems will be evaluated and operating and maintenance procedures will be identified to meet the requirements of 49 CFR Part 192 Subpart N, *Qualification of Pipeline Personnel*. Pipeline personnel will be trained, tested, and evaluated according to a written qualification program. Furthermore, as preliminarily identified in Appendix A, *SoCalGas Standards Review Summary*, the training associated with the standards and procedures potentially applicable to Angeles Link should be updated or created for the applicable job classifications. Training conducted prior to completion of the O&M plan and OQ training program could incorporate the physical and chemical properties of hydrogen, PPE, and leak detection, providing a basis for hydrogen safety training. Additional considerations for hydrogen education and training for the workforce for Angeles Link are included in the *Workforce Planning & Training Evaluation* study.

SoCalGas's [H2] Innovation Experience[20] is a fully integrated demonstration project that shows how renewable hydrogen could be used to safely transition to clean and resilient energy systems of the future. Providing public awareness and visibility into these advancements, along with collaboration with industry experts to help prepare additional standards for dedicated pipelines for hydrogen transport, support the development of transmission pipeline procedures inclusive of safety requirements.

Accredited Organizations

Several organizations are accredited to provide hydrogen safety training and operator training. The following organizations are summarized below for SoCalGas to consider for further information and potential outreach:

AIChE – Center for Hydrogen Safety[21]

The American Institute of Chemical Engineers' (AIChE's) Center for Hydrogen Safety (CHS) is a global non-profit organization promoting hydrogen safety and best practices worldwide. The CHS provides education and resources for several aspects of hydrogen, including publications, conference information and proceedings, first responder training, safety training, webinars, and other general information.

AIChE is a member society of the Accreditation Board for Engineering and Technology (ABET). It plays a role in the accreditation process for chemical engineering programs to verify specific quality standards are met.

Baker Engineering and Risk Consultants, Inc. (BakerRisk)[22]

BakerRisk is an international consulting firm with over 175 qualified/certified scientists and engineers in the U.S., Canada, and the U.K. offices. Through specialized testing services and research and development (R&D) for studying various hazards, BakerRisk aims to support its clients in preventing, quantifying, and mitigating accidents. BakerRisk provides training on hydrogen safety and offers in-person and virtual training options.

[20] [H2] innovation experience: SoCalGas, A Sempra Energy utility. (n.d.-b). https://www.socalgas.com/sustainability/h2home.

[21] CHS: Center for Hydrogen Safety. AIChE. (2024, May 1). https://www.aiche.org/chs.

[22] Risk management, training, engineering services. BakerRisk. (2024, January 25). https://www.bakerrisk.com/.

Canadian Standards Association (CSA Group)

The CSA Group, accredited by the Standards Council of Canada (SCC), is internationally recognized, and its standards and certifications are often accepted and adopted globally. The CSA Group collaborates with regulatory authorities and government agencies to align the developed standards and certification programs with regulatory requirements.

As part of the growing interest in hydrogen as a fuel source, the CSA Group established the CSA Hydrogen Advisory Group (H2AG), which includes participants from various representative categories across the hydrogen ecosystem, to actively monitor hydrogen activities and engage with stakeholders to evaluate and address potential standardization needs. Participants in the H2AG represent various categories from production to end use in industries like transportation, fuel and appliances, petroleum and natural gas, and natural resources.

Dräger[23]

Dräger is an international company with a presence in over 190 countries. Dräger manufactures medical and safety technology products in hospitals, fire departments, emergency services, authorities, and mining industries. Dräger offers several types of safety solutions/technologies for detection and PPE, also including providing guidance on planning, installing, and maintaining safety and gas detection systems.

Gas Technology Institute (GTI)[24]

GTI Energy is a research and training organization aiming to advance economy-wide decarbonization of energy systems. For the past 80 years, GTI Energy has been mainly focused on natural gas and energy training, but also conducts workshops and hosts conferences.

GTI Energy also collaborates with industry experts to conduct research, product development, and demonstration projects focused on clean hydrogen production, storage, delivery, and use through its GTI Energy's Hydrogen Technology Center.

International Association for Hydrogen Safety (HySafe)[25]

HySafe is an international association that focuses on hydrogen safety through collaboration, research, and the exchange of information among professionals and organizations. The association contributes to developing guidelines and publications addressing various aspects of hydrogen safety, including production, storage, transportation, and utilization. HySafe also organizes conferences, workshops, and events to provide a forum for presenting research findings and discussions and disseminating information related to hydrogen safety.

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[23] Welcome to dräger us. Leading Medical & Safety Technology. (n.d.). https://www.draeger.com/en-us_us/Home.

[24] Home. GTI Energy. (2024, May 14). https://www.gti.energy/.

[25] Safety, I. A. for H. (n.d.). HySafe. https://hysafe.info/.

U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy (EERE)*[26]*

The EERE accelerates development and facilitates the deployment of energy efficiency, renewable energy technologies and market-based solutions that strengthen U.S. energy security, environmental quality, and economic vitality. The Hydrogen Safety Panel (HSP) and the Hydrogen Tools Portal (H2Tools) are two initiatives of the EERE.

The HSP was established in 2003 and consists of members assembled to provide guidance and expertise on hydrogen safety, including considerations for hydrogen technologies, safety engineering, and related fields. The HSP offers recommendations, best practices, collaboration, and insights to support the safe handling, transportation, storage, and use of hydrogen.

H2Tools was developed by the Pacific Northwest National Laboratory through support from EERE, whose goal is to support the implementation of the practices and procedures that will ensure safety in the handling and use of hydrogen in various fuel cell applications. The portal combines and enhances the utility of various tools and web-based content on the safety aspects of hydrogen and fuel cell technologies to help inform those tasked with designing, approving, or using systems and facilities and those responding to incidents.

11.0 LESSONS LEARNED

The Hydrogen Safety Panel has collected incidents involving various hydrogen infrastructure and documented them in the March 2020 "Hydrogen Incident Examples" (Pacific Northwest National Laboratory, 2020).[27] While these incidents do not involve SoCalGas, the lessons learned from these incidents are valuable for SoCalGas's continued hydrogen safety planning and are compiled in the H2Tools.org Lessons Learned database.[28] A sample of the incidents identified and the lessons learned, which involve pressure relief devices, hydrogen cylinders, small diameter piping, fueling stations and compression equipment, are summarized in Table 7 below, *Hydrogen Safety Lessons Learned*.

Table 7 - Hydrogen Safety Lessons Learned

Incident Category	Description/Root Cause	Lessons Learned
Pressure Relief Device Incidents	- On January 15, 2002, an uncontrolled hydrogen release occurred due to the rupture of a hydrogen storage tube's burst disc. This disc failed due to being	- Eliminate burst discs from hydrogen storage assembly. Redesign venting system for the pressure relief valves to prevent or inhibit moisture build up and allow moisture drainage.

[26] Office of Energy Efficiency & Renewable Energy | Department of Energy. (n.d.-c). https://www.energy.gov/eere/office-energy-efficiency-renewable-energy.

[27] Hydrogen incident examples. (n.d.-b). https://h2tools.org/sites/default/files/Hydrogen_Incident_Examples.pdf.

[28] Lessons learned | hydrogen tools. (n.d.-d). https://h2tools.org/lessons?search_api_fulltext=.

Incident Category	Description/Root Cause	Lessons Learned
	overloaded by mechanical stresses developed as water expanded and formed ice while in direct contact with the burst disc. The degraded condition of the vent cap (defective equipment) enabled water to access the burst disc. - On Jan 8, 2007, an explosion occurred during a delivery of compressed hydrogen gas at a coal-fired power plant. Evidence pointed to the premature failure of a pressure relief device rupture disk, which had been repaired by the vendor six months before the explosion.	- Contract documents for the hydrogen and nitrogen supplies will stipulate that suppliers of potentially hazardous equipment will provide plant management with written documentation describing the supplier's preventive maintenance program. - Verify that all pressure relief devices contain fuse-backed adapters. - Explore eliminating rupture disk pressure relief devices and substituting spring-style relief valves. - Confirm that temporary offices/facilities are not co-located with hazardous chemical storage sites. - Job Hazard Analysis (JHA) to be done on unloading hydrogen - A competent plant employee must be present during all hydrogen unloading activities.
Hydrogen Cylinder Incidents – Hydrogen Gas Regulator Failure	On February 6, 2013, a single-stage regulator "failed" while flowing hydrogen gas from a standard 200 ft^3 gas bottle. During the event, a solenoid valve was opened to allow hydrogen to flow when a loud noise was noted, and gas began flowing out of the pressure relief valve on the side of the regulator. It was noted that the low-pressure gauge on the regulator was "pegged" at the high side (200 psi). The valve on the bottle was shut off, and the hydrogen flow was immediately stopped. Hydrogen flowing out of the relief valve did not ignite. With the bottle shutting off, the regulator was replaced with another regulator of the same type, and activities continued. The failed regulator was taken apart to determine the failure's cause. A small elastomeric ring that seals the internal nozzle to the seat assembly was deformed	- Without additional protection, downstream components can be exposed to pressures exceeding the set pressure to the full bottle pressure. If items downstream of the regulator are not rated for full bottle pressure, it is recommended that protection be added to the system. - Pressure relief device discharges need to be routed to a safe location. In a pressure-relieving event, the flow must be directed away from personnel, preferably so that the shut-off valve can be accessed safely. - Adequate ventilation is an important consideration in the layout of a compressed gas system. Inert gases (as potential asphyxiants) and toxic and

Incident Category	Description/Root Cause	Lessons Learned
	and lodged in the nozzle orifice, preventing the seat assembly from properly seating and allowing high-pressure hydrogen to flow into the low-pressure side of the regulator continuously. The regulator has a pressure relief valve as protection, and it operated properly, relieving the pressure in the system. Fortunately, nothing downstream of the regulator was damaged. What led to the failure of the elastomer ring has yet to be discovered (at the time of reference writing).	flammable gases can pose a significant hazard if not properly ventilated.
Piping Incidents – Failure of Stainless-Steel Valves due to Hydrogen Embrittlement	On August 19, 1986, difficulties were experienced with two solenoid-operated globe valves in a charging system. When shut, the valves could not be reopened without securing all charging pumps. During a refueling outage, the two valves were disassembled and examined to determine the cause of the malfunction. It was found that the springs of the disc guide assembly in both valves had undergone complete catastrophic failure. The springs initially had 25 coils and were found in sections of only 1-2 coils. Metallurgical analysis of the failed springs attributed the probable cause of failure to hydrogen embrittlement. The springs are made of 17-7 PH stainless steel. Discussion with the valve manufacturer revealed that similar failures occurred on three previous occasions. These spring failures were also attributed to hydrogen embrittlement.	- Onsite personnel must ensure that their vendors receive comprehensive specifications on the application, use and service conditions associated with all stainless-steel valves implemented in applications susceptible to hydrogen embrittlement. - A web-based resource developed by Sandia National Laboratories to provide data on hydrogen embrittlement of various materials is available at Technical Reference for Hydrogen Compatibility of Materials.
Piping Incidents – Hydrogen Leak from Underground Pipe and Explosion	On October 31, 1980, an explosion occurred at a NASA hydrogen storage and use facility that had been in a non-operational mode for several months while undergoing modifications for future tests. No one was in the facility at the time of the explosion. The facility's other supply systems and utilities had been severed or ruptured. Shrapnel and debris were ejected up to 540 feet away. Firefighters and emergency	- Active H_2 sensors should be installed and continuously monitored in all enclosed buildings near H_2 sources. All buildings near areas where hydrogen is used should be designed to preclude H_2 entrapment (e.g., sloping roof with ventilation at the highest point). - Underground carbon steel lines beneath concrete pad areas should

Incident Category	Description/Root Cause	Lessons Learned
	medical personnel were sent to the area to verify that no one was injured and to extinguish small residual fires. Damage was significant, including the destruction of two support buildings. Costs incurred from the explosion were estimated to be approximately $5.9 million. Detectable levels of gaseous hydrogen were recorded at several locations adjacent to the concrete pad for five days following the event. The findings of the investigation board were as follows: - The explosion was the result of a hydrogen leak. - A gaseous hydrogen leak occurred in an underground NPS 3 ASTM A106 Grade B, XXS WT carbon steel pipe. The pipe was coated with coal tar primer and coal tar enamel, wrapped with asbestos felt impregnated with coal tar, covered with a second coat of coal tar enamel, and wrapped in Kraft paper in accordance with American Water Works Association Standard G203. The source of the leak was an oval hole about 0.15 x 0.20 inches at the pipe's inner surface and about 2 inches in diameter at the outer surface of the pipe. Upon excavation of the pipe, it was noted that the coating was not present at the leak point. This resulted in galvanic corrosion over 15 years and the eventual rupture when high-pressure gas was applied to the thin pipe membrane. The pipe was 8 feet 9 inches below the concrete pad. - Before the pipe rupture, a pneumatically operated gaseous hydrogen isolation gate valve,	not be used for H_2 transmission. All H_2 lines are now stainless steel and above ground at this NASA location. - H_2 transmission lines buried underground should be proof-tested and leak-checked periodically. - Any below-grade piping installation should be in open trenches covered by grating. - Facilities should be protected from H_2 at a safe distance by manual isolation valves. If remote-operated valves (ROVs) are required for operational isolation, the ROVs should be in series with and downstream of the manual isolation valve. - The pressure between isolation valves and stand shut-off valves should be routinely monitored daily. - Field repair of mechanically severable valves in high-pressure systems should be eliminated. - Valves repaired in the field should be subjected to functional and leak checks, including actuator and valve seals at simulated operating conditions. A written procedure should be prepared and used. - Valves utilizing pneumatic actuators should have the actuator piston and piston nut staked (or locked by other positive means) in the installed condition. - All high-pressure gas lines scheduled to be inactive for over six months should be physically isolated from active systems by blind flanges. - Supply system status of pressure vessels and lines (pressure and quantity) should be recorded at the start and completion of operations

Incident Category	Description/Root Cause	Lessons Learned
	designed for 6000 psi service, and located about 280 feet from the facility, failed in the open position. Pneumatic pressure had been removed earlier in the day, and failure analysis indicated that the valve had been damaged during recent field servicing. This allowed hydrogen gas from two hydrogen storage tanks to enter the pipe. - Gaseous hydrogen was trapped in large quantities in sand and gravel under the apron surface (a 1-foot-thick concrete pad about 160 x 140 feet). The hydrogen then entered the basement of the electrical control and instrumentation terminal building, located immediately adjacent to the facility, through penetrations in the basement wall, including cable ducts, cable pulls, and two 24-inch-diameter air conditioning ducts. Gaseous hydrogen was transported through the air conditioning ducts to a support building about 90 feet from the terminal building. - An explosion originated in the basement of the terminal building through electrical contact with a sump pump motor. A shock wave traveled through the air conditioning ducts and caused a second explosion of lesser magnitude in the support building. The actual ignition source in the terminal building is unknown; an electrical arc from a sump pump was the most likely source. - The TNT equivalent of the blast was between 100 and 475 pounds, depending on the location. - After that event, no mild steel was again used for high pressure hydrogen piping at that site.	each day. All reservoirs should be isolated each day before weekends and holidays at the close of business. - Corrosion protection systems for underground lines should be reviewed and tested to confirm the adequacy of the systems. - Operational and support buildings at hazardous sites should be isolated (i.e., interconnecting air conditioning systems should be avoided). Seals should physically isolate buildings connected to hazardous sites by tunnels and conduits. If physical isolation is impractical, positive airflow should be maintained in tunnels and conduits. - Explosive gas detection meters should be included in the equipment carried by firefighters and emergency medical personnel. - Fire alarm transmitters should be located at all hazardous locations. - Emergency instructions for isolating H_2 and utilities for hazardous locations should be permanently posted with names and telephone numbers of key individuals to be contacted.

Incident Category	Description/Root Cause	Lessons Learned
Hydrogen Compressor Incidents – Compressor Piping Incident	On April 5, 2006, the malfunctioning of the non-return valve of the hydrogen compressor caused the pressure between the hydrogen bottle and the compressor to rise to the maximum allowed pressure of 275 bar. The rupture disk of the safety valve broke, and the hydrogen content of the gas bottle and the pipe section involved was released on top of the building. The flame was seen for a very short period by a guard. The non-return valve was dismantled, cleaned, and tested. After positive testing, the system was restarted and pressurized without further malfunctioning.	The following corrective actions were taken: - The non-return valve was dismantled, cleaned, and tested. After positive testing, the system was restarted and pressurized without further malfunctioning. - The hydrogen discharge pipe was extended from the low roof of the compressor building (2.5 m) to the higher roof of a neighboring building (6 m). With this modification, potential hydrogen ignition would occur approximately 6 meters from the ground, farther from personnel than the 2.5 meters of the previous situation. - The compressor was sent to the manufacturer for preventive maintenance to lower the frequency of component malfunctioning. - Plans for regular maintenance of the non-return valve will be recorded in the next revision of the Design and Safety Report. - A flame arrestor was purchased and mounted at the end of the exhaust pipe on top of the building.
System Design, Operator, and Maintenance Incidents – Hydrogen Storage Siting [Near Miss]	On April 27, 1989, during an inspection, three potential safety problems were identified concerning the location of a hydrogen storage facility. The hydrogen storage facility was on a building's roof, made of 30-inch-thick reinforced concrete. The following potential safety problems were identified during the inspection: 1. Hydrogen gas leakage from the storage facility near the air intakes of the building's ventilation system had the potential introduce a flammable or explosive gas mixture into the enclosure. Because the hydrogen storage facility, containing four 8000-scf hydrogen tanks at up to 2450 psig,	The hydrogen facility in this example did not meet industrial guidelines for facilities of this type from the standpoint of (1) the separation distance needed between a hydrogen pipe break and the building ventilation intake to prevent the buildup of a flammable or explosive gas mixture inside the enclosure, and (2) the separation distance needed to prevent damage to safety-related structures resulting from the explosion of an 8,000-scf hydrogen tank. Safety concerns such as hydrogen leaks and storage tank detonations must be considered and used to create effective new construction designs that mitigate the

Incident Category	Description/Root Cause	Lessons Learned
	was Seismic Category II, a seismic event may result in a hydrogen leak. Furthermore, the pressure relief valves in the hydrogen facility exhausted downward to within 6 inches of the roof near the ventilation system air intakes. 2. A detonation of a hydrogen storage tank could structurally damage and affect the performance of safety-related equipment on the building's roof, such as the ventilation system intake and exhaust structure, the emergency pressurization system, and the building itself. 3. An explosion of the hydrogen delivery truck that provides hydrogen to the facility through a fill line located at ground level on the wall of the auxiliary building could structurally damage safety-related component cooling water pumps located inside the auxiliary building and near the hydrogen fill line.	consequences of such events. Existing buildings that house hydrogen storage tanks must properly analyze the risks associated with using and storing such systems.
System Design, Operator, and Maintenance Incidents – Improper Purging Procedure Results in Hydrogen Fire	On December 31, 1969, steam turbines at a power station drove a large, hydrogen-cooled generator. During maintenance shutdowns, the hydrogen cooling loop in the generator was purged with carbon dioxide. After carbon dioxide concentrations were measured with a densitometer to verify the complete removal of hydrogen, the generator was purged with air and the maintenance was performed. This purging procedure was used before the explosion. The carbon dioxide reading was reported to be 100% at the top of the generator. The cooling system was then purged with air, and a 1/2-inch pipe in the cooling loop was cut to install some new instrumentation. When the pipe was cut, pressurized gas was emitted at the opening. Workers assumed the gas was either carbon dioxide or air and proceeded with the new instrument installation. Unfortunately,	This incident illustrates the importance of thoroughly purging hydrogen from a large, complex piece of equipment. Uniform mixing and dilution are unlikely in all the partially enclosed spaces, crevices, etc. If a hazardous operation such as welding must be performed with an atmosphere of air (instead of inert gas) in the equipment, then reliable gas concentration measurements should be obtained at several different locations. In the case of the generator, a direct measure of hydrogen concentration was more reliable than the 100 percent CO2 reading on the densitometer. Furthermore, the gas composition should have been determined at the welding site and the generator's top.

Incident Category	Description/Root Cause	Lessons Learned
	some hydrogen was still in the pipe and the rest of the cooling loop. When the welder struck an arc, a flame developed at the pipe opening and flashed back into the generator. This caused a low-level explosion within the generator shroud. The explosion damaged the generator's ventilation baffle plates and auxiliary equipment, which caused the plant to be out of service for 26 days.	
System Design, Operator, and Maintenance Incidents – Flanged Joint Hydrogen Gas Leak and Fire	On June 8, 1998, during the operation of a succinic acid plant, hydrogen leaked from a flanged joint on a safety valve at the upper part of a reactor, which generated a hydrogen flame. Before the incident, the safety valve was removed and reattached during an inspection at a turnaround shutdown. An incorrectly sized, smaller gasket was installed in the joint, and the tightening force on the bolts was inadequate. Therefore, a gap was generated as time passed, and unreacted hydrogen leaked.	- Construction errors are more difficult to detect once construction is complete. It is important to develop and use a systematic oversight process to minimize construction errors during the construction process. - Thorough control of parts during the construction process is required. - Bolts should be tightened equally and fully. - A new support for distributing the weight of piping is installed. - Thoroughness of checks after construction is going to be initiated.
Fueling Station Incidents – Pressure Relief Device Fails	On May 4, 2012, a pressure relief valve failed on a high-pressure storage tube at a hydrogen fueling station, causing the release of approximately 300 kilograms of hydrogen gas. The gas ignited at the exit of the vent pipe and burned for 2 1/2 hours until the local fire department permitted technicians to enter the station and stop the flow of gas. During this incident, the fire department evacuated nearby businesses and an elementary school, closed adjacent streets, and ordered a high school to shelter in place. The station's operating systems worked as designed for an emergency. All equipment and fuel supplies were completely isolated, and all storage vessels were within	- These problems could have been avoided by adequate quality assurance/quality control procedures during the design and safety reviews. - The canopy was added to the station after the HazOps review. The prestart-up safety review by all parties and the local authority having jurisdiction did not recognize the setback distance of the canopy. Had an engineering management of change, follow-up HazOp or other form of risk assessment been conducted, the vent likely stacks adjacent to the canopy would have been raised to avoid damage in the event of a fire.

Incident Category	Description/Root Cause	Lessons Learned
	acceptable and safe pressure and temperature limits before and throughout the incident. After a thorough analysis of the incident, corrective actions were taken to replace pressure relief valves, heighten vent stacks, modify response procedures, and improve communication procedures with first responders. A considerable amount of time was taken to review the station design, evaluate emergency action plans and procedures, meet with the public, train first responders, and conduct follow-up drills with employees and first responders. The station reopened nine months after the incident and has since been fully operational. Three root causes were noted during the investigation: (1) the use of incompatible materials in the manufacturing of the PRD valve, (2) improper assembly resulting in over-torquing of the inner assembly, and (3) over-hardening of the inner assembly materials by the valve manufacturer.	- Before reopening the station, physical changes were made using the correct PRD valves and higher vent stacks. New and modified procedures were instituted to improve the timely communication of station status during emergencies. Additional training of personnel focused on improving the response time and effective communication between employees, first responders, and the hydrogen equipment supplier.
Fueling Station Incidents – Fueling Station High-Pressure Storage Leak	On June 10, 2019, a hydrogen leak originating from a tank within a high-pressure storage unit serving a hydrogen vehicle fueling station resulted in a fire and explosion. No damage was reported to the separate forecourt hydrogen dispenser or other major station components within the backcourt compound. The incident's root cause was subsequently identified as an assembly error of a specific plug in a hydrogen tank in the high-pressure storage unit. The inner bolts of the plug had not been adequately torqued. This led to a hydrogen leak, creating an ignited mixture of hydrogen and air. The source of the ignition has not been positively identified. An inspection and integrity verification program for the high-pressure storage units with similar plugs was implemented,	- Implement rigorous assembly, verification, and documentation procedures for equipment. - Increase automated leak detection frequency.

Incident Category	Description/Root Cause	Lessons Learned
	including check and re-torque of tank plugs. Additional measures implemented include revised assembly, verification, and documentation of procedures and increased automated leak detection frequency. Depending on the site, additional ignition control measures are considered, including loose gravel removal/smooth surface around the high-pressure storage unit, additional backcourt compound ventilation, and higher extent use of explosion-proof components.	

The main causes of the identified failures were due to component failure or equipment design/selection issues. A general conclusion from these incidents is that there is great importance in safe and proper equipment design and construction as well as development of procedures for O&M. Lessons learned focus on having the right materials and operating procedures for hydrogen service.

12.0 CONCLUSION

The safe transportation of hydrogen gas in pipelines is paramount to harnessing its potential as a clean and sustainable energy source. As illustrated above, the safe transportation of 100% clean renewable hydrogen by pipeline is feasible. The identified safety requirements, ranging from material selection, pipeline design, leak detection and monitoring programs, emergency response procedures, and public awareness plans, form a comprehensive framework to mitigate risks associated with hydrogen transport.

Safe pipeline management is achieved through a combination of codes, regulations, standards, and best practices that are paired with considerations on system architecture, operational controls, procedures, continuous improvement and evaluation, and management of change. This structure and content can be tailored to align with the physical and chemical properties that are unique to hydrogen. Lessons learned can be leveraged to further refine and establish new standards, design, procedures, and best practices as part of continuous improvement.

Evaluation of SoCalGas gas standards and specification sheets resulted in identification of potential impacts, required updates, and/or new processes to be created to accommodate a 100% clean renewable hydrogen pipeline system. The following specification and standard topics that cover SoCalGas's current natural gas operations can be considered for potential modifications or new specifications/standard development for implementation of a clean renewable hydrogen energy transport system:

1. Material requirements
2. Material traceability requirements
3. Facility maps (for new production, transmission, and storage facilities)
4. Control room management plan

5. Equipment specifications (e.g., gas compressor specifications and pressure vessel specifications updated to include specifics for hydrogen service)
6. Fire prevention and protection plan
7. Operator qualification program
8. Corrosion control and monitoring requirements
9. Leak testing and monitoring requirements
10. Integrity management programs

The evaluation provides transparency into how established safety requirements are embedded in the existing framework and confirms that the current natural gas infrastructure Specifications, Standards & Procedures provide a solid foundation for building the hydrogen infrastructure Specification, Standards & Procedures.

The existing SoCalGas Control Room Management and Emergency Response Plan could be leveraged as a basis for Angeles Link. Once the preferred system route of Angeles Link is identified, future discussions with Gas Control and Emergency Response teams are needed to further revise and develop these procedures. For Emergency Response, SoCalGas may consider hydrogen-specific items such as notification practices, reportability, and coordination between First Responding Agencies (i.e., Local Fire Department, Police Departments, County EOCs, etc.). Hydrogen training for these Emergency and First Responding groups is available and would be a new activity due to the difference in nature of hydrogen and natural gas fuel sources. SoCalGas may consider establishing separate Gas Control and Emergency Response teams for hydrogen.

Education and training requirements for the workforce operating and maintaining hydrogen infrastructure can be applied to the development of training programs and operator qualifications. Organizations already accredited to undertake various hydrogen safety education and training include: AIChE, BakerRisk, CSA Group, Dräger, GTI, HySafe, and EERE. Various resources for education and training are available for both pipeline operators, emergency and first responders, and the public. Additionally, public awareness plans are both required and support safe operations of pipeline facilities and should be developed to support new hydrogen infrastructure as appropriate.

In conclusion, pipeline transportation of clean renewable hydrogen is feasible and can be safely achieved through compliance with Federal and State codes, standards, regulations, and procedures identified within this document. The application of and compliance with these elements must be intrinsically integrated throughout design and development choices, asset management structure, procedures, training, operations, and handling of hydrogen within a hydrogen pipeline system. Industry recommended best practices and lessons learned can be applied. SoCalGas is well positioned to safely build, operate, and maintain a clean renewable hydrogen pipeline system by leveraging its experience operating and maintaining a developed gas transmission and distribution system, existing highly trained and qualified workforce, and comprehensive integrity management and emergency response procedures.

13.0 STAKEHOLDER COMMENTS

The input and feedback from stakeholders including the Planning Advisory Group (PAG) and Community Based Organization Stakeholder Group (CBOSG) has been instructive to the development of this Safety Study. Some of the feedback that has been received related to this Safety Study is summarized below. All feedback received is included, in its original form, in the quarterly reports submitted to the CPUC and published on SoCalGas's website.[29] Feedback topics that were not addressed are also identified.

Quarter 1 to Quarter 4 2023 Reports

- **California Hydrogen Business Council**
  - Engage Center for Hydrogen Safety for Angeles Link Project.
- **Protect Playa Now**
  - At the workshop on July 19, 2023, news broke that there was a hydrogen explosion in Kern County at a bus fueling station. A person raised their hand and shared this information. The CBO Stakeholder group has not received any response from SoCalGas.
- **Food and Water Watch**
  - A comprehensive plan must be presented to the CBOSG regarding SoCalGas's emergency response protocols in the event of a hydrogen leak, and the protocol for how SoCalGas would report and work with local and state government entities in the event of a leak.
- **Air Products**
  - CPUC has yet to determine that hydrogen transportation would be subject to CPUC jurisdiction and therefore it is unclear whether General Order 112 would be applicable.
- **Communities for Better Environment**
  - Questions regarding specific protocols for alerting residents along transmission corridor for safety risks.

Preliminary Data & Findings Document

- Two comment letters received from Communities for a Better Environment and Air Products
  - One letter requested a preliminary risk analysis and further safety considerations for the major risks of leakage, exposure, flammability, storge, explosion, and end-use related health risks.
  - One letter raised questions about the use of odorants, diffusion of hydrogen relative to the odorant, and compatibility with pipe materials and end uses.

Summary of How Comments were Addressed

- The Center for Hydrogen Safety, Hydrogen Safety Panel is conducting a third-party review of the safety study, *Plan for Applicable Safety Requirements* with results of their review expected end of second quarter 2024.
- Emergency response protocols are described in section 7.0 and Public Awareness Plans in section 8.0.
- Incorporated Safety Management System (SMS) framework, with American Petroleum Institute Recommended Practice (API RP) 1173 – Risk Management section 4.0.
- Regarding the Kern County incident in July 2023, SoCalGas is not involved in this incident. The incident is still under investigation and the lessons learned have not been published at this time.

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[29] Angeles Link: SoCalGas, A Sempra Energy utility. (n.d.-a). https://www.socalgas.com/sustainability/hydrogen/angeles-link.

The Center for Hydrogen Safety's H2 Tools website[30] was utilized and incorporated the lessons learned in section 9.0.

- The CPUC's Decision 22-12-055 (OP 6 (f)) requires SoCalGas to evaluate safety concerns involved in pipeline transmission, storage, and transportation of hydrogen applicable to the Angeles Link Project. Regulatory requirements and industry-standard codes exist for hydrogen, primarily anchored by 49 Code of Federal Regulations (CFR) Part 192 Subparts A through P and the California Public Utilities Commission (CPUC) General Order (GO) 112-F governing natural gas transmission and distribution and addressing flammable gases such as hydrogen. As such, potential safety best practices may be derived from GO 112-F and should be appropriately evaluated as it may apply to a clean renewable hydrogen transport system.
- Several odorant studies are incorporated in section 6.0 to support the considerations and feasibility of odorizing hydrogen.

Stakeholder engagement plays a pivotal role for the Angeles Link project to foster inclusive feedback in the design and decision-making process, build trust and transparency, and provide lasting benefits to the communities SoCalGas serves. Throughout Phase 1 of Angeles Link, workshops, and quarterly meetings with Community Based Organizations (CBO) and Planning Advisory Group (PAG) were conducted to provide feasibility study updates and solicit stakeholder feedback and involvement. Additionally, SoCalGas has routinely met with the California Public Utilities Commission's Safety Enforcement Division to provide updates and to collaborate on the project.

[30] Home | hydrogen tools. (n.d.-a). https://h2tools.org/.

14.0 GLOSSARY

Accreditation Board for Engineering and Technology (ABET) - Accredited college and university programs in the disciplines of applied and natural science, computing, engineering and engineering technology at the associate, bachelor's and master's degree levels. [31]

American Institute of Chemical Engineers (AICHE) - World's leading organization for chemical engineering professionals, with more than 60,000 members from more than 110 countries. [32]

American National Standards Institute (ANSI) - A private, nonprofit organization that administers and coordinates the U.S. voluntary standards and conformity assessment system. [33]

American Petroleum Institute (API) - Formed in 1919 as a standards-setting organization and has developed more than 800 standards to enhance operational and environmental safety, efficiency and sustainability. [34]

American Society for Testing and Materials (ASTM) - A nonprofit organization that develops and publishes approximately 12,000 technical standards, covering the procedures for testing and classification of materials of every sort [35]

American Society of Mechanical Engineers (ASME) - A nonprofit professional organization that enables collaboration, knowledge sharing, and skill development across all engineering disciplines, while promoting the vital role of the engineer in society. [36]

Batching of In-Line-Inspection tools - The tool is loaded into the middle of two isolation pigs (one in front of the ILI tool and one behind) and the ILI tool is in a compatible pressurized gas, such as nitrogen (or a slug of diesel if the tool requires a liquid coupling)

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[31] About abet. ABET. (2023, October 2). https://www.abet.org/about-abet/.

[32] About Aiche. AIChE. (2023, July 7). https://www.aiche.org/about https://www.aiche.org/about.

[33] American National Standards Institute. (n.d.). ANSI introduction. ANSI. https://www.ansi.org/about/introduction https://www.ansi.org/about/introduction.

[34] About API. Energy API. (n.d.-a). https://www.api.org/about https://www.api.org/about.

[35]ASTM International. ANSI Webstore. (n.d.). https://webstore.ansi.org/sdo/astm?msclkid=b5145c8e3c9110b215d53ac1f2f86bb8&utm_source=bing&utm_medium=cpc&utm_campaign=Standards-US&utm_term=ASTM+standards+store&utm_content=ASTM ASTM International. ANSI Webstore. (n.d.). https://webstore.ansi.org/sdo/astm?msclkid=b5145c8e3c9110b215d53ac1f2f86bb8&utm_source=bing&utm_medium=cpc&utm_campaign=Standards-US&utm_term=ASTM+standards+store&utm_content=ASTM.

[36] About ASME. ASME. (n.d.-a). https://www.asme.org/about-asme#:~:text=Founded%20in%201880%20as%20the%20American%20Society%20of,the%20vital%20role%20of%20the%20engineer%20in%20society.

Boiler and Pressure Vessel Code (BVPC) - Issued once every two years, is comprised of 32 separate volumes which establish rules of safety governing the design, fabrication and inspection of boilers and pressure vessels, including nuclear power systems. [37]

California Public Utilities Commission (CPUC) - Regulates privately owned electric, natural gas, telecommunications, water, railroad, rail transit, and passenger transportation companies, in addition to authorizing video franchises. [38]

Cathodic Protection - A technique to prevent corrosion of a metal surface by making that surface the cathode of an electrochemical cell. [39]

Center for Hydrogen Safety (CHS) - Nonprofit, non-bias, corporate membership organization within AIChE that promotes the safe operation, handling, and use of hydrogen and hydrogen systems across all installations and applications. [40]

Code of Federal Regulations (CFR) - A codification (arrangement of) the general and permanent rules published in the Federal Register by the executive departments and agencies of the Federal Government.

[41]**Community Based Organizations (CBO):** A public or private nonprofit organization representing a community or a significant segment of a community and working to meet community needs. [42]

Compressed Gas Association (CGA) - An American National Standards Institute (ANSI) accredited Standards Developing Organization, CGA works directly with federal, state, and provincial agencies and fire code officials to promote safe and responsible practices and regulations. [43]

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[37] 2023 ASME BPVC is now shipping! 2023 ASME BPVC - Boiler Pressure Vessel Code | American Society of Mechanical Engineers. (n.d.). https://store.accuristech.com/pages/bpvc_boiler_pressure_vessel_code?sid=msn&utm_source=bing&utm_medium=cpc&msclkid=f8a6a620c76c16f248c7c0793a9b1a9d&utm_campaign=ASME+BPVC&utm_term=2023+boiler+pressure+vessel+code&utm_content=2023+ASME+BPVC.

[38] Auth, T. (n.d.). About the CPUChttps://www.cpuc.ca.gov/about-cpuc/cpuc-overview/about-us#:~:text=About%20the%20California%20Public%20Utilities%20Commission%20%28CPUC%29%20The,transportation%20companies%2C%20in%20addition%20to%20authorizing%20video%20franchises.

[39] The Federal Register. Federal Register: Request Access. (n.d.-a). https://www.ecfr.gov/current/title-40/chapter-I/subchapter-I/part-280.

[40] Center for Hydrogen Safety Fact Sheet. AIChE. (2019, May 24). https://www.aiche.org/CHS/center-hydrogen-safety-fact-sheet

[41] National Archives and Records Administration. (n.d.). Code of federal regulations. National Archives and Records Administration. https://www.archives.gov/federal-register/cfr.

[42] Community-Based Organization (CBO): NIH. Community-Based Organization (CBO) | NIH. (n.d.). https://clinicalinfo.hiv.gov/en/glossary/community-based-organization-cbo.

[43] What we do. Compressed Gas Association. (n.d.). https://www.cganet.com/what-we-do/.

Control Center Modernization (CCM) - Will further digitalize the existing natural gas transmission and distribution system with new field assets such as optical pipeline monitoring (OPM) stations and high consequence area (HCA) methane sensors.

Control Room Operators - Monitor the pressure and flow of gas in the system utilizing a supervisory control and data acquisition (SCADA) system 24 hours a day, 365 days a year.

Cybersecurity and Infrastructure Security Agency (CISA) - Works with partners to defend against today's threats and collaborate to build a more secure and resilient infrastructure for the future. [44]

Department of Transportation (DOT) - A federal agency of the United States government that oversees the transportation system of the country. The DOT aims to ensure the safety, efficiency, accessibility, and sustainability of various modes of transportation, such as air, road, rail, water, and transit. The DOT also supports the development and innovation of transportation infrastructure, technology, and policy.

Emergency Shutdown Devices (ESD) - Systems designed to rapidly shut down the pipeline operation in the event of a detected leak or other hazardous situations that will isolate sections of the pipeline to minimize risks.

Enterprise Risk Management (ERM) - ERM extends beyond compliance and financial risk by using a comprehensive approach to view risks across five categories: compliance, financial, operational, reputational, and strategic. [45]

Federal Emergency Management Agency (FEMA) - FEMA's mission is to help people before, during and after disasters, and our core values and goals help us achieve it. [46]

Gas Technology Institute (GTI) - An organization dedicated to advancing the economy-wide transformation needed to deeply decarbonize energy systems while supplying the energy needed to support rising standards of living and economic growth worldwide. [47]

Geographic Information System (GIS) - Geographic Information Systems (GIS) are systems that capture, store, analyze, and display spatial or geographic data. GIS can be used to create maps, models, and simulations that show the patterns, relationships, and trends of various phenomena that occur on the Earth's surface or in the atmosphere.

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[44] About Cisa: CISA. Cybersecurity and Infrastructure Security Agency CISA. (n.d.). https://www.cisa.gov/about.

[45] Centers for Disease Control and Prevention. (2020, June 29). Enterprise risk management. Centers for Disease Control and Prevention. https://www.cdc.gov/other/riskmanagement.html#:~:text=ERM%20extends%20beyond%20compliance%20and%20financial%20risk%20by,as%20well%20as%20a%20more%20transparent%2C%20risk-aware%20culture.

[46] About Us. FEMA.gov. (n.d.). https://www.fema.gov/about.

[47] Vision. GTI Energy. (2024, May 17). https://www.gti.energy/about/vision/.

High Consequence Areas (HCA) - Unusually sensitive environmental areas (defined in 195.6), urbanized areas and other populated places (delineated by the Census Bureau, and commercially navigable waterways. [48]

Hydrotesting - The method used to pressure test an extinguisher's critical components (cylinder, shell, hose assembly, etc.) for leaks and structural flaws by pressurizing them with a liquid. [49]

Inline Inspection (ILI) - A technique used to assess the integrity of natural gas transmission pipelines from the inside of the pipe and is used by SoCalGas as part of its ongoing pipeline integrity program. [50]

International Association for Hydrogen Safety (HySafe) - The focal point for all hydrogen safety related issues. [51]

International Organization for Standardization (ISO) - Brings global experts together to agree on the best way of doing things – for anything from making a product to managing a process. [52]

Material Specification (MSP) - Detail the physical and chemical properties, manufacturing processes, and performance characteristics of the selected materials. This includes information on strength, durability, finish, and any specific testing or certification required. [53]

Maximum Allowable Operating Pressure (MAOP) - Maximum Allowable Operating Pressure (MAOP) is the maximum pressure at which the equipment may be operated under; in other words, it is the maximum pressure in the new and cold condition of the equipment.

National Fire Protection Association (NFPA) - Started as a Boston-based organization for fire sprinkler codes has grown to become the leading global advocate for the elimination of death, injury, property, and economic loss due to fire, electrical, and related hazards. [54]

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[48] HL Im fact sheet. PHMSA. (n.d.-a). https://www.phmsa.dot.gov/pipeline/hazardous-liquid-integrity-management/hl-im-fact-sheet.

[49] ETool: Evacuation plans and procedures - emergency standards - portable fire extinguishers - hydrostatic testing. Occupational Safety and Health Administration. (n.d.-a). https://www.osha.gov/etools/evacuation-plans-procedures/emergency-standards/portable-extinguishers/hydro.

[50] In-line inspection of pipelines - SoCalGas. (n.d.-b). https://www.socalgas.com/documents/news-room/fact-sheets/In-LinePipelineInspection.pdf.

[51] Why to become member? (n.d.). http://www.hysafe.org/WhyMember#:~:text=What%20is%20IA%20HySafe%3F%20The%20International%20Association%20for,by%20the%20European%20Commission%20co-funded%20network%20of%20excellence.

[52] About ISO. ISO. (2024a, March 14). https://www.iso.org/about-us.html.

[53] Forehand, L. (n.d.). Chapter 6: Building Materials and Specifications. Building Systems and Codes for Designers. https://lbcc.pressbooks.pub/buildingsystemsandcodes/chapter/building-materials-and-specifications/.

[54] Learn more about NFPA: The National Fire Protection Association. nfpa.org. (n.d.). https://www.nfpa.org/About-NFPA.

Nominal Pipe Size (NPS) - Related to the inside diameter in inches, and NPS 12 and smaller pipe has outside diameter greater than the designated size. [55]

Occupational Safety and Health Administration (OSHA) - Assures safe and healthful working conditions by setting and enforcing standards, and by providing training, outreach, education and assistance. [56]

Operations and Maintenance (O&M) - Activities performed by an individual, or group of individuals, (1) to perform a function on a pipeline facility, or (2) to provide upkeep of a pipeline facility. This includes in-kind replacement of an existing section of pipe necessitated by severe corrosion, where the capacity of the pipe segments is maintained, and service is not expanded. It also includes maintenance and repair tasks performed on the right-of-way or within the confines of a "pipeline facility", as defined. This would include ordinary repairs to a pipeline, including replacement of one or more pipe joints or segments that have been severely damaged by threats such as corrosion or third-party damage. [57]

Operator Qualification (OQ) - Each pipeline operator is responsible for developing an OQ program, following their written OQ plan, establishing a covered task list applicable to their system, and defining the training and qualification requirements for personnel performing covered tasks on their pipeline facility. [58]

Optical Pipeline Monitoring (OPM) - The Optical Pipeline Safety Monitoring System (OPM) sends pulses of light the thickness of a human hair through glass that can be measured inside the optical cable. When installed along a pipeline, the technology can detect vibrations, stress, or abnormal changes in temperature to within 20 feet of where a problem may be developing. [59]

Personal Protective Equipment (PPE) - Equipment worn to minimize exposure to a variety of hazards. [60]

Piggability - In-Line Inspection (ILI) tools are referred to as "intelligent" or smart Pipeline Integrity Gauges (PIG's) which are devices that travel inside the pipeline and collect data using various sensors. There are different types of ILI tools, such as: Cleaning PIGs, smart PIGs, etc.

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[55] PI-21-0008. PHMSA. (2021, September 1). https://www.phmsa.dot.gov/regulations/title49/interp/pi-21-0008.

[56] Occupational Safety and Health Administration (OSHA): Usagov. Occupational Safety and Health Administration (OSHA) | USAGov. (n.d.). https://www.usa.gov/agencies/occupational-safety-and-health-administration.

[57] Pipeline Safety Stakeholder Communications. PHMSA. (n.d.-d). https://primis.phmsa.dot.gov/comm/glossary/index.htm?nocache=5217#OperationsandMaintenanceTasks.

[58] Operator qualification overview. PHMSA. (n.d.-a). https://www.phmsa.dot.gov/pipeline/operator-qualifications/operator-qualification-overview.

59 SoCalGas' Innovative Optical Pipeline Safety Monitoring System set to expand after successful pilot program: SoCalGas Newsroom. (2023, September 6). https://newsroom.socalgas.com/stories/socalgas-innovative-optical-pipeline-safety-monitoring-system-set-to-expandafter#:~:text=The%20Optical%20Pipeline%20Safety%20Monitoring%20System%20%28OPM%29%20sends,feet%20of%20where%20a%20problem%20may%20be%20developing.

[60] Personal Protective Equipment. (n.d.-b). https://www.osha.gov/sites/default/files/publications/osha3151.pdf.

Pipeline and Hazardous Materials Safety Administration (PHSMA) - Mission is to protect people and the environment by advancing the safe transportation of energy and other hazardous materials that are essential to our daily lives. [61]

Potential Impact Radius (PIR) - The radius of the potential impact circle (PIC), measured in feet surrounding the point of failure, within which the potential failure of a pipeline could have significant impact on people or property. [62]

Risk Assessment Mitigation Phase (RAMP) - Identification of major risks to be addressed, examination of alternative mitigation options and their expected risk reduction, and a description of a proposed risk mitigation plan. [63]

Safety - The presence of controls for known hazards, actions to anticipate and guard against unknown hazards, and the commitment to continuously improve the ability to recognize and mitigate hazards.

Safety Management System (SMS) - Formal, top-down, organization-wide approach to managing safety risk and assuring the effectiveness of safety risk controls. It includes systematic procedures, practices, and policies for the management of safety risk. [64]

Specified Minimum Yield Strength (SMYS) - SMYS is the minimum yield strength, expressed in pounds per square inch (psi) gage, prescribed by the specification under which pipe material is purchased from the manufacturer. [65]

Standards Council of Canada (SCC) - A Crown corporation established by an Act of Parliament in 1970 to foster and promote voluntary standardization in Canada. [66]

Tetrahydrothiophene (THT) - Appears as a water-white liquid. About the same density as water and insoluble in water. Vapors heavier than air. Used as a solvent and to make other chemicals. [67]

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[61] PHMSA's mission. PHMSA. (n.d.-a). https://www.phmsa.dot.gov/about-phmsa/phmsas-mission.

[62] PHMSA's mission. PHMSA. (n.d.-a). https://www.phmsa.dot.gov/about-phmsa/phmsas-mission.

[63] Auth, T. (n.d.). Sempra 2021 ramp. California Public Utilities Commission. https://www.cpuc.ca.gov/about-cpuc/divisions/safety-policy-division/risk-assessment-and-safety-analytics/risk-assessment-mitigation-phase/sempra-ramp/sempra-2021-ramp.

[64] Safety Management System (SMS). | Federal Aviation Administration. (n.d.). https://www.faa.gov/about/initiatives/sms.

[65] Pipeline Safety Stakeholder Communications. PHMSA. (n.d.). https://primis.phmsa.dot.gov/comm/glossary/index.htm?nocache=5217#SpecifiedMinimumYieldStrength.

[66] SCC. ISO. https://www.iso.org/member/1619.html.

[67] U.S. National Library of Medicine. (n.d.). Tetrahydrothiophene. National Center for Biotechnology Information. PubChem Compound Database. https://pubchem.ncbi.nlm.nih.gov/compound/tetrahydrothiophene.

Transportation Security Administration (TSA) - Protects the nation's transportation systems to ensure freedom of movement for people and commerce. [68]

U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy (EERE) - EERE's mission is to accelerate the research, development, demonstration, and deployment of technologies and solutions to equitably transition America to net-zero greenhouse gas emissions economy-wide by no later than 2050, and ensure the clean energy economy benefits all Americans, creating good paying jobs for the American people—especially workers and communities impacted by the energy transition and those historically underserved by the energy system and overburdened by pollution. [69]

Unified Command (UC) - A collaborative process that allows agencies with different responsibilities for an incident to work together to manage it. It's an application of the Incident Command System (ICS) that's used when more than one agency is involved, or when the incident crosses political jurisdictions.

[68] Transportation Security Administration (TSA): Usagov. Transportation Security Administration (TSA) | USAGov. (n.d.). https://www.usa.gov/agencies/transportation-security-administration.

[69] About the office of Energy Efficiency and Renewable Energy | Department of Energy. (n.d.). https://www.energy.gov/eere/about-office-energy-efficiency-and-renewable-energy.

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Brown, A. A. (2019, May 30). *Hydrogen Transport*. Retrieved from The Chemical Engineer: https://www.thechemicalengineer.com/features/hydrogen-transport/

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National Fire Protection Association. (2023). NFPA-2112, Standard on Flame-Resistant Clothing for Protection of Industrial Personnel Against Short-Duration Thermal Exposures from Fire. Quincy, Massachusetts: National Fire Protection Association.

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Pacific Northwest National Laboratory. (n.d.). *Lower and Higher Heating Values of Fuels*. Retrieved from Hydrogen Tools: https://h2tools.org/hyarc/calculator-tools/lower-and-higher-heating-values-fuels

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16.0 APPENDICES

- Appendix A - SoCalGas Standards Review Summary

Appendix A

SOCALGAS STANDARDS REVIEW SUMMARY

49 CFR Part 192 and GO-112F are the regulatory codes having jurisdiction for pipelines transporting hydrogen and other gases. This applies to both SoCalGas natural gas infrastructure and the proposed Angeles Link hydrogen infrastructure. These regulatory codes cover a wide variety of requirements which can generally be grouped into: Design, Construction, Operations and Maintenance. 49 CFR Part 192.605 contains specific language for a procedural manual for operations, maintenance, and emergencies. Regulatory code(s) for hydrogen transportation in pipelines will impact SoCalGas's existing specifications, standards, and procedures (SSPs) accordingly. Code-specific language is an important component of the SSPs that can drive the workforce training program and operator qualification program for operator personnel.

Methodology for Specifications, Standards & Protocols Evaluation

The evaluation conducted as part of this work scope focused on the existing specifications, standards, and procedures for applicability to hydrogen gas and potential for new procedure development. SoCalGas specifications, standards, and procedures were reviewed and categorized per the following methodology:

1. Specifications, standards, and procedures were reviewed by regulatory codes outlined in the document profile summary (at the end of each SSP), emphasizing 49 CFR Part 192 and CPUC GO-112F requirements. Each SSP was reviewed for applicability and efficacy for hydrogen infrastructure.
  - Not applicable to hydrogen service (no changes)
  - Changes/editing are not required but are applicable for hydrogen service
  - Changes/editing will be required for hydrogen service
  - New standards, specifications, or procedures that may be needed due to evolving hydrogen regulations
2. The SSP review was documented and formatted to include the SSP number, Title, and applicable 49 CFR Part 192 regulatory codes, along with the above designated categories.

Summary

The following specification and standard topics covering SoCalGas's current natural gas operations should be considered for modifications or new specifications / standard development for implementation of a clean renewable hydrogen energy transport system:

1. Material requirements
2. Material traceability requirements
3. Facility maps (for new production, transmission, and storage facilities)
4. Control room management plan
5. Equipment specifications (e.g., gas compressor specifications and pressure vessel specifications updated to include specifics for hydrogen service)
6. Fire prevention and protection plan

7. Operator qualification program
8. Corrosion control and monitoring requirements
9. Leak testing and monitoring requirements
10. Integrity management programs

Of the approximate 1,600 SSPs reviewed;

- Approximately 21% of SoCalGas's current SSPs are not applicable to hydrogen service
- Approximately 34% of SoCalGas's current SSPs are applicable to hydrogen service and may require changes or revisions
- Approximately 30% of SoCalGas's current SSPs are applicable but may not require changes or revisions
- The remaining 15% of SoCalGas's current SSPs may require a new SSP specific to hydrogen service

ANGELES LINK

PRELIMINARY DATA AND FINDINGS: WORKFORCE PLANNING & TRAINING EVALUATION

April 2024

SoCalGas

STUDY INTRODUCTION

- This study evaluates operations and maintenance protocols for utility workers regarding hydrogen infrastructure and workforce needs in terms of staging and growth for the Project
- Future workforce job estimates will be provided in draft study to be released later in 2024
- This study is being prepared as directed by CPUC Decision (D.22-12-055, OP 6 (e)) which requires SoCalGas to provide the findings and results from the Phase One feasibility studies

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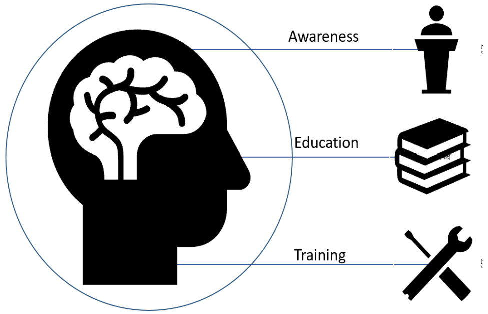
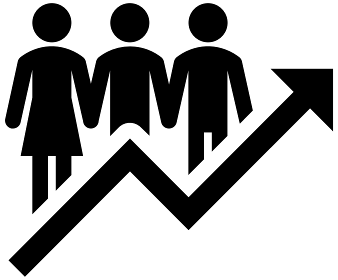
WORKFORCE STUDY CONSIDERATIONS

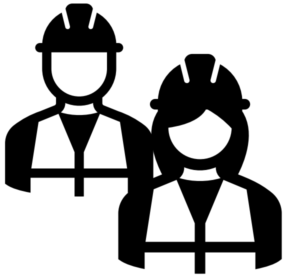
Sharing Knowledge — Collaborate with industry, government, unions, and local communities on workforce initiatives



Workforce Planning — Utilize resourcing data to plan for hydrogen industry workforce needs; new skilled and upskilled workers



Build Hydrogen Job Pathways — Support workforce centers, universities/trade schools, and skills/training programs



STUDY APPROACH/SCOPE

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WORKFORCE METHODOLOGY/FORECASTING

Workforce Staging Timing & Evaluation

Construction Workforce Timing & Evaluation

Compressor Stations
- Contractors
- Inspectors
- Compliance Inspections

Pipeline
- Contractors
- Inspectors
- Compliance Inspections

Operations & Maintenance Workforce Timing & Evaluation

Compressor Stations
- Engineering and Technical Support
- Management and Supervision
- Field Workforce

Pipeline
- Engineering and Technical Support
- Management and Supervision
- Field Workforce

Pipeline Infrastructure Configuration → Construction O&M Sequencing and Schedule → Direct Labor Hours Resources → Indirect Labor Support Services → Resource Loading

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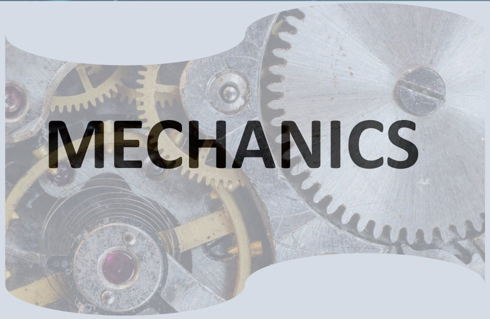
WORKFORCE PLANNING & TRAINING PRELIMINARY FINDINGS

- Identify skill requirements, specifically qualifications required for various roles involved in hydrogen pipeline construction and pipeline operations
- Workforce training for safety and regulatory compliance
- Identify gaps in the required skills within the existing workforce

- Determine workforce size to estimate the number of resources needed
- Continuous monitoring and adaptation for workforce management



- Education and training given to the project management and operations workforce for material and component selection
- Operator qualifications to provide appropriate training and awareness to operations personnel
- Training programs to enhance existing workforce skills and/or prepare new workforce for hydrogen related work

ANGELES LINK

PRODUCTION PLANNING & ASSESSMENT

PRELIMINARY DATA AND FINDINGS

April 2024

SoCalGas

STUDY INTRODUCTION

- The Hydrogen Production Planning & Assessment (Production Study) analyzes clean renewable hydrogen production potential in SoCalGas's service territory through 2045, and evaluates potential sources, input requirements and estimated cost of production
- SoCalGas will not be producing hydrogen but analyzed potential production options
- This study is being prepared as directed by CPUC Decision (D.22-12-055, OP 6 (b)), which requires SoCalGas to provide the findings and results from the Phase One feasibility studies

STUDY APPROACH / SCOPE

H2 Production Technologies

Evaluate hydrogen production technologies that use renewable energy resources, such as solar and wind, and meet the clean renewable hydrogen standard as defined in D.22-12-055

H2 Production Volumes

Assessment of potential clean renewable hydrogen production volumes to meet estimated potential demand

H2 Production Land Assessment

Evaluation of land for potential clean renewable hydrogen production facilities

H2 Production Costs

Assessment of capital and operating costs, focusing on solar powered electrolytic production facilities

STUDY ASSUMPTIONS

- Third-party production of clean renewable hydrogen, not produced by SoCalGas
- Angeles Link is envisioned to potentially serve throughput scenarios of 0.5 - 1.5 million metric tonnes per year (MMTPY), which is a portion of the estimated 1.9 - 5.9 MMTPY* of hydrogen demand in SoCalGas service territory
- A preliminary desktop evaluation was conducted to identify suitable land for hydrogen production
- Three primary production locations including San Joaquin Valley, Lancaster, and Blythe
- Minimum acreage for solar/electrolytic hydrogen production between 6-7 acres per megawatt of solar capacity
- Standalone behind-the-meter solar generation provides power to operate electrolyzer units
- In the long-term, an estimated storage working capacity of 0.125 MMT, 0.305 MMT, 0.415 MMT assumed to be required upon full buildout by 2045

*Hydrogen demand estimates provided in SoCalGas's Draft Angeles Link Demand Report, January 2024

PRELIMINARY FINDINGS

Renewable Power and Electrolyzers

- Solar power paired with electrolyzers expected as the primary renewable energy source and technology used for clean renewable hydrogen production at scale
- Solar generation is a mature technology and among the lowest cost renewable source, and can be co-located near hydrogen production
- Solar irradiance in most of SoCalGas's territory is some of the most efficient in the country
- Other renewable sources may support hydrogen production but on a smaller scale due to resource limitations in Central and Southern California
- Proton Exchange Membrane (PEM) electrolyzers have startup times and ramp rates as well as turndown capabilities that are suitable as a technology to pair with intermittent and variable power supplies such as solar

PRELIMINARY FINDINGS

ANGELES LINK

Land Assessment and Production Areas

- Based on preliminary analysis, approximately 2 million acres of suitable land is identified in three primary production locations
- Production locations include San Joaquin Valley, Lancaster, and Blythe
- Land required to support 1.5 MMTPY production volume is estimated to be 240,000 acres, which represents approximately 11% of the land identified as potentially suitable for hydrogen production from all three production areas.

Energy from the Grid

- Excess renewable energy (e.g., solar) that would otherwise be curtailed could be used sporadically to generate clean renewable hydrogen
- If production facilities are grid connected (this is not considered in the design case for Angeles Link), the curtailed renewable energy is expected to be used opportunistically to produce hydrogen

Role of Storage for Supply/Demand Balancing

- Third-party storage will play an important role to balance hydrogen supply with demand, primarily due to the intermittent nature of renewables and expected demand profiles of the power generation, mobility, and industrial sectors

PRELIMINARY ROUTING/CONFIGURATION ANALYSIS, INCLUDING RIGHT-OF-WAY AND FRANCHISE

PRELIMINARY DATA AND FINDINGS

ANGELES LINK

April 2024

SoCalGas

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STUDY INTRODUCTION

- The Preliminary Routing/Configuration Analysis identifies and compares possible routes and configurations for the Project to determine preferred routing/configuration alternatives for the hydrogen system
- Also evaluates existing pipeline corridors or rights-of-way, other known existing rights-of-way, franchise rights, designated federal energy corridors or rights-of-way, and the need for new rights-of-way;
- Evaluates technical considerations, major crossings, elevations, terrain types, environmental justice concerns and other potential geographical and urban challenges.
- This study is being prepared as directed by CPUC Decision (D.22-12-055, OP 6 (i)), which requires SoCalGas to provide the findings and results from the Phase One feasibility studies

PRELIMINARY ROUTING & CONFIGURATION

- Phase 1 Objectives
  - Consider existing pipeline rights-of-way, franchise rights, and designated federal energy corridors
  - Connect identified areas of hydrogen production and demand
  - Identify several preferred routing alternatives for the hydrogen system
  - Evaluate Route Features (Social including Environmental Social Justice, Engineering, Environmental)

- System Evaluation
  - Overall pipeline corridors assessed based on similar geographic, environmental, constructability, and community factors
  - Various production and demand locations considered

- Pipeline Corridor Evaluation
  - Pipeline corridors divided into “segments” to evaluate engineering, environmental, and social criteria

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SEGMENT EVALUATION – FEATURE GLOSSARY

Engineering	Environmental	Social
Adverse Soil Conditions Class Location Existing SoCalGas Right of Way Fault Areas High Consequence Areas Mainline Valve Overhead/Underground Utilities Physical Conflict Pipeline Constructability Railroad/Road Crossings Route Length Sloped Terrain Trenchless Crossings	Coastal Zones Conservation Areas Cultural & Tribal Resources Endangered/Threatened Species Floodplains Landfills & Hazardous Waste Sites Stream Crossings Wetlands	Disadvantaged Communities Land Use Military Facility/Property National Register of Historic Places (NRHP) Historic Locations Pasture/Agricultural Land Proximity to Buildings Public & Recreational Areas Special Circumstances

*List in alphabetical order

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SoCalGas

PRELIMINARY ROUTING CONSIDERATIONS

Considerations from previous slides and additional factors such as:

» Federal Corridors
- Department of Energy/BLM/Forest Service
  - – Energy Corridors on Federal Lands
- Dept. of Energy and Dept. of Transportation
  - – Alternative Fuels Data Center
- National Pipeline Mapping System (NPMS) by PHMSA

» SoCalGas Existing Infrastructure

» Alliance for Renewable Clean Hydrogen Energy Systems (ARCHES) Initiatives

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SoCalGas

RIGHT-OF-WAY AND FRANCHISE PRELIMINARY FINDINGS

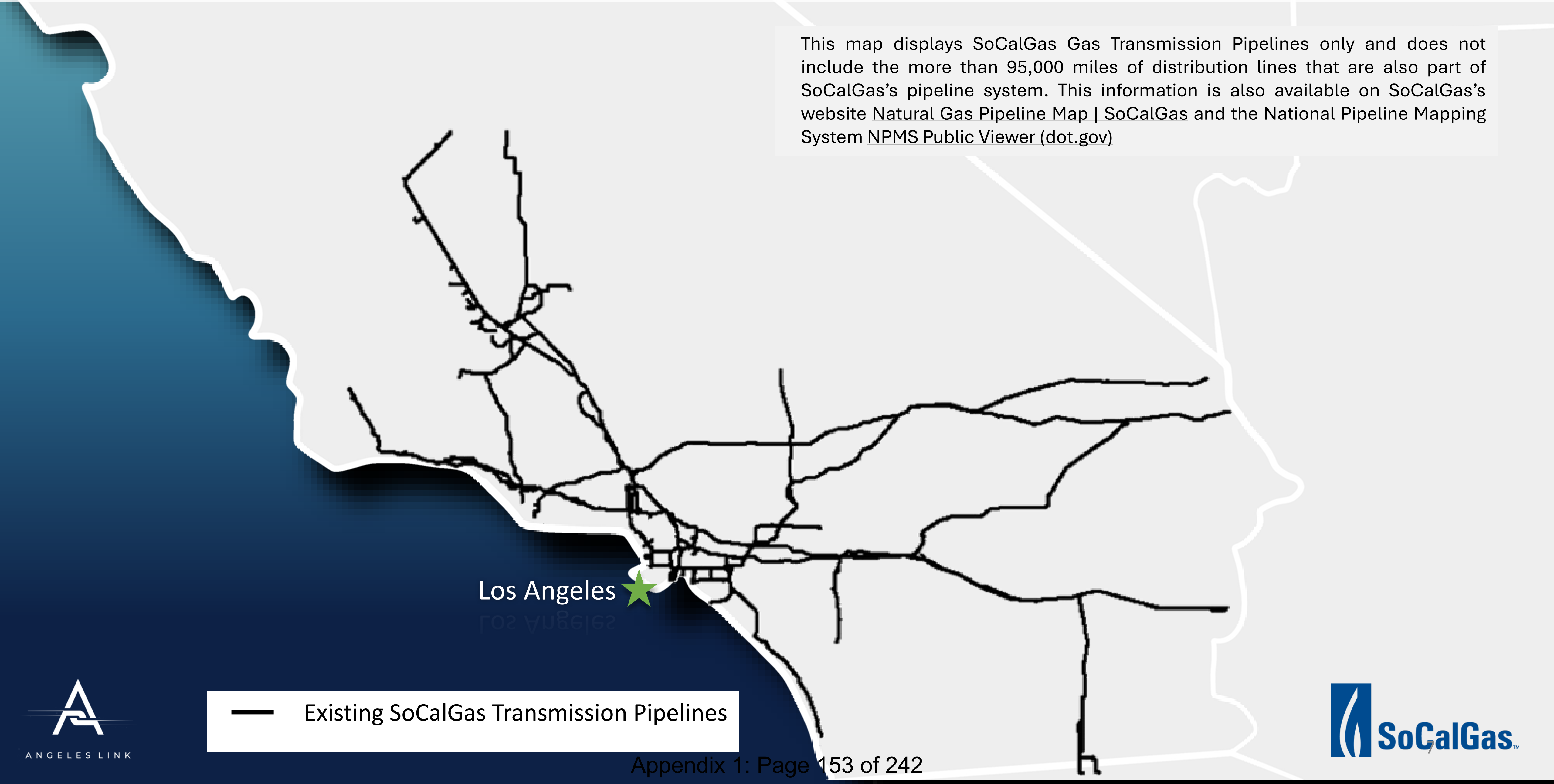
- An initial right-of-way (ROW) evaluation assessed existing and potential future ROWs to accommodate potential pipeline segments
  - Assessment considered corridors under evaluation
- The franchise evaluation included review of existing franchise information within SoCalGas service territory
- Tools for evaluation included GIS mapping tools, pipeline maps, ownership data (federal, state, private)
- Based on preliminary pipeline routing information, there are 60 municipalities with which SoCalGas has franchise agreements and approximately 50% of the potential routes are proximate to ROWs for existing facilities

ANGELES LINK

SoCalGas

EXISTING SOCALGAS NATURAL GAS TRANSMISSION PIPELINES

This map displays SoCalGas Gas Transmission Pipelines only and does not include the more than 95,000 miles of distribution lines that are also part of SoCalGas's pipeline system. This information is also available on SoCalGas's website Natural Gas Pipeline Map | SoCalGas and the National Pipeline Mapping System NPMS Public Viewer (dot.gov)

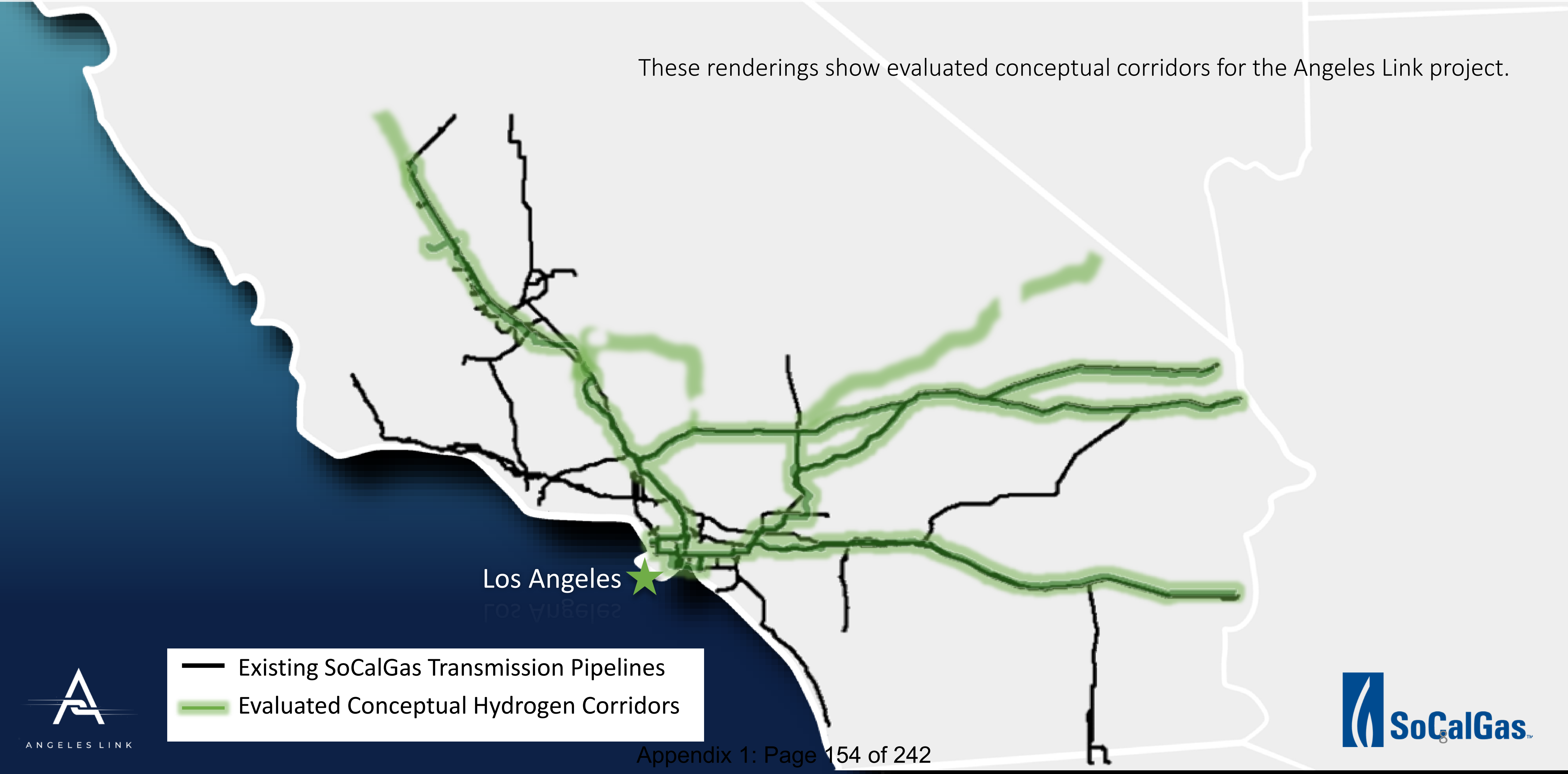


ANGELES LINK

SoCalGas

EXISTING SOCALGAS NATURAL GAS TRANMISSION PIPELINES AND CORRIDORS UNDER EVALUATION

These renderings show evaluated conceptual corridors for the Angeles Link project.

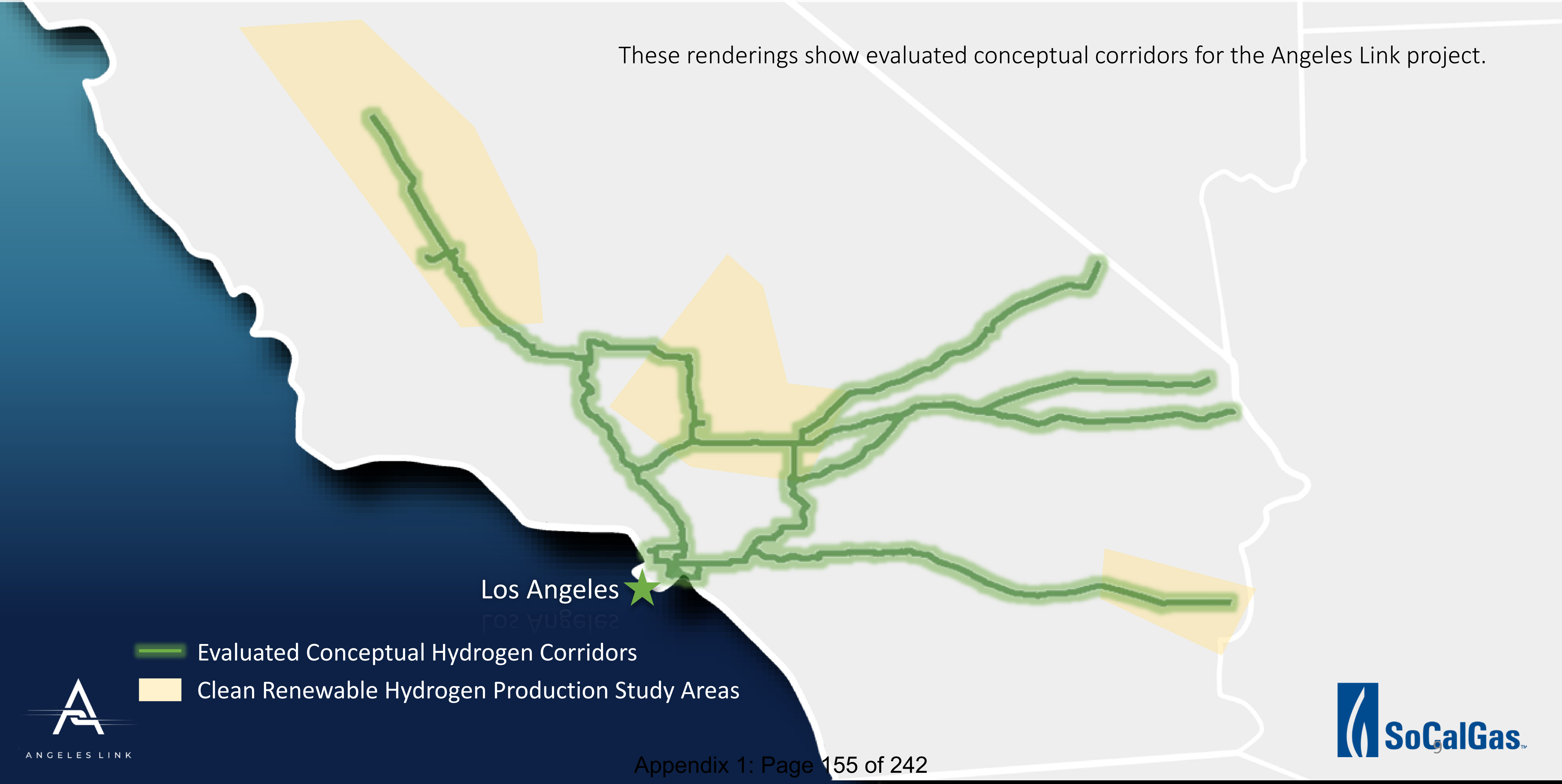


ANGELES LINK

SoCalGas

CORRIDORS UNDER EVALUATION

These renderings show evaluated conceptual corridors for the Angeles Link project.



CORRIDORS UNDER EVALUATION

These renderings show evaluated conceptual corridors for the Angeles Link project.

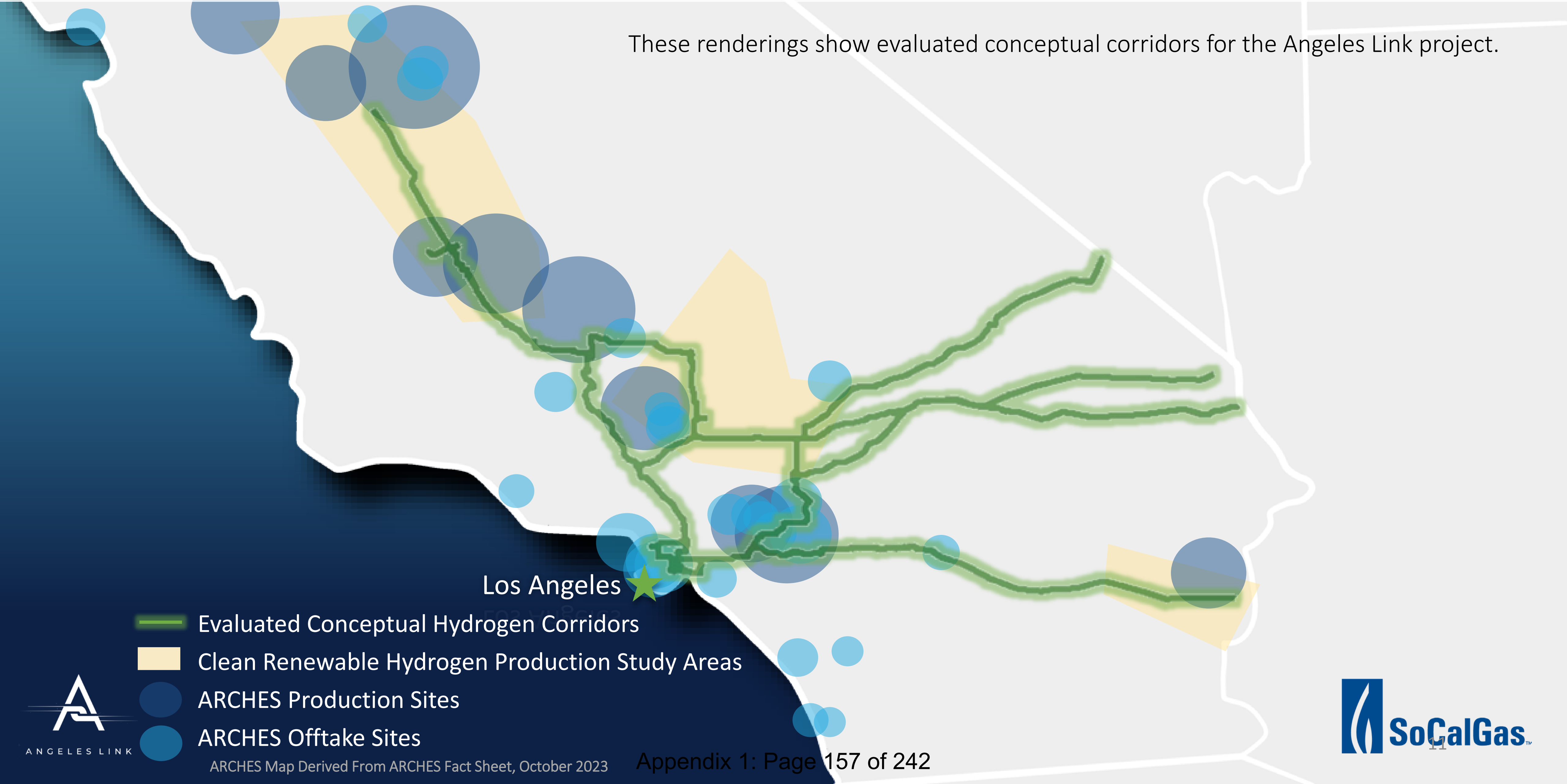
ANGELES LINK

ARCHES Map Derived From ARCHES Fact Sheet, October 2023

SoCalGas

CORRIDORS UNDER EVALUATION

These renderings show evaluated conceptual corridors for the Angeles Link project.



ARCHES Map Derived From ARCHES Fact Sheet, October 2023

EVALUATION COMPONENTS

Phase 1 Approach: Evaluation of a wide range of routes and corridors that can be narrowed down to a set of preferred routes based on a variety of elements.

- Production
- Demand
- Environmental
- Project Cost
- Resiliency & Reliability
- Land Considerations (ROW/Franchise)
- Route Features (Social including Environmental Social Justice, Engineering, Environmental)
- Other Large-Scale California Infrastructure Projects

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CONCEPTUAL EXAMPLE 1 OF 2

These renderings show conceptual examples that may be evaluated for the Angeles Link project.
Potential Angeles Link routes are still to be determined and analyzed for feasibility including hydraulics, engineering, etc.

Preliminary

CONCEPTUAL EXAMPLE 2 OF 2

These renderings show conceptual examples that may be evaluated for the Angeles Link project.
Potential Angeles Link routes are still to be determined and analyzed for feasibility including hydraulics, engineering, etc.

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Preliminary

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NEXT STEPS

- Phase 1 Pipeline Routing/Configuration Study is still underway and will:
  - Consider existing pipeline rights-of-way, franchise rights, and designated federal energy corridors
  - Route Features (Social, Engineering, Environmental)
  - Connect identified areas of hydrogen production & demand throughout the Central and Southern California area
  - Evaluate pipeline corridors and identify several preferred routing alternatives for the hydrogen system
- Various configurations are still under evaluation and Phase 2 will identify a preferred system route
- The draft Pipeline Routing/Configuration Study is expected to be completed and shared with the CBOSG and PAG for review and comment in Q3 2024
- Route alternatives pursuant to CEQA and NEPA will also be studied in later stages of project development
- A localized hub alternative will be studied within the Phase 1 Project Options and Alternatives
- The Environmental and Environmental Social Justice Analysis will also evaluate and consider environmental social justice and engagement opportunities.

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REFERENCE MATERIAL

ARCHES H2

Alliance for Renewable Clean Hydrogen Energy Systems

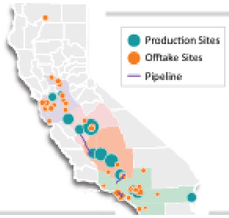
Meet ARCHES

ARCHES is California's designated U.S. Department of Energy (DOE) H2Hub, established to accelerate the deployment of renewable, clean hydrogen (H2) projects and infrastructure to advance a zero-carbon economy. As part of the Bipartisan Infrastructure Law, the DOE is creating Regional Clean Hydrogen Hubs across the United States. After a rigorous application and review process, ARCHES was one of 7 hubs selected and was awarded up to $1.2 billion in federal funding.

The state has committed to a clean energy future, and to achieve this, Governor Newsom is establishing a hydrogen workgroup to streamline project approval and completion. Additionally, the Governor has directed the Office of Business and Economic Development (GO-Biz) to develop a Hydrogen Market Development Strategy in coordination with ARCHES. **ARCHES will accelerate the development and deployment of renewable, clean H2 projects and infrastructure to reduce greenhouse gas emissions, improve local air quality, create good paying jobs, and advance a zero-carbon economy.**

ARCHES is committed to ensuring an equitable transition to renewable hydrogen and all projects must advance diversity, equity, inclusion and accessibility. Projects will be focused in communities with the largest pollution burden and at least 40% of the benefits from projects will flow to disadvantaged communities. Along with the creation of over 200,000 new jobs, it is estimated ARCHES' projects will ultimately result in $2.95 billion per year (starting in 2030) in economic value including increased health and health-care cost savings due to significant reductions in air pollution.

Anticipated ARCHES projects by 2030



Final details are pending DOE approval

BY THE NUMBERS

222,400 new jobs created

$2.95 billion per year economic value of increased **health and health cost savings** by 2030 and beyond

1,705 **fewer hospitalizations** per year for respiratory and cardiac illness

400+ **partner organizations** representing civic, business, labor, transportation, and communities across CA

At least 40% of the **benefits** from ARCHES' projects flow **to California's disadvantaged communities**

ARCHES Objectives and Projects

Developing a diverse portfolio of clean energy solutions, including hydrogen, is the responsible approach to help California achieve the state's ambitious clean energy goals. ARCHES is anticipated to develop major deployment clusters around Los Angeles and the Bay Area and extend into the Central Valley, Inland Empire, and other regions with heavy transportation corridors and ports to facilitate goods movement and ensure California maintains its position as a powerhouse in the global economy. **Through the application process, ARCHES identified a number of projects up and down the state—many shovel ready—supporting three essential hard-to-decarbonize end-use sectors: heavy-duty vehicles, power plants, and ports.**

ARCHES Support Network

ARCHES has unprecedented diverse support from over 400 organizations and individuals representing state and local governments, higher education institutions, business and industry leaders, organized labor, and community advocates who have wholeheartedly endorsed a hydrogen hub in California.

They have all joined together, under the banner of ARCHES, to fast-track the development and deployment of renewable, clean hydrogen projects and infrastructure for the benefit of all.

University of California · Renewables 100 Policy Institute · CalChamber · Berkeley Lab · IBEW NECA · CARB · NCPA · California Hispanic Chambers of Commerce · California African American Chamber of Commerce · California Transit Association

Partial list

BENEFITS OF CLEAN HYDROGEN FOR CALIFORNIA

- **Hydrogen is a catalyst for California's green economy and green jobs**
  Hydrogen presents real opportunities to retain and expand California's clean energy workforce, which will build the infrastructure needed to power and implement H2.
- **Hydrogen will help ensure energy reliability and fuel independence**
  As we continue to transition to more electric technologies, the demand on electricity will only continue to increase. Supplementing our existing power portfolio with clean hydrogen will ensure that the energy sectors employ both electrons and molecules to enable us to reliably decarbonize all sectors of the economy, while maintaining economic leadership and advancing environmental, health and social justice objectives.
- **Hydrogen is key in helping decarbonize hard to electrify industries**
  Hydrogen can help decarbonize hard to electrify sectors like shipping, aviation, agriculture, heavy duty transport and energy intensive industries like cement, steel, and refineries.
- **Hydrogen will clean California's air and preserve water resources**
  Renewable hydrogen enables heavy industries, diesel transportation and power plants to run on zero-emission technologies that will directly help reduce pollution and conserve water, thus protecting California's air and water resources.

archesH2.org

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PRELIMINARY DATA AND FINDINGS: PLAN FOR APPLICABLE SAFETY REQUIREMENTS

April 2024

SoCalGas

STUDY INTRODUCTION

- This study evaluates safety concerns and develops an assessment of applicable safety requirements for employee, contractor, system, and public safety

- This study is being prepared as directed by CPUC Decision (D.22-12-055, OP 6 (f)), which requires SoCalGas to provide the findings and results from the Phase One feasibility studies

STUDY APPROACH/SCOPE

Study approach identified applicable topics for consideration

Regulations

Review existing pipeline regulations and standards

Construction

Evaluation of design, construction and maintenance requirements

Communication

Assessment of public communication tools

SAFETY STUDY CONSIDERATIONS

1. Pipelines can be a safe and efficient method of transporting large volumes of gas over long distances
2. A comprehensive framework of safety requirements can mitigate hydrogen transport risks
3. SoCalGas has an existing safety framework that can be built upon to include 100% hydrogen transport

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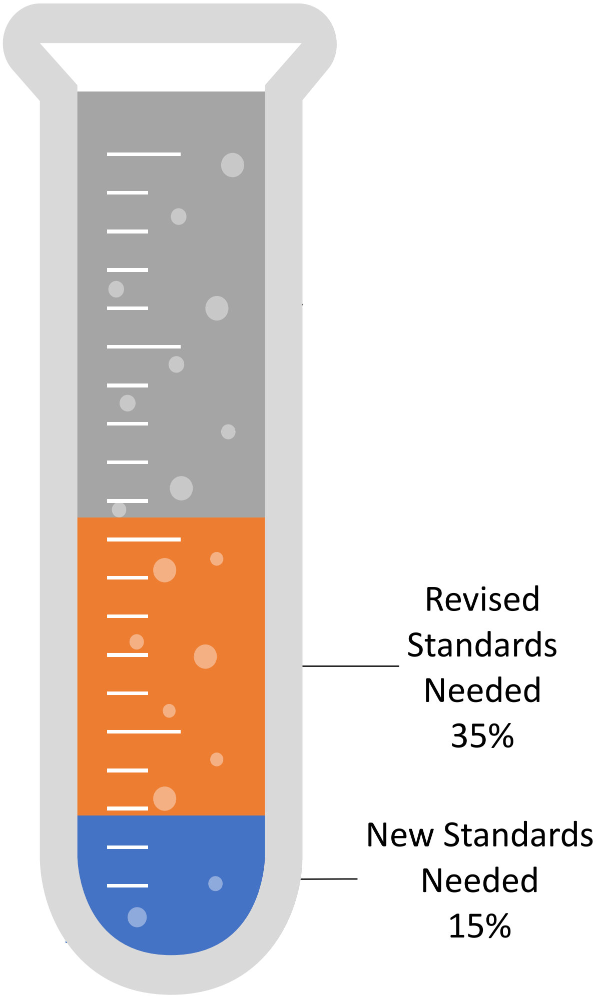
SOCALGAS STANDARDS REVIEW

- **Evaluation of ~1600 SoCalGas existing specification, standards, and procedures (SSPs)**
  - ~500 SSPs may apply to hydrogen infrastructure and subject to potential modifications
  - ~200 potential new SSPs
- **Development of SoCalGas Standards and material specifications around hydrogen**
  - Created eight line-classes and ten material specification sheets for H2 and hydrogen blends
- **Center for Hydrogen Safety**
  - On-going collaboration with the Hydrogen Safety Panel for an expert third-party review of our Angeles Link Safety Study



DESIGN, CONSTRUCTION, OPERATION & MAINTENANCE

Design & Construction

Design considerations will apply code ASME 31.12 specifically for hydrogen piping and pipeline

Material selection and compatibility will be critical in the safe design and operation for pure hydrogen

Proven welding procedures and technologies used in other industries that are currently using pure hydrogen

Operation & Maintenance

Leak detection equipment is available and can be utilized for hydrogen detection

In-line inspection (ILI) of hydrogen pipelines is feasible

Studies show odorization of pure hydrogen gas is feasible

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PUBLIC AWARENESS PLAN

Public Awareness Program

Safety	Pipeline Safety Resource	API 1162

Audience
- Public
- Emergency planning and response officials
- Public officials and governing councils
- Excavators

Program
- Pipeline purpose and reliability
- Hazard awareness and prevention measures
- Leak recognition and response
- Emergency preparedness communications
- Damage prevention
- Pipeline locations

Communication Method
- Bill inserts
- News release
- Advertising
- Brochures
- Direct mail
- Email
- Safety website
- Meetings

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EMERGENCY RESPONSE PLAN

Five Phases of Emergency Management

- Prevention
- Preparedness
- Response
- Recovery
- Mitigation

Source: FEMA

SoCalGas Monitoring and Event Response

- Customer Contact Center
- Dispatch
- System Operator
- Watch Desk 24/7

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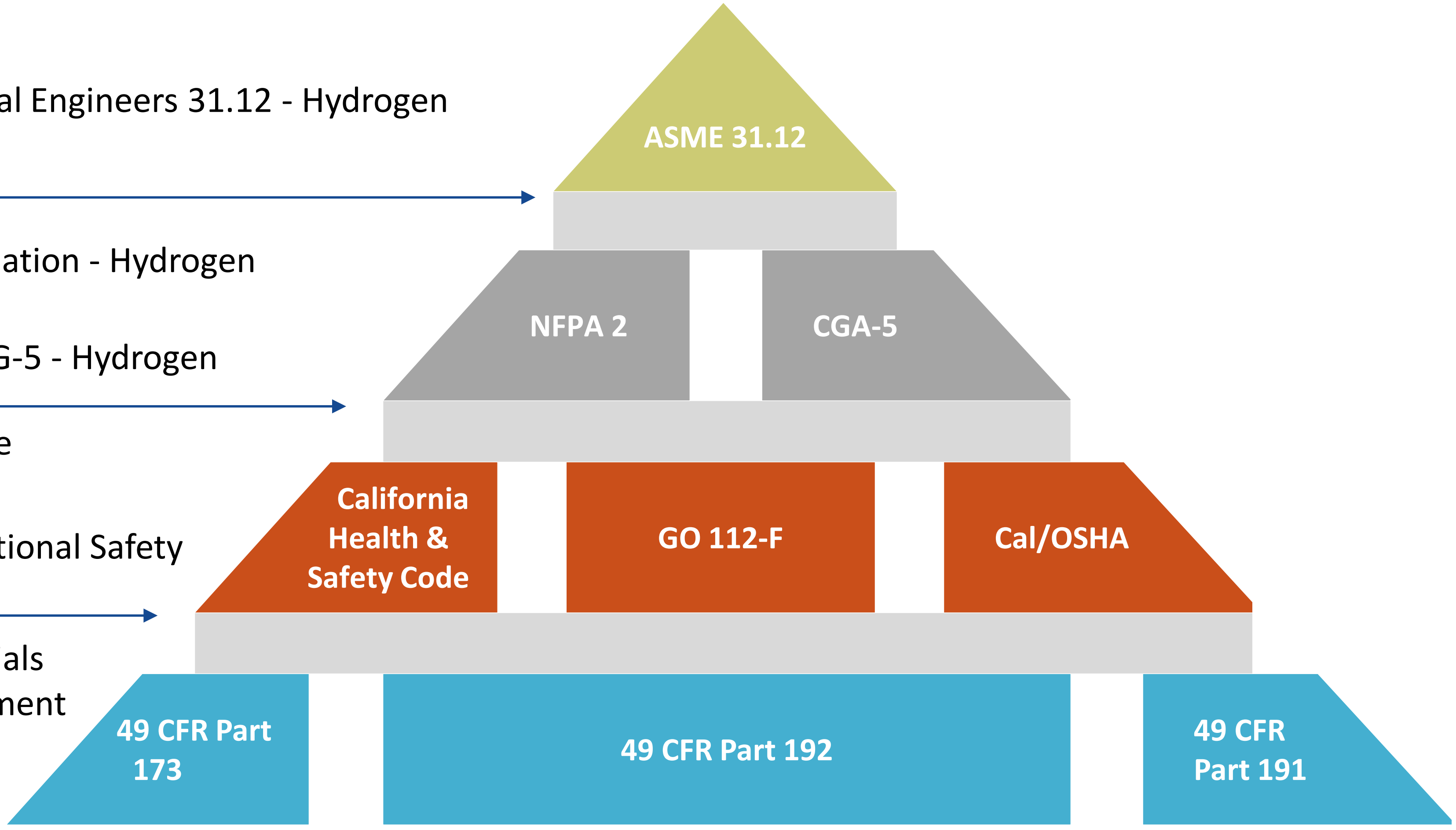
SAFETY STUDY PRELIMINARY FINDINGS

- American Society of Mechanical Engineers 31.12 - Hydrogen Piping and Pipelines

- National Fire Protection Association - Hydrogen Technologies Code
- Compressed Gas Association G-5 - Hydrogen

- California Health & Safety Code
- CPUC General Order No. 112-F
- Cal/OSHA - Division of Occupational Safety and Health

- Pipeline and Hazardous Materials Safety Administration, Department of Transportation – 49 Code of Federal Regulations.



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PIPELINE SIZING AND DESIGN CRITERIA

PRELIMINARY DATA AND FINDINGS

May 2024

SoCalGas

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STUDY INTRODUCTION

- The Pipeline Sizing & Design Criteria study (i) estimates potential pipeline sizes for the pipeline route from production to end-use; (ii) identifies specific materials for pipeline, fittings, and differences in operational equipment; (iii) discusses hydrogen storage technologies and environments; and (iv) evaluates compression characteristics and options.

- This study is being prepared as directed by CPUC Decision (D.22-12-055, Ordering Paragraph [OP] 6 (i)), to provide the findings from Phase 1 feasibility studies in support of “Identification and comparison of possible routes and configurations.”

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STAKEHOLDER INPUT SUMMARY

- Stakeholder engagement plays a pivotal role in the Angeles Link project to foster inclusive design and decision-making, build trust and transparency, and provide lasting benefits to the communities SoCalGas serves.

- Topics addressed in the Pipeline Sizing & Design Criteria study include but are not limited to:

General Suggestion	Action Taken
Evaluate and identify potential storage technologies	Storage technologies considered at a high-level in Underground Storage and Aboveground Storage sections
Consider Re-use of existing pipelines	Re-using existing natural gas pipelines is discussed in Repurposing Review section
Evaluate pipeline resiliency and redundancy in pipeline systems	Pipeline configuration resiliency and redundancy is evaluated in Preferred Route Configurations section

RELATIONSHIP TO OTHER STUDIES

- Preliminary pipeline routes have been developed as part of the Preliminary Routing/Configuration Analysis (OP 6 (i))
- The preliminary pipeline routes are subject to change and may be further refined, which will likely modify the findings of this study and other studies (e.g., High-Level Feasibility Assessment & Permitting Analysis)
- Data from the Production Planning and Assessment and Demand Study were used to inform sizing model assumptions
- Preliminary results from the Pipeline Sizing & Design Criteria study are being used to develop some cost estimates for High-Level Economic Analysis & Cost Effectiveness (OP 6 (d)) study
- "Safety considerations, pressures, and maintenance operations associated with design" are addressed in the Plan for Applicable Safety Requirements (OP 6 (f)) study

STUDY APPROACH

Gather input from production, demand, and routing studies

Model potential Angeles Link system and design

Evaluate pipe size, materials, compression, and storage requirements

Incorporate findings into future design and operations considerations

STUDY APPROACH

- Pipeline System
  - Production, Demand, and Routing study inputs were used to set hydraulic simulation* parameters
  - Multiple sizing options were considered; focused on maintaining reasonable pressure loss and providing operational resiliency
  - Sizing may be influenced by availability of storage to meet anticipated operating conditions over time
- Review of Hydrogen Storage Technologies and Environments
  - Explored potential aboveground and underground geologic technologies and environments, including salt caverns, hard rock caverns/mineshafts, and depleted oil and gas fields
  - Excludes storing hydrogen in chemical carriers, such as ammonia and dibenzyltoluene
- Compression Characteristics
  - Summarizes compression and associated energy requirements based on computer modeling results
  - Explores different types of compressor technologies available on the market

*Hydraulic simulation is a process in which a pipe network is modeled using physical attributes and theoretical equations. The results from a hydraulic model are used to analyze system behavior such as fluid velocity, pressure differences, and flow distribution.

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STUDY ASSUMPTIONS

- Pipeline system was hydraulically modeled using ProMax software with the following assumptions:
  - Steady-state conditions (parameters remain constant over time)
  - Model piping based on routing and elevation information from the Preliminary Routing/Configuration Analysis
  - Multiple scenarios to support annual throughput ranging from 0.5, 1.0, and 1.5 million metric tons per year
  - Third-party clean renewable hydrogen production potentially located in San Joaquin Valley, Lancaster, and Blythe based on input from the Production Planning and Assessment study
  - Potential compressor stations located near third-party production areas
  - Majority of demand and off-take concentrated in Los Angeles Basin (for modeling purposes only)

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PRELIMINARY FINDINGS – PIPELINE SYSTEM

- Preliminary pipeline system findings:
  - Pipe sizes ranging from 12-inch up to 36-inch in nominal diameter
  - One to three compressor stations, with reciprocating compressors (pending further engineering analysis)
  - Maximum Allowable Operating Pressure (MAOP) is approximately 1,200 pounds per square inch gauge (psig)
  - Lowest delivery pressure to the Ports of Los Angeles and Long Beach is approximately 200 psig
  - Select pipelines modeled as two-parallel lines (dual run) for functional flexibility

PRELIMINARY FINDINGS – PIPELINE SYSTEM

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- Preliminary Pipeline System Scenario results presented in table below
- Range of pipe and compressor sizes are similar to typical natural gas transmission system

Scenario[1]	Capacity, million metric tons/year	Primary Production Location[2]	Total Route Mileage	Range of Nominal Pipe Sizes	Total Compressor Stations	Range of Compressor Sizes
1	0.5	San Joaquin Valley (SJV)	355	12-in to 30-in	1	33,000 hp
2	0.5	Lancaster	314	12-in to 24-in	1	33,000 hp
3	0.5	Blythe	303	12-in to 30-in	1	33,000 hp
4	1.0	SJV, Lancaster	392	12-in to 36-in	2	33,000 hp (each)
5	1.0	Lancaster, Blythe	537	12-in to 30-in	2	33,000 hp (each)
6	1.0	SJV, Blythe	578	12-in to 30-in	2	33,000 hp (each)
7	1.5	SJV, Lancaster	390	16-in to 36-in	2	50,000 hp (each)
8	1.5	SJV, Lancaster, Blythe	616	12-in to 36-in	3	33,000 hp (each)

[1] For certain scenarios, select pipelines were modeled as dual-run for functional flexibility.
[2] Blythe scenarios were not carried through for detailed modeling.

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PRELIMINARY FINDINGS – UNDERGROUND STORAGE OPTIONS

- Angeles Link is proposed to be an intrastate hydrogen system that would transport clean renewable hydrogen between regional third-party production, storage, and end use areas within Central and Southern California.
- For purposes of evaluating potential future market conditions and thoroughly evaluating storage technology, this study compiles a dataset of identified potential underground hydrogen storage sites across California, Utah, Arizona, and New Mexico that include depleted reservoirs in oil and gas fields, salt caverns, and abandoned underground mines[1].
- Due to a lack of data regarding abandoned mines and saline aquifers, only oil and gas fields within California and salt basins across the 4-state area were further evaluated. A total of 297 oil and gas fields and 6 salt caverns were assessed for the geologic characteristics and feasibility for underground hydrogen storage facilities. The following geologic elements were assessed based on available information at the time of evaluation.

Depleted Oil & Gas Fields	Salt Caverns
Seal (leak prevention at top and sides)	Depth (storage pressure limitations)
Trap (container size and shape)	Form (suitability for cavern formation)
Reservoir (acceptable injection and recovery performance)	Roof Stability (regulatory/form constraints)
Loss Potential (biological and geochemical processes)	Rock Composition (geomechanical and geochemical stability)

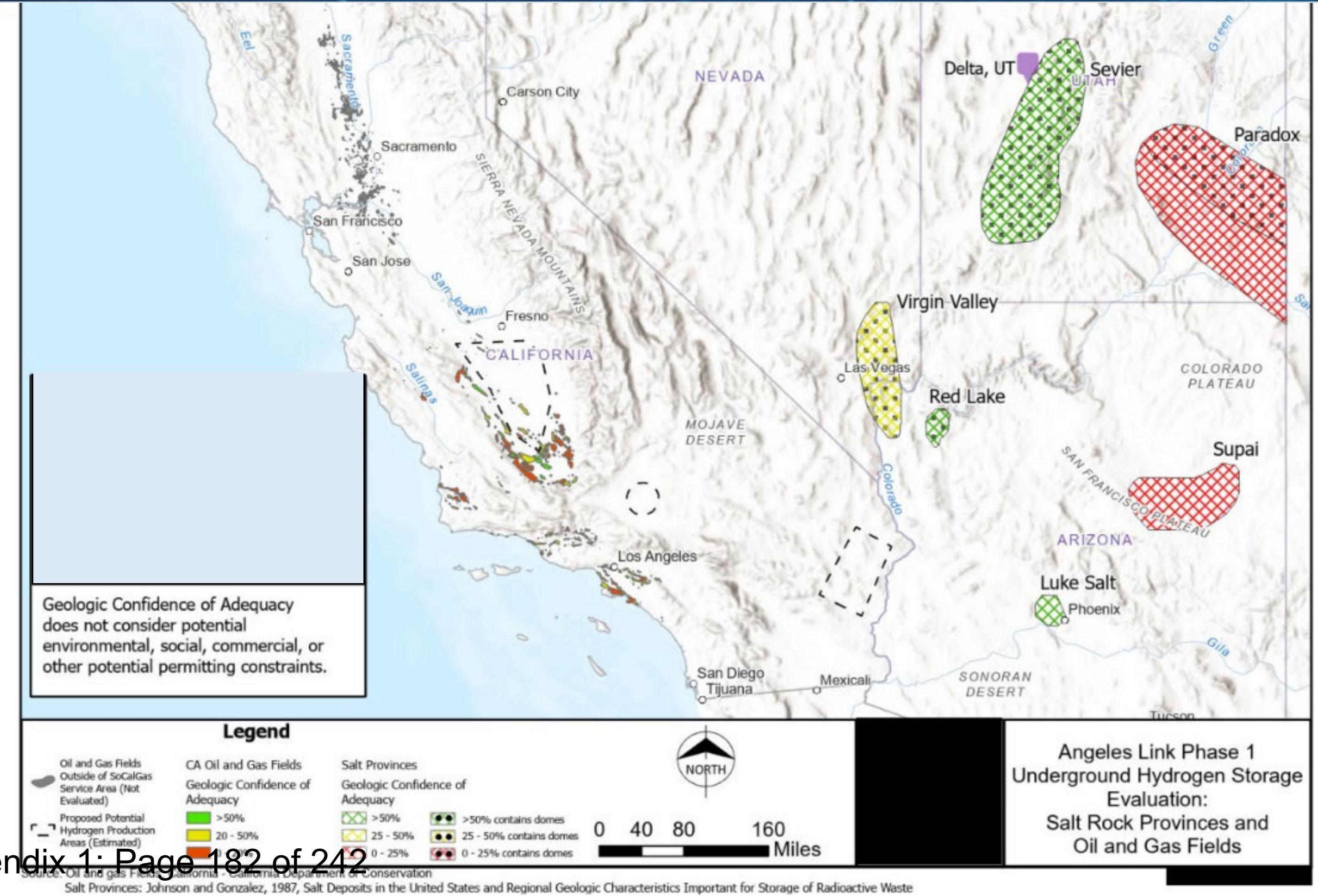
[1]This study contributes to a larger body of storage research projects SoCalGas supports, including: Department of Energy's Subsurface Hydrogen Assessment, Storage, and Technology Acceleration (SHASTA), Gas Technology Institute and Electric Power Research Institute's Low-Carbon Resources Initiative, the Pipeline Research Council International – Emerging Fuels Institutes, and the California Energy Commission's Grant Funding Opportunity (GFO-23-503) on the Feasibility of Underground Hydrogen Storage in California focusing on existing underground gas storage facilities.

PRELIMINARY FINDINGS – POTENTIAL UNDERGROUND STORAGE EVALUATED

- Geologic elements were assessed and assigned a confidence level from 0 to 1:
  - 0 indicates a high confidence of inadequacy
  - 1 indicates a high confidence of adequacy
  - 0.5 indicates uncertainty; in which either there is little data available, or the data do not clearly point to adequate or inadequate confidence
- The elements were multiplied to arrive at a composite relative “Geologic Confidence of Adequacy” level, ranging from 0-100% as shown on the map

Key Findings:

- Salt caverns likely provide the most commercially-tested underground storage option within the 4-state area
- Depleted oil and gas fields are promising candidates to provide local underground storage in California
- While SoCalGas facilities were evaluated for geologic adequacy because they are located within the study area, they are not currently being considered as storage options for Angeles Link.



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PRELIMINARY FINDINGS – POTENTIAL ABOVEGROUND STORAGE EVALUATED

- Several potential aboveground storage technologies were evaluated and presented below:

Storage Type	Physical Storage - Compressed Gas	Physical Storage - Liquid	Materials Storage – Metal Hydrides
Equipment Type	Cylinders, pressure vessels, tanks	Insulated spherical vessels, cylindrical tanks	Metal hydrides stored in containment systems
Typical Operating Conditions	5,000-10,000 psi, -40 to 185°F	Up to 150 psi, -423°F (cryogenic)	Varies depending on absorption process
Commercially Available Capacity per unit	Up to 20 tonne (20,000 kg) per cylinder	Up to 312 tonne (312,000 kg) per sphere	Up to 0.25 tonne (250 kg) per unit

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HIGH LEVEL FEASIBILITY ASSESSMENT & PERMITTING ANALYSIS

PRELIMINARY DATA AND FINDINGS

April 2024

SoCalGas

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LINK

STUDY INTRODUCTION

- The High-Level Feasibility Assessment & Permitting Analysis assesses at a high level the potential environmental and regulatory approvals, including federal, state and local environmental permitting and regulatory approvals, regulatory approval timing, and environmental constraints applicable to Angeles Link

- This study is being prepared in alignment with the CPUC Decision (D.22-12-055, OP 6 (i)), which requires SoCalGas to identify and compare possible routes and configurations for the Project

STUDY APPROACH AND INTERDEPENDENCIES

Develop Potential Pipeline Routes

Overlay Land Ownership and Environmental Constraints

Identify Potential Regulatory and Permitting Requirements

STUDY ASSUMPTIONS

- Pipeline routes are preliminary and subject to change and/or further refinement, which will likely modify the permitting preliminary findings
- Evaluation based on desktop level analysis with future permitting requirements to be determined during future phases
- Mapping relies on publicly available GIS data
- Potential pipeline routes are proximate to established pipeline, transportation or energy corridors and public rights-of-way to the extent feasible
- Pipelines will be constructed underground to the extent feasible, within a 100-foot corridor, and impacts from installation will be temporary.
- Permit timelines are based on regulatory requirements or published agency timelines where available and otherwise based on estimated regulatory agency turnaround time based on previous experience

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PRELIMINARY FINDINGS – FEDERAL

- Federal action will be required to authorize Angeles Link, and therefore the project will be subject to the National Environmental Protection Act (NEPA)
- Federal authorizations/permits along potential pipeline alignments may include:
  - Right-of-way grants for encroachment on land managed by the Bureau of Land Management
  - Encroachment on land under management by the Bureau of Reclamation
  - Activity impacting Waters of the U.S. under jurisdiction of U.S. Army Corps of Engineers
  - Activity impacting protected species under jurisdiction of the U.S. Fish & Wildlife pursuant to the Endangered Species Act (ESA)
  - Department of Defense easement acquisition
  - US Forest Service special use permit

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PRELIMINARY FINDINGS - STATE

- The California Public Utilities Commission (CPUC) will serve as the California Environmental Quality Act (CEQA) lead agency
- State authorizations/permits along potential pipeline alignments may include:
  - Encroachment permit(s) within Caltrans right-of-way
  - Crossing of aqueduct(s) subject to California Department of Water Resources (DWR)
  - Wetlands/waters under the jurisdiction of the State Water Resources Control Board pursuant to the federal Clean Water Act and California Water Code and California Department of Fish and Wildlife pursuant to the Fish and Game Code
  - Protected species under the jurisdiction of the California Department of Fish and Wildlife pursuant to the California Endangered Species Act (CESA)
  - State Lands Commission lease
  - California Department of Parks and Recreation special use permit

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PRELIMINARY FINDINGS – REGIONAL & OTHER PERMITS, ENVIRONMENTAL CONSTRAINTS AND TIMING CONSIDERATIONS

- Regional or other agency, entity authorizations, or permits along potential pipeline alignments may include:
  - Dust control plan by air quality management district/air pollution control district
  - Encroachment permit from Union Pacific Railroad
  - Right-of-way or easement acquisition from special districts for encroachment
- Environmental constraints identified for further evaluation and consideration of potential pipeline alignments, for example:
  - Protected species, wetlands/waters, critical habitat plans
- Permitting timing assumptions range from months to several years, based on:
  - Current agency regulations
  - Regulatory agency published timeframes as listed by the permitting agencies through publicly available resources
  - SoCalGas's consultant experience working with the applicable agencies and pipeline infrastructure permitting

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HIGH-LEVEL ECONOMIC ANALYSIS AND COST EFFECTIVENESS

PRELIMINARY DATA AND FINDINGS

May 2024

SoCalGas

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STUDY INTRODUCTION

- The High-Level Economic Analysis & Cost Effectiveness study uses a methodology to measure cost effectiveness that includes gathering cost estimates, performing an economic analysis to determine the potential levelized cost of delivered clean renewable hydrogen (LCOH) to end users, and comparing the cost effectiveness of Angeles Link against various project alternatives.

- This study is being prepared as directed by CPUC Decision (D.22-12-055, Ordering Paragraph [OP] 6 (d)), requiring SoCalGas to evaluate the cost effectiveness of the Project against alternatives and determine a methodology to measure cost effectiveness between alternatives.

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RELATIONSHIP TO OTHER STUDIES

- **Project Options and Alternatives** – The selected alternatives from the Project Options and Alternative study will be evaluated in the High-Level Economics and Cost Effectiveness study. The costs will then be reflected in Project Options and Alternatives Study.
- **Pipeline Sizing and Design** – The estimated costs for pipeline and compression from the Preliminary Pipeline Sizing and Design (OP 6 (i)) will be used to compare Angeles Link to alternatives.
- **Production –** The estimated hydrogen production costs developed in the Production study will be used as an input to estimate the levelized cost of hydrogen.
- **Water –** The estimated water related costs from the Water Resources Evaluation study will be used (as needed) as an input to estimate the levelized cost of hydrogen.

STUDY APPROACH

- This study will compare the estimated costs of Angeles Link to the selected alternatives from the Project Options and Alternatives study.
- The Project Options and Alternatives study grouped the selected alternatives into two categories:

1. Hydrogen Delivery Alternatives[1]
    - Trucking – Gas and Liquid trucking
    - Shipping – Liquid hydrogen shipping and methanol hydrogen shipping
    - In-basin hydrogen production using electric transmission and distribution
    - Localized Hub
2. Non-Hydrogen Alternatives
    - Electrification
    - CCS

[1] Hydrogen delivery alternatives used the scope configurations designed for Angeles Link. The cost assumptions were determined using public literature and proprietary modeling.

COST EFFECTIVENESS METHODOLOGY

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- The study will compare estimated costs for the Project against selected alternatives using metrics noted in the table below.

Hydrogen Delivery Alternatives	Non-Hydrogen Alternatives
▪ Comparison metric is Levelized Cost Of Hydrogen (LCOH)[1]	▪ Comparison metrics vary based on end-use: ▪ Power Sector - Levelized Cost of Electricity (LCOE)[2] ▪ Mobility Sector – Total Cost of Ownership (TCO)[3] ▪ Industrial Sector – LCOE and LCOH (metric is use case dependent (e.g., LCOE for co-generation, LCOH for refining)

1. The levelized cost of hydrogen is a common metric used to benchmark cost competitiveness of hydrogen taking into account the investments required to produce and deliver hydrogen to an end-user. This methodology enables different production and delivery routes to be compared on a similar basis.
2. The levelized cost of electricity is a common metric used to benchmark the cost competitiveness of producing electricity taking into account the investments required to produce and deliver electricity to an end-user. LCOE with hydrogen would use hydrogen to generate electricity; LCOE for electrification would use other, non-hydrogen renewables to generate electricity; LCOE with Carbon Capture would use natural gas with a carbon capture and sequestration investment.
3. Total cost of ownership is a common metric used to benchmark cost competitiveness when comparing different fuels in the mobility sector. TCO takes into account the vehicle's cost, operation and maintenance.

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DATA SOURCES FOR STUDY ASSUMPTIONS

Theme	Item	Data Source for Angeles Link	Data Source for Alternatives
Production	Scale, Capex, and Opex*	Production Study	Production Study
Storage	Storage needs	Production Study	Production Study
	Capex, Opex	*Int'l Journal of Hydrogen* - adjusted for project storage needs, Production Study for H_2 purification costs	Storage assumptions in the analysis of alternatives are identical to those for Angeles Link for underground storage, and sourced from public literature for above ground storage and proprietary modeling
Midstream	System Configuration	Pipeline Sizing and Design Criteria Analysis	Pipeline Sizing and Design Criteria Analysis
	Capex	SoCalGas	Public literature and proprietary modeling
	Opex	SoCalGas Inputs and proprietary modeling	

* Capex: capital expenditure, Opex: operations and maintenance expenses

STUDY ASSUMPTIONS
Non-Hydrogen Alternatives

End-use	Angeles Link	Non-Hydrogen Alternatives		Metrics	Sources
		Electrification	CCUS		
Mobility *(HD trucks and transit buses)*	Fuel cell electric vehicles	Battery electric vehicles	Not applicable to use case	TCO ($/mi)	Models supplemented by national lab and CA based assumptions
Power	Hydrogen power plant	Battery energy storage	Gas + CCS power plant	LCOE ($/MWh)	Power service and other economic models
Industry *(varies by industry, example used Cement)*	Hydrogen Kiln	Electric Kiln	N/A	Fuel cost ($/MMBtu$_e$)	Models supplemented by CA-based assumptions

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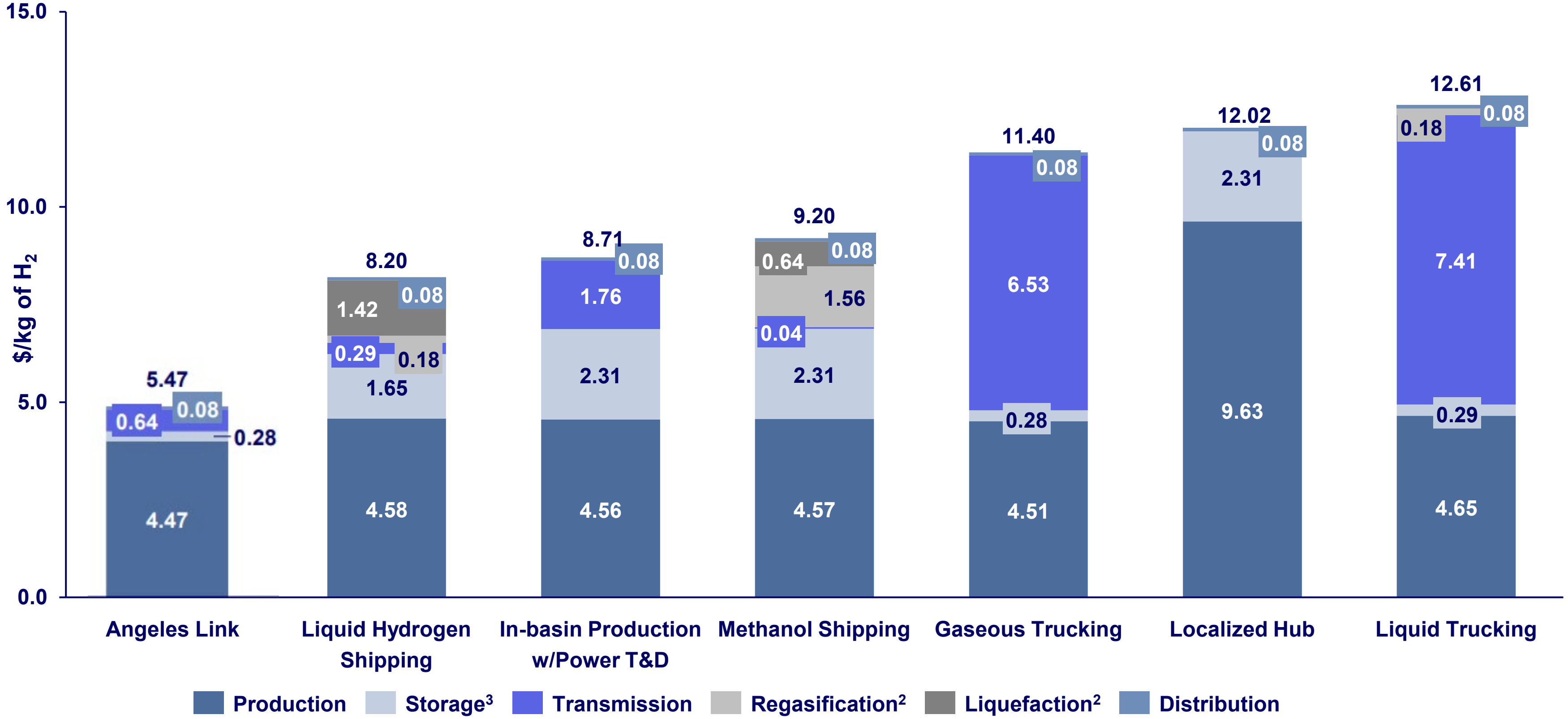
PRELIMINARY FINDINGS
Hydrogen Delivery Alternatives

Angeles Link and Hydrogen Delivery Alternatives LCOH[1], US$ 2024



1) Assumes commencement of construction in 2028 and it includes ITC/PTC as well as tax shields
2) Liquefaction and regasification – also includes conversion to methanol and vice versa for the methanol shipping alternative
3) Due to accessibility, we assumed underground storage for Angeles Link and trucking options, and above ground storage for the rest of the alternatives

Key Takeaways

- Pipeline is the most feasible and cost-effective solution to bring hydrogen into the LA Basin at scale
- Localized Hub feasibility is limited by the renewable electricity supply constraints and high cost of in-basin production
- Other delivery alternatives (trucking, shipping and in-basin production with T&D) are significantly more costly than Angeles Link

PRELIMINARY FINDINGS
Non-Hydrogen Alternatives - Electrification*

Alternative	Use Case	State Policy	Reliability & Resiliency	Maturity	Scalability	End-User Req'mens	Cost Eff.*	Key Findings
Angeles Link	Power							• Molecules are easier to store than electrons, supporting system reliability • While battery storage is mature and simpler to deploy at scale, it is cost-prohibitive to overbuild for longer duration system reliability needs without advances in other Long Duration Energy Storage (LDES) technologies
Electrification								
Angeles Link	Mobility							• Molecule-based storage and refueling is more reliable and resilient • Fuels are better suited to serve the operational requirements of long-haul, high payload, high duty-cycle vehicles than batteries
Electrification								
Angeles Link	Food & Bev							• AL is more cost-effective for high heat applications. • Electrification is the more mature, scalable solution for low-medium heat applications
Electrification								
Angeles Link	Cement							• Molecules are easier to store than electrons, supporting system reliability • AL is more cost-effective than electrification.
Electrification								

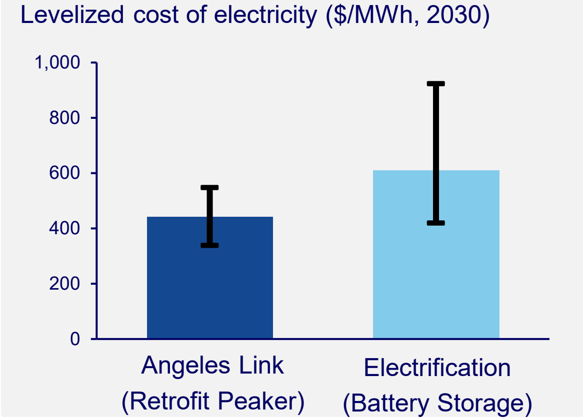
*The purpose of this slide is to illustrate the comparison between Angeles Link and the non-hydrogen alternatives. Cost effectiveness reflects the cost of the alternative indexed to the cost of Angeles Link

Highest Score — Lowest Score

ANGELES LINK

PRELIMINARY FINDINGS
Non-Hydrogen Alternatives - Electrification

Power
(peaking/reliability: 12 hour duration)

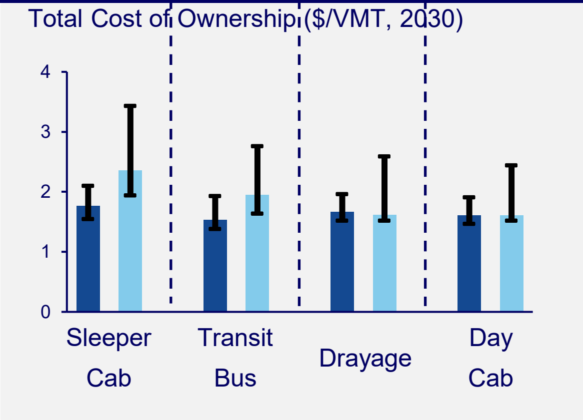


- High relative capital costs of oversized battery storage outweigh H2 fuel costs, making AL more cost-effective
- Maturation of other Long Duration Energy Storage (LDES) technologies like Compressed Air Energy Storage (CAES) and Vanadium Redox Flow Batteries (VRFB) will likely be needed to serve this role with electrification

Key Takeaways

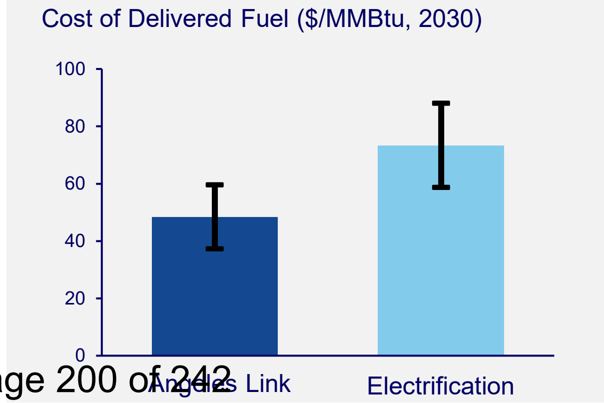
- Angeles Link is more economical to serve several key sectors of the California economy including:
  - Power
  - Mobility
  - High heat industrial processes

Mobility
(long-haul, heavy-duty)



- Fuel cell Electric Vehicles (FCEVs) are most cost-effective vs. Battery Electric Vehicles (BEVs) where faster refueling times offer operational cost savings
- Fuel/charging cost and operational patterns are largest drivers of sensitivity ranges
- FCEVs have technical advantages in applications with high duty cycles, long range requirements, and heavy payloads

Industry – Food & Beverage
(fuel switching)



- AL is cost-effective due to relatively high electricity tariffs in California
- Electrification of low-medium heat is more technically feasible

High-Level Economics and Cost Effectiveness Timeline

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PROJECT OPTIONS AND ALTERNATIVES

PRELIMINARY DATA AND FINDINGS

May 2024

SoCalGas

STUDY INTRODUCTION

- This study evaluates project options and alternatives, including electrification and a localized hydrogen hub.

- This study is being prepared as directed by CPUC Decision (D.22-12-055, Ordering Paragraph [OP] 6 (d)), requiring SoCalGas to consider and evaluate project alternatives, including a localized hydrogen hub or electrification.

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RELATIONSHIP TO OTHER STUDIES

- **Pipeline Sizing & Design** - Preliminary results of the pipeline sizing and design analysis will help develop a high-level cost estimate for Angeles Link, which will be compared against hydrogen delivery alternatives (e.g., trucking and shipping) and non-hydrogen alternatives (e.g., electrification and renewable natural gas).

- **High-Level Economics and Cost-Effectiveness** - Alternatives that meet the criteria established in the Project Options and Alternatives study (e.g., electrification) will be carried forward to the High-Level Economics and Cost Effectiveness study

- **Environmental & Environmental Social Justice Analysis** - Alternatives that meet the criteria established in the Project Options and Alternatives study will be carried forward to the Environmental & Environmental Social Justice Analysis study

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STUDY APPROACH

The study approach is noted in the six steps below:

Step 1

Identify potential alternatives including localized hub

Step 2

Evaluate potential alternatives against identified criteria

Step 3

Dismiss alternatives that fail to satisfy step 2 criteria

Step 4

Select alternatives to carry forward for further analysis

Step 5

Feed alternatives into cost effectiveness study and environmental & social justice studies

Step 6

Incorporate findings from cost effectiveness & environmental studies and evaluate alternatives' fulfillment of purpose and need.*

**The Scope of Work Descriptions for the Project Options and Alternatives study identified the underlying purpose and need for Angeles Link, including supporting the State's decarbonization goals.*

PORTFOLIO OF POTENTIAL ALTERNATIVES

Screening List

Step 1

Identify potential alternatives including localized hub

<u>Hydrogen Delivery Alternatives</u>

1. Localized hub
2. Power Transmission & Distribution (T&D) with in-basin hydrogen production
3. Liquid hydrogen trucking
4. Gaseous hydrogen trucking
5. Liquid hydrogen shipping
6. Methanol shipping
7. Ammonia shipping
8. Hybrid of compressed truck + liquid train

<u>Non-Hydrogen Alternatives</u>

1. Electrification
2. Carbon Capture & Storage (CCS)
3. Other clean fuels and technologies evaluated for specific use cases and screened out include:
   - Renewable Natural Gas (RNG)
   - Energy efficiency
   - Nuclear
   - Hydro
   - Geothermal
   - Plug-in Hybrid
   - Biofuels, and
   - Ethanol

SCORING CRITERIA FOR ALTERNATIVES

- Alternatives were mapped across a set of various criteria based on the delivery type

Step 2

Evaluate potential alternatives against identified criteria

Delivery Alternatives		State Policy	Technological Maturity	Range	Reliability & Resiliency	Ease of Implementation	End User Requirements	Scalability
Hydrogen	**Angeles Link** 1.Localized hub 2.Power Transmission &Distribution (T&D) with in-basin hydrogen production 3.Liquid hydrogen trucking 4.Gaseous hydrogen trucking 5.Liquid hydrogen shipping 6.Methanol shipping 7.Ammonia shipping 8.Hybrid of compressed truck + liquid train	✓		✓	✓	✓		✓
Non - Hydrogen	**Angeles Link** 1. Electrification 2. CCS	✓	✓		✓	✓	✓	✓

SCORING CRITERIA EVALUATION EXAMPLE (HYDROGEN DELIVERY ALTERNATIVES)

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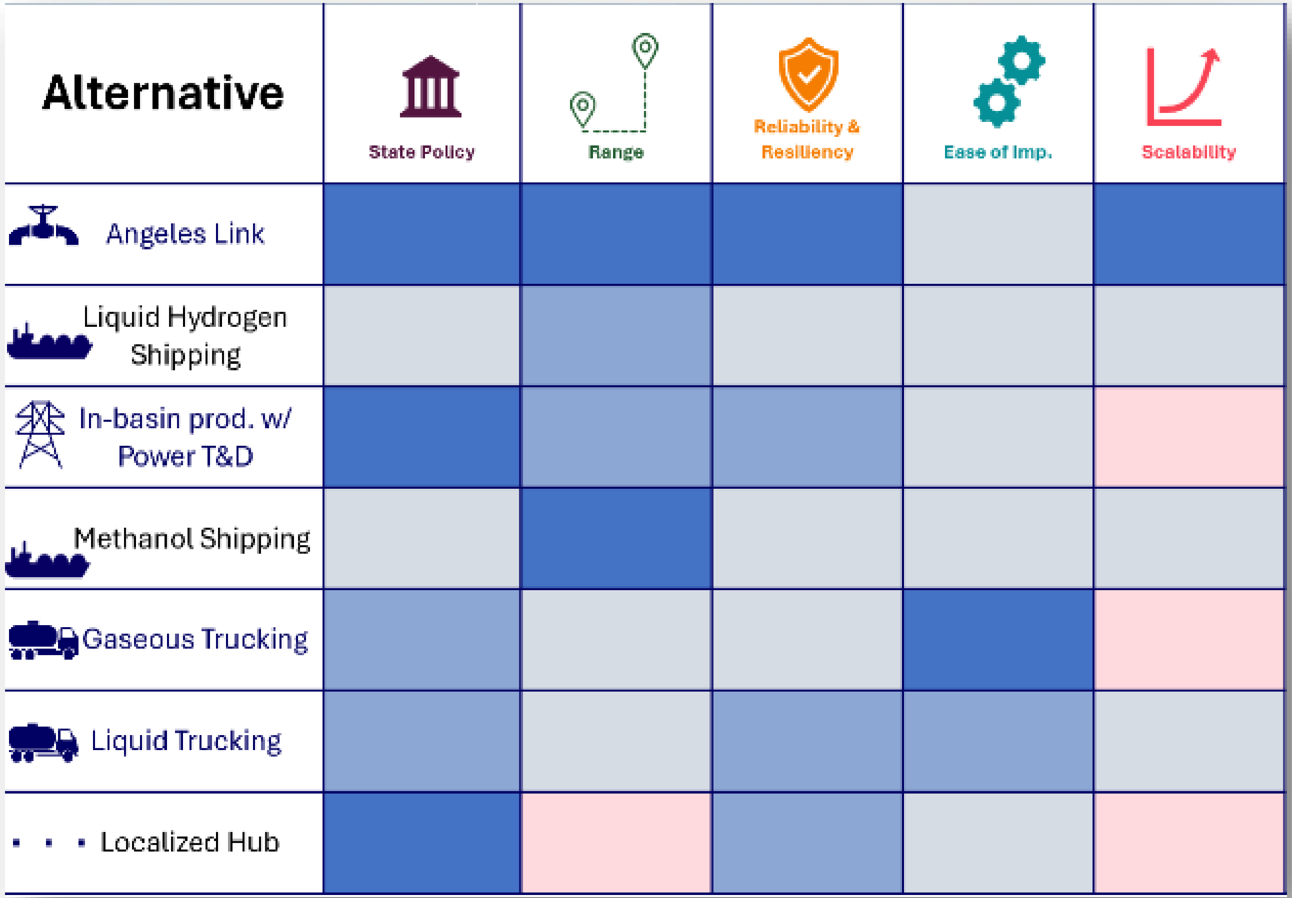
Step 2
Evaluate potential alternatives against identified criteria

- In order to be further evaluated, alternatives must meet a set of criteria, including:
  1. **Alignment with California's Environmental Law and Public Policies**
     - California Air Resources Board (CARB) 2022 Scoping Plan and Advanced Clean Fleets regulation
     - Executive Order N-79-202 re: deployment of zero-emissions vehicles
  2. **Range** – ability to effectively deliver hydrogen to support needs
  3. **Reliability and Resiliency** – support overall energy reliability and resiliency
  4. **Ease of Implementation** – can the alternative be implemented considering existing infrastructure
  5. **Scalability** – does the alternative have the scaling potential to meet expected future needs



Illustrative scoring framework against identified criteria for hydrogen delivery alternatives

Highest Lowest

ALTERNATIVES CARRIED FORWARD

- The established criteria determined which alternatives would move forward for cost-effectiveness analysis and environmental & social justice analysis.

Step 3

Dismiss alternatives that fail to satisfy step 2 criteria

Step 4

Select alternatives to carry forward for further analysis

Step 5

Feed alternatives into cost effectiveness study and environmental & social justice studies

Alternatives Carried Forward*

- Hydrogen Delivery Alternatives
  - Gaseous hydrogen trucking
  - Liquid hydrogen trucking
  - Liquid hydrogen shipping
  - Methanol shipping
  - In-basin production using transmission & distribution
  - Localized hub
- Non-Hydrogen Alternatives
  - Electrification
  - CCS

***Excluded Hydrogen Delivery Alternatives to the LA Basin:**

1. Train Delivery excluded due to long loading time challenges and schedules, inflexible routes and limited scale.
2. Ammonia Shipping excluded due to the Haber-Bosch process to convert hydrogen to ammonia which needs to be running 24/7 and is infeasible with solar power constraints.

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HYDROGEN DELIVERY PATHWAYS DESCRIPTION

Gaseous Trucking

Hydrogen produced at the defined production locations is compressed and loaded at production facilities, then transported to end users via compressed hydrogen trucks.

Liquid Trucking

Hydrogen produced at the defined production locations is liquefied and loaded at production site, then transported to end users via liquid hydrogen trucks.

Liquid Hydrogen Shipping

Specialized vessels that will transport liquid hydrogen to LA area, to be transferred into liquid storage spheres and then regasified.

Methanol Shipping

Vessels that will transport methanol from Northern CA to LA area. Methanol is then transferred into a methanol-to-hydrogen reconversion facility as liquid hydrogen before regasified at the terminal.

In-basin production using Transmission & Distribution

Transmit renewable energy as electrons through multiple high voltage lines to the LA Basin for hydrogen production in-basin.

Localized Hub

As part of Phase One, SoCalGas must study the feasibility of a localized clean renewable hydrogen hub solution located in the Los Angeles Basin, with hydrogen generation and end users in close proximity.

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NON-HYDROGEN ALTERNATIVES DESCRIPTIONS

Electrification

Electrification refers to a combination of **system level** transformation and **use-case level*** technology changes including the grid infrastructure required to support growing electric load. In our analysis we used the use case level.

CCS

CCS refers to the carbon capture and sequestration technology as an alternative means of meeting the purpose and need of Angeles Link.

**Use-case level electrification implies "replacing technologies or processes that use fossil fuels, like internal combustion engines and gas boilers, with electrically-powered equivalents, such as electric vehicles or heat pumps." (EIA)*

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PRELIMINARY FINDINGS
Hydrogen Delivery Alternatives*

Step 6
Incorporate findings from cost effectiveness & environmental studies and evaluate alternatives' fulfillment of purpose and need.

Alternative	State Policy	Range	Reliability & Resiliency	Ease of Imp.	Scalability	Env. Impact	Cost Effectiveness	Key Findings
Angeles Link						Pending Environmental Impact Study Results		Appropriate for distance/scale.
Liquid Hydrogen Shipping								Efficient long-distance transportation of H_2, requires specialized handling and above ground storage facilities.
In-basin prod. w/ Power T&D								In-basin hydrogen production incurs additional electric T&D costs, and is also limited by hard to resolve transmission constraints. Scalability limited by above ground storage need.
Methanol Shipping								Requires additional processing steps, specialized handling and storage facilities. Suitable for relatively long-distances.
Gaseous Trucking								Quickly deployable. Scalability of on-road transportation is limited.
Liquid Trucking								Quickly deployable. Scalability of on-road transportation is limited. Higher costs due to storage and loading costs.
Localized Hub								Limited scalability and higher costs.

*The purpose of this slide is to illustrate the comparison between Angeles Link and the hydrogen delivery alternatives.

Highest — Lowest

PRELIMINARY FINDINGS
Non-Hydrogen Alternatives

Electrification

- Electrification was assessed both at a system level and on a use-case level. Evaluation of system-level electrification comprised a high-level review of existing research, third-party studies, and California policies.
- Comprehensive system-level electrification would require detailed load forecasting, power system dispatch modeling and power flow studies, and therefore is outside of the scope for Phase 1.

Power: Angeles Link system, coupled with long-term energy storage has the potential to serve clean molecules to support clean firm power generation, cannot be replicated by a combination of renewable power and battery storage.	**Mobility:** Angeles Link is better suited to serve the operational requirements of heavy-duty, long-range applications.	**Industrial:** Clean renewable hydrogen delivered by Angeles Link is competitive with electrification.

CCS

- CCS provides a potential pathway to support California's decarbonization goals, but it is reliant on sufficient scale and utilization of supporting infrastructure.
- In sectors such as Power, Cogeneration, and Cement, CCS can be cost effective, but adoption will be determined by the availability of siting carbon capture equipment, development of supporting transport and storage infrastructure, and aggregation of emissions to achieve scale.
- Angeles Link is well-positioned to serve the sectors and facilities where CCS is not viable or other policy and regulatory considerations.

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PRELIMINARY FINDINGS
Non-Hydrogen Alternatives - Electrification*
Based on Use Case

Alternative	Use Case	State Policy	Reliability & Resiliency	Maturity	Scalability	End-User Req'mens	Env. Impact	Cost Eff.	Key Findings
Angeles Link	Power						Pending Environmental Impact Study Results		• Molecules are easier to store than electrons, supporting system reliability • While battery storage is mature and simpler to deploy at scale, it is cost-prohibitive to overbuild for longer duration system reliability needs without advances in other Long Duration Energy Storage (LDES) technologies
Electrification									
Angeles Link	Mobility								• Molecule-based storage and refueling is more reliable and resilient • Fuels are better suited to serve the operational requirements of long-haul, high payload, high duty-cycle vehicles than batteries
Electrification									
Angeles Link	Industrial Heat								• AL is more cost-effective for high heat applications. • Electrification is the more mature, scalable solution for low-medium heat applications
Electrification									
Angeles Link	Cement								• Molecules are easier to store than electrons, supporting system reliability • AL is more cost-effective than electrification.
Electrification									

*The purpose of this slide is to illustrate the comparison between Angeles Link and the non-hydrogen delivery alternatives.

Highest Score — Lowest Score

SUMMARY

- The study follows a 6-step process to identify, evaluate, and carry forward select alternatives to the High-Level Economics and Cost Effectiveness study and the Environmental & Environmental Social Justice study.
- Project options and alternatives evaluation include:
  1. Hydrogen delivery alternatives including the localized hub
  2. Non-hydrogen delivery alternatives including electrification
- Alternatives are evaluated based on a set criteria focusing on alignment with California's clean energy policies, range of deliverability, energy reliability and resiliency, ease of implementation, scalability, technological maturity, and end user requirements.
- Shortlisted alternatives include:

Hydrogen Delivery Alternatives	Non-Hydrogen Alternatives
▪ Gaseous Trucking ▪ Liquid Trucking ▪ Liquid Hydrogen Shipping ▪ Methanol Shipping ▪ In-basin production using transmission & distribution (T&D) ▪ Localized Hub	▪ Electrification ▪ CCS

- The last step, step 6, provides an analysis that incorporates cost-effectiveness and environmental findings and assesses purpose and need.

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FEEDBACK

- Number of stakeholders commented[1] on our study methodology, including but not limited to, Communities for a Better Environment, Food and Water Watch, Utility Consumers' Action Network, and Air Products

Thematic Comments	Plan to Incorporate/Address
As SoCalGas continues studying options and alternatives, demystifying hydrogen for the average consumer should also be considered, especially given the DOE award and partnership with ARCHES	SoCalGas will continue using PAG/CBOSG engagement to help expand education around hydrogen's relationship with California's decarbonization goals, reducing emissions in disadvantaged communities, and enhancing reliability and resiliency.
Do not include methane, fossil gas enabled alternatives. Electrification is a clean, safe, and affordable way to meet California and Los Angeles's climate goals.	• Analysis will advance those alternatives that support California's decarbonization policies. • While hydrogen can be a zero-carbon enabler of electrification and Angeles Link focuses on the hard-to-electrify sectors, electrification is included as an alternative in Project Options & Alternatives and will be evaluated as such in the cost effectiveness study and environmental and environmental social justice study.

1. All comments are available on the living library in the Comment Letters folder located on the Homepage. https://arellanoassociates.sharepoint.com/sites/SCGAngelesLink

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FEEDBACK, CONT'D

Thematic Comments	Plan to Incorporate/Address
Include localized hub, electrification of end uses, trucking and marine shipping, and behind-the-meter green hydrogen production and use of electrolyzers powered by on-site renewables or grid-delivered renewable electricity.	• Localized hub, electrification of end uses, trucking, and marine shipping are being addressed as part of the Project Options and Alternatives study. • The Production Planning & Assessment Study will analyze production of electrolytic hydrogen powered by on-site renewables and curtailed renewables when feasible.
Compare private merchant pipeline investment options in relation to Angeles Link	• Investor-owned utilities such as SoCalGas are "the private sector." Unlike Angeles Link, a private merchant pipeline is not dedicated to public use subject to transparency, non-discrimination requirements, rate regulation, or other regulatory oversight. Input received to date has not included information on an alternative private merchant pipeline for consideration in this study that would meet the Project's purpose and need.

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Project Options and Alternatives Timeline

September 2023
PAG/CBO
Technical Approach
Presentation

June 2024
PAG/CBO
Prelim. Findings
Presentation

June 2024
PAG/CBO
Draft Study
Issued for Review

June/July 2024
PAG/CBO
Comment
Incorporation

August 2024
Study
Publication

Phase 2
Future
Considerations

Today

ENVIRONMENTAL & ENVIRONMENTAL SOCIAL JUSTICE ANALYSIS

PRELIMINARY DATA AND FINDINGS

June 2024

ANGELES LINK

STUDY INTRODUCTION

- The Environmental & Environmental Social Justice Analysis study evaluates at a high level the potential environmental impacts associated with the construction and operation and maintenance of Angeles Link, as well as the potential environmental and social impacts associated with potential alternatives to the project.
- This study also identifies environmental justice communities that may be impacted by the project. Based on stakeholder input, the ESJ Analysis will be included in a larger Environmental Social Justice Plan.
- This study is being prepared as directed by CPUC Decision (D.22-12-055, Ordering Paragraph [OP] 6 (l) and (n)), to provide plans for addressing and mitigating impacts to disadvantaged communities and other environmental justice concerns and to provide the findings from Phase 1 feasibility studies demonstrating the project’s compliance with environmental law and public policies.

STUDY APPROACH

Review potential pipeline routes and project alternatives

Evaluate potential impacts of Angeles Link and alternatives in topic areas*, including environmental justice, based on publicly available datasets

Apply study findings in future routing refinements

*Study describes existing conditions along 1,300 miles of potential pipeline routes and evaluates topic areas of air quality, greenhouse gas emissions, biological resources, cultural and tribal cultural resources, energy, hazards and hazardous materials, hydrology and water quality, and land use and planning. ESJ Analysis will be included in a larger Environmental Social Justice Plan.

RELATIONSHIP TO OTHER STUDIES AND PROCEEDINGS

- Preliminary pipeline routes have been developed as part of the Preliminary Routing/Configuration Analysis (Routing Study) (OP 6 (i)) and project alternatives have been analyzed as part of the project Options and Alternatives study (OP 6 (d))

- Preliminary pipeline routes are subject to change and will be further refined, which will further inform the environmental analysis of the project in future phases

- SoCalGas previously mapped disadvantaged and vulnerable communities within its service territory as part of the Climate Adaptation Plan Order Instituting Rulemaking (OIR), incorporating data from CalEnviroScreen, which is available for public access here: SoCalGas Disadvantaged and Vulnerable Communities (arcgis.com)

STUDY ASSUMPTIONS

- Results and impact analysis are based upon publicly available datasets and information
- Pipeline would be located underground and within previously disturbed areas to the extent feasible
- Study evaluated potential impacts that could occur within 100 feet of each side of the proposed pipeline corridors for certain topic areas (i.e., air quality, greenhouse gas emissions, biological resources, energy, hazards and hazardous materials, hydrology and water quality, land use and planning, and environmental justice), and within a 0.25 miles of the proposed pipeline corridors for cultural/tribal cultural resources
- Construction of the pipeline could be in stages
- Operational activities are considered for a 30-year period

PRELIMINARY FINDINGS - ENVIRONMENTAL LAWS AND PUBLIC POLICIES

- This preliminary evaluation indicates that Angeles Link can be constructed and operated in accordance with environmental laws and public policies.
- This study determines that the project may lead to potential impacts from construction and operation and maintenance (O&M) activities in all resources analyzed in this study.
- Potential environmental impacts will continue to be analyzed once preferred pipeline routes are identified at the conclusion of Phase 1. This additional analysis will be used to help refine the preferred routes in Phase 2 to avoid and minimize potential environmental impacts. The extent of potential impacts will not be known until the project is refined and engineering is developed.
- The project is expected to undergo review pursuant to the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA) at the conclusion of Phase 2, in compliance with applicable environmental laws.
- The project is being undertaken in furtherance of the State's climate goals, as outlined in Assembly Bill (AB) 32 and the Climate Change Scoping Plan to "scale up new options such as renewable hydrogen for hard-to-electrify end uses and biomethane where needed" and Governor's Executive Order to develop California's Hydrogen Market Development Strategy.
  - Governor Newson: "California is all in on clean, renewable hydrogen – an essential aspect of how we'll power our future and cut pollution." Governor Newsom Announces New Strategy to Develop a Hydrogen Economy of the Future | California Governor

Evaluation of Alternatives

IDENTIFICATION OF POTENTIAL ALTERNATIVES

Alternatives are evaluated in the project Options and Alternatives study

- Project options include potential pipeline routes which are evaluated in the Preliminary Routing/Configuration Analysis
- Seven criteria used in project Options and Alternatives study to determine which alternatives to advance for further evaluation:
    - Compatibility with State Policy – does the alternative align with California's Clean Energy and Environmental Policies
    - Range – does the alternative have the ability to effectively deliver hydrogen to demand
    - Reliability and Resiliency – does the alternative support energy reliability and resiliency
    - Ease of Implementation – can the alternative be implemented considering existing infrastructure
    - Scalability – does the alternative have the scaling potential to meet expected future needs
    - Technological Maturity* – based on current level of technology readiness, is the alternative likely to be commercially available within the project timeframe
    - End User Requirements* – does the alternative support potential end use cases

*These assumptions are specific to non-hydrogen alternatives

EVALUATION OF PROJECT ALTERNATIVES

- **Angeles Link and eight (8) alternatives** were evaluated according to environmental topic areas
  - Air quality, cultural and tribal cultural resources, biological resources, energy, greenhouse gas emissions, hazards and hazardous materials, hydrology and water quality, land use and planning
- Study identifies "**potential impact**" or "**no impact**" in each topic area given currently available project information

Hydrogen Delivery Alternatives	Non-Hydrogen Alternatives
▪ Alt. 1: Gaseous Trucking ▪ Alt. 2: Liquid Trucking ▪ Alt. 3: Liquid Hydrogen Shipping ▪ Alt. 4: Methanol Shipping ▪ Alt. 5: In-basin hydrogen production using transmission and distribution (In-basin) ▪ Alt: 6: Localized Hub	▪ Alt. 7: Electrification ▪ Alt. 8: Carbon Capture Utilization & Storage (CCUS)

- During the preferred route selection process in Phase 2, SoCalGas intends to continue route optimization processes, with consideration for a variety of factors that seek to avoid, minimize, and mitigate potential impacts while maximizing operational efficiency and safety. Moreover, the evaluation does not account for inclusion of such measures adopted during the CEQA/NEPA process.
- Findings are preliminary and do not account for the potential benefits from end-users of the clean energy delivered by each alternative/project; for example, a project with less impacts may not have the same benefits

HYDROGEN DELIVERY PATHWAYS ALTERNATIVES

Gaseous Trucking

Hydrogen produced at the defined production locations is compressed and loaded at production facilities, then transported to end users in Central and Southern California via compressed hydrogen trucks.

Liquid Trucking

Hydrogen produced at the defined production locations is liquefied and loaded at production site, then transported to end users in Central and Southern California via liquid hydrogen trucks.

Liquid Hydrogen Shipping

Specialized vessels that will transport liquid hydrogen to LA area, to be transferred into liquid storage spheres and then regasified.

Methanol Shipping

Vessels that will transport methanol from Northern CA to LA area. Methanol is then transferred into a methanol-to-hydrogen reconversion facility as liquid hydrogen before regasified at the terminal.

In-basin production using Transmission & Distribution

Transmit renewable energy as electrons through multiple high voltage lines to the LA Basin for hydrogen production in-basin.

Localized Hub

As part of Phase One, SoCalGas must study the feasibility of a localized clean renewable hydrogen hub solution located in the Los Angeles Basin, with hydrogen generation and end users in close proximity.

NON-HYDROGEN ALTERNATIVES

Electrification

Electrification refers to a combination of **system level** transformation and **use-case level*** technology changes including the grid infrastructure required to support growing electric load. For purposes of evaluating potential environmental impacts of the project and alternatives, the environmental high-level assessment evaluated impacts of the system level transformation.

CCS

CCS refers to the carbon capture and sequestration technology as an alternative means of meeting the purpose and need of Angeles Link.

**Use-case level electrification refers to "replacing technologies or processes that use fossil fuels, like internal combustion engines and gas boilers, with electrically-powered equivalents, such as electric vehicles or heat pumps." (EIA)*

Assessment Criteria*	High-Level Assessment
Air Quality • Conflict with or obstruct implementation of an applicable air quality plan; result in a cumulatively considerable net increase of criteria pollutants; expose sensitive receptors to pollutant concentrations; result in other emissions adversely affecting a substantial number of people	• The project and alternatives are expected to have construction and operational impacts to air quality. • For example, for various alternatives, impacts may occur from construction and operation activities, including pipeline and electric transmission line construction, vehicle miles traveled from truck trips, nautical miles traveled from ships, and from construction of liquefaction and regassification facilities.
Biological Resources • Direct or indirect impacts to candidate, sensitive, or special status species or modification of their habitat,-impacts to any riparian habitat, wetlands, or other sensitive natural community; interference with movement of native resident or migratory fish or wildlife species or with established wildlife corridors; conflict with local policies protecting biological resources, provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved habitat conservation plan.	• The project and alternatives are expected to have construction and operational impacts to biological resources. • For example, for various alternatives, impacts may occur, including for pipeline and electric transmission line construction, vehicle miles traveled from truck trips, and nautical miles traveled from ships. • For certain construction activities, potential impacts may occur in previously-disturbed areas. • Potential impacts during operational phases of certain facilities, such as underground pipelines or electric transmission lines during periodic operations and maintenance activities.

**The high-level assessment uses applicable questions from the CEQA Guidelines Appendix G as a framework to evaluate potential impacts in selected resource areas. Findings are preliminary and high level and therefore 1) do not represent if an impact is significant from the CEQA/NEPA perspective nor address the magnitude of the impact; 2) do not capture all impact areas that will be evaluated in a CEQA/NEPA document; and 3) do not account for the project's or alternatives' benefits, including those benefits from the use of the clean energy delivered by the project or alternative.*

Assessment Criteria*	High-Level Assessment
Cultural Resources • Cause substantial adverse change(s) in the significance of historical and/or archaeological resources, or disturbance of human remains.	• The project and alternatives are expected to have construction and operational impacts to cultural resources. • For example, for various alternatives, impacts may occur from pipeline and electric transmission line construction. • For certain construction activities, potential impacts may occur in previously-disturbed areas. • Potential impacts may occur during periodic operational and maintenance phases of certain facilities, such as underground pipelines or electric transmission lines.

**The high-level assessment uses applicable questions from the CEQA Guidelines Appendix G as a framework to evaluate potential impacts in selected resource areas. Findings are preliminary and high level and therefore 1) do not represent if an impact is significant from the CEQA/NEPA perspective nor address the magnitude of the impact; 2) do not capture all impact areas that will be evaluated in a CEQA/NEPA document; and 3) do not account for the project's or alternatives' benefits, including those benefits from the use of the clean energy delivered by the project or alternative.*

Assessment Criteria*	High-Level Assessment
Energy • Wasteful, inefficient, or unnecessary consumption of energy resources; conflict with state or local plans for renewable energy or energy efficiency.	• The project and alternatives are not expected to result in the wasteful, inefficient, or unnecessary consumption of energy. • Potential impacts from alternatives, such as trucking and shipping, may require energy consumption through diesel fuel. However, over time trucks and ships may transition to electric, hydrogen fuel-cells, or lower carbon intensive fuels. • For the project and some alternatives, periodic operations and maintenance could result in limited energy consumption. • The project and certain alternatives may temporarily conflict with state or local plans for renewable energy or energy efficiency during construction. For example, potential conflicts could occur during construction of pipelines, vehicle miles traveled from trucks, and nautical miles traveled from ships.
Greenhouse Gas Emissions • Generate GHG emissions, either directly or indirectly, including conflicts with applicable plans, policies, or regulations for reducing GHG emissions.	• The project and alternatives are expected to have construction and operational impacts related to GHG emissions. • For example, for various alternatives potential impacts are expected to occur from pipeline and electric transmission line construction, vehicle miles traveled from trucks, nautical miles traveled from ships, and construction of liquefaction and regassification facilities.

**The high-level assessment uses applicable questions from the CEQA Guidelines Appendix G as a framework to evaluate potential impacts in selected resource areas. Findings are preliminary and high level and therefore 1) do not represent if an impact is significant from the CEQA/NEPA perspective nor address the magnitude of the impact; 2) do not capture all impact areas that will be evaluated in a CEQA/NEPA document; and 3) do not account for the project's or alternatives' benefits, including those benefits from the use of the clean energy delivered by the project or alternative.*

PRELIMINARY FINDINGS – POTENTIAL ENVIRONMENTAL IMPACTS OF PROJECT & ALTERNATIVES

Assessment Criteria*	High-Level Assessment
Hydrology and Water Quality • Cause water quality degradation; groundwater depletion or recharge; alter existing drainage patterns; location within flood hazard; conflict with Water Quality Control or Ground Water Management plans.	• The project and alternatives are expected to have construction and operational impacts related to hydrology and water quality. • For example, for various alternatives, potential impacts are expected to occur from pipeline construction and construction of liquefaction and regassification facilities. • Construction activities for the project and alternatives could cause short-term water quality impacts, and/or could potentially conflict with water quality control or ground water management plans. • Construction activities for several facilities, such as underground pipelines, could be constructed in floodplains and/or cause erosion.

**The high-level assessment uses applicable questions from the CEQA Guidelines Appendix G as a framework to evaluate potential impacts in selected resource areas. Findings are preliminary and high level and therefore 1) do not represent if an impact is significant from the CEQA/NEPA perspective nor address the magnitude of the impact; 2) do not capture all impact areas that will be evaluated in a CEQA/NEPA document; and 3) do not account for the project's or alternatives' benefits, including those benefits from the use of the clean energy delivered by the project or alternative.*

PRELIMINARY FINDINGS – POTENTIAL ENVIRONMENTAL IMPACTS OF PROJECT & ALTERNATIVES

Assessment Criteria	High-Level Assessment
Land Use • Physically divide a community; conflict with existing plans, policies, or regulations.	• The project and alternatives could have construction and operational impacts, and associated impacts to communities, related to land use, such as electric transmission lines for the power transmission & distribution or electrification alternatives. • Depending on location of pipeline routes and other facilities, potential conflict could occur with existing land use plans, policies, or regulations.
Tribal Cultural Resources • Cause a substantial adverse change in the significance of a tribal cultural resource.	• The project and alternatives may have construction and operational impacts to tribal cultural resources. • For example, for various alternatives, potential impacts may occur in previously-disturbed areas, from pipeline and electric transmission line construction, construction of liquefaction and regassification facilities. • Potential impacts during periodic operational and maintenance phases of certain facilities such as underground pipelines or electric transmission lines may occur.

**The high-level assessment uses applicable questions from the CEQA Guidelines Appendix G as a framework to evaluate potential impacts in selected resource areas. Findings are preliminary and high level and therefore 1) do not represent if an impact is significant from the CEQA/NEPA perspective nor address the magnitude of the impact; 2) do not capture all impact areas that will be evaluated in a CEQA/NEPA document; and 3) do not account for the project's or alternatives' benefits, including those benefits from the use of the clean energy delivered by the project or alternative.*

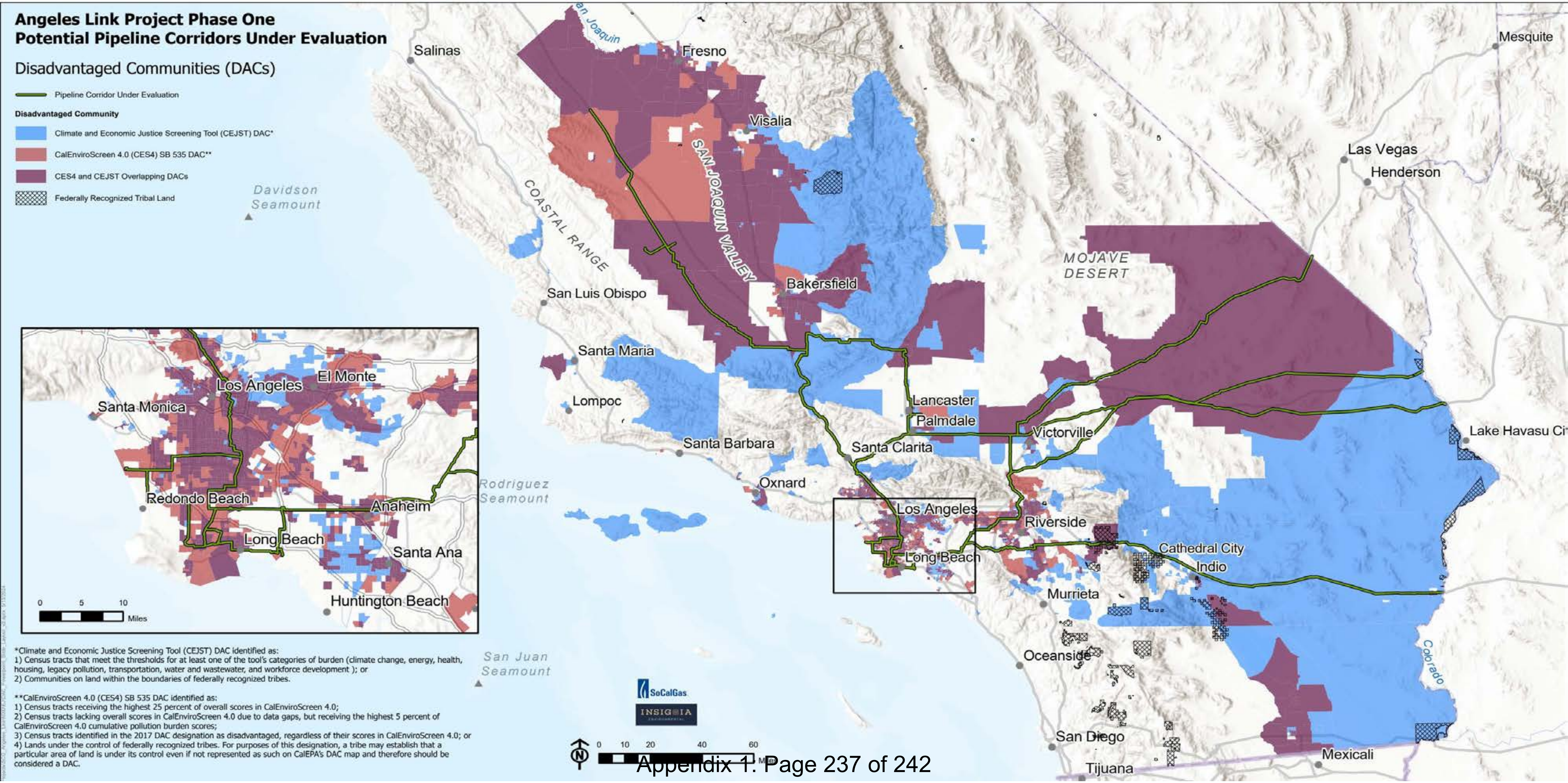
Environmental Social Justice

ENVIRONMENTAL SOCIAL JUSTICE (ESJ) EVALUATION

- ESJ is addressed in three different parts of the Angeles Link Phase 1 activities
- Evaluation considers approximately 1,300 miles of potential pipeline corridors, including four individual preferred pipeline routes that traverse approximately 450 miles
- Based on stakeholder input, ESJ will be addressed in one ESJ Plan

ESJ – Desktop Analysis	ESJ – Routing	ESJ – Stakeholder Engagement
Environmental justice mapping based on CalEnviroScreen and the Climate and Economic Justice Screening Tool (CEJST) data and indicators	Uses environmental mapping data to identify Disadvantaged Communities (DAC)	Request from CBOSG members during workshop to help in developing a more robust, in-person community stakeholder engagement plan
Provides data community profile; census tract statistics; disadvantaged communities; socioeconomic conditions; public services; and minority/ethnicity	Pipeline configurations will continue to be evaluated and refined based on DAC community data	Focused in-person stakeholder engagement plan to be implemented in Phase 2
Total distance evaluated included approximately 1,300 linear miles	Total distance for preferred pipeline routes traverses approximately 450 miles within the originally evaluated 1,300 miles	Will include communities along the preferred pipeline route

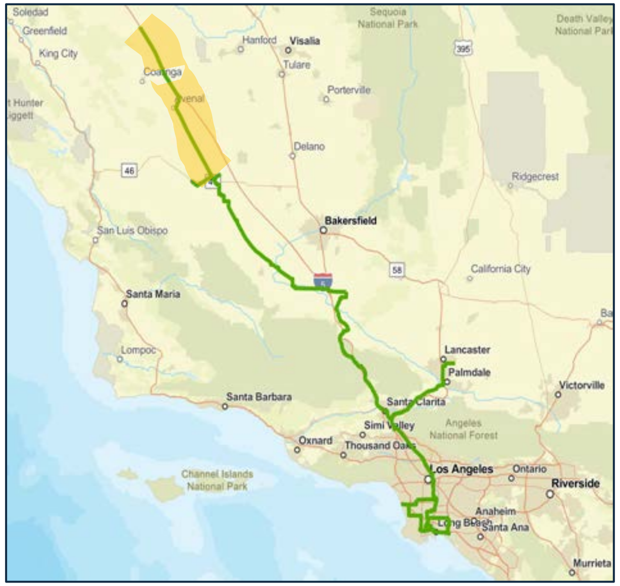
ALL POTENTIAL PIPELINE ROUTE OPTIONS COMBINED WITH DACs



ESJ DESKTOP ANALYSIS ON PREFERRED PIPELINE ROUTE OPTIONS - PRELIMINARY FINDINGS

ANGELES LINK

ROUTE A



DAC Mileage: 63%

ROUTE B

DAC Mileage: 67%

ROUTE C

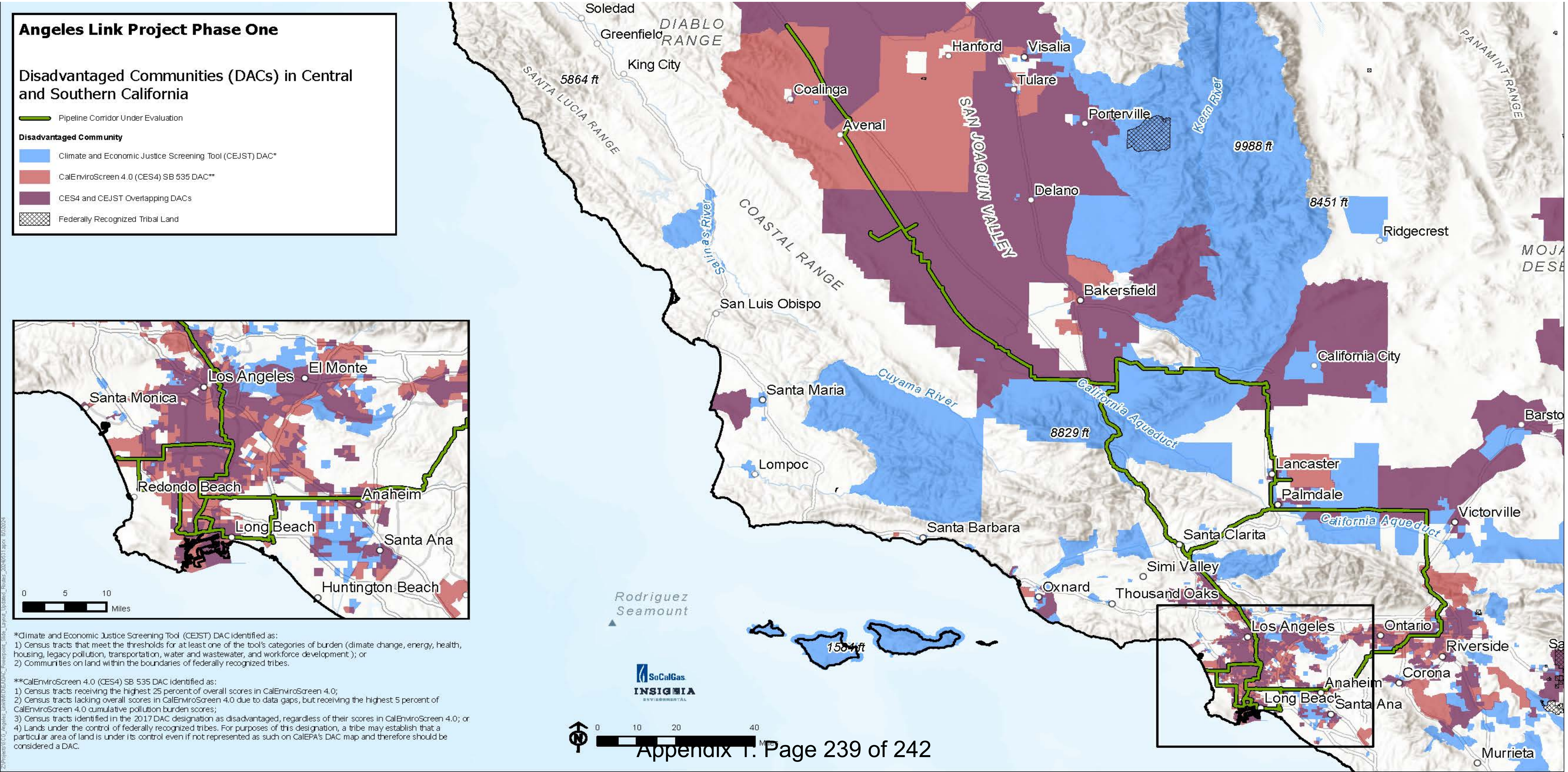
DAC Mileage: 57%

ROUTE D

DAC Mileage: 54%

- Preliminary Routing and Configuration Study identifies four individual preferred pipeline route options
- DAC mileage is the percent of the pipeline route within a Disadvantaged Community as identified by CalEnviroScreen and/or CJEST

ANGELES LINK PREFERRED PIPELINE ROUTE OPTIONS COMBINED AND EVALUATED WITH DACs



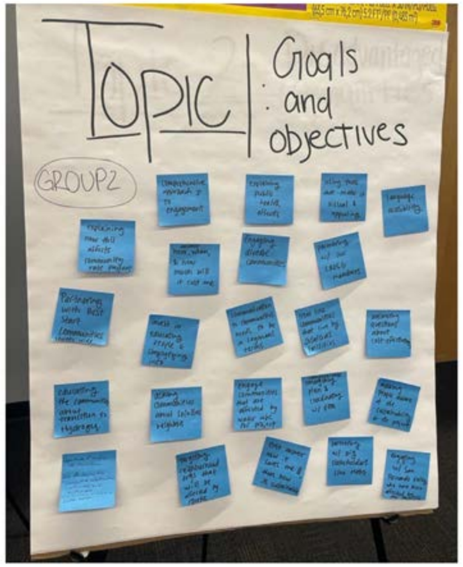
ANGELES LINK

PRELIMINARY FINDINGS ROUTING AND ESJ

- Addressing potential impacts and directing project benefits to Disadvantaged Communities (DACs) and Environmental Social Justice (ESJ) communities is a top priority for SoCalGas with the Angeles Link project.
- Angeles Link has the potential to reduce greenhouse gas emissions, improve air quality, create union jobs, grow small and diverse businesses, and generate millions of dollars in community benefits
- Hydrogen production and demand centers are concentrated in DACs. Most of the preferred pipeline routes in the San Joaquin Valley and the Los Angeles Basin that would connect them are also designated as DACs or ESJ communities.
- Federal government’s Justice40 Initiative requires that at least 40% of the overall benefits of ARCHES projects flow to DACs.
- This study determines that the project may lead to potential impacts from construction and operation and maintenance (O&M) activities in all resources analyzed in this study.
- ESJ plan development in Phase 1, with more robust, in-person community and CBO engagement in Phase 2. ESJ Plan and CBOSG to inform how to engage DACs in Phase 2.

ESJ ENGAGEMENT PLAN BACKGROUND

- Supports following Ordering Paragraph (OP) of Final Decision:
  - *OP 6 (l): "Plans for addressing and mitigating impacts to disadvantaged communities and other environmental justice concerns"*
- Desktop ESJ analysis originally developed as part of Environmental Analysis (Insignia)
  - Stakeholders wanted more than a desktop GIS analysis (Part of Environmental Analysis)
- ESJ Plan developed in response to stakeholder feedback provided during July 2023 CBOSG workshop.
- Preliminary framework of the ESJ Plan was presented to CBOSG members in September 2023.
  - Breakouts at CBOSG meeting informed the development of the ESJ Plan.



ANGELES LINK

DAC ENGAGEMENT STRATEGIES

- Partner with CBOs, using “Promotora" model along preferred routes to convene community meetings to solicit feedback from DACs
- Hold focus groups with community leaders in DAC/ESJ communities
- Communicate with communities via local and targeted media
- Coordinate information sharing with local elected and public officials
- Establish a toll-free hotline for those with no/limited internet access

ANGELES LINK

SoCalGas™

Appendix 2 – PAG and CBOSG Written Comments

Air Products and Chemicals, Inc.
1940 Air Products Blvd.
Allentown, PA 18106-5500
www.airproducts.com

May 3, 2024

VIA EMAIL TO
ALP1_PAG_FEEDBACK@INSIGNIAENV.COM

Emily Grant
Angeles Link Senior Public Affairs Manager
Southern California Gas Company
555 West Fifth Street
Los Angeles, CA 90013

Re: Angeles Link Planning Advisory Group (PAG) Feedback of Air Products and Chemicals Inc. on the Preliminary Routing/Configuration, Franchise, and Right-of-Way Analyses; Production Planning & Assessment; and Plan for Applicable Safety Requirements

Air Products and Chemicals, Inc. ("Air Products") submits the following feedback concerning the Preliminary Findings of three of the five Angeles Link technical studies that were made available on April 11: Preliminary Routing/Configuration, Franchise and Right-of-Way Analyses; Production Planning and Assessment, and Plan for Applicable Safety Requirements.

Air Products expects that the below feedback will be addressed in the final Studies and in Southern California Gas Company's (SoCalGas) quarterly reporting. Air Products also welcomes any response that SoCalGas may wish to provide to the comments below.

General Comments

Air Products continues to have concerns about the lack of substance in the materials that Southern California Gas Company (SoCalGas) is presenting for the Phase 1 studies. The Preliminary Findings released on April 11 contain little of substance and defer many of the details to future phases of study. The lack of detail prevents meaningful review and input on the Phase 1 studies by members of the Angeles Link Planning Advisory Group and will limit the value of the final Phase 1 studies. Though titled "Preliminary Data and Findings," the information consists of simple slide decks that range from six to sixteen slides, with at least half of the slides consisting of an introduction and other non-substantive material. There was even less substance presented on these important subjects than the five previously released preliminary findings reports.

Comments on Specific Preliminary Findings

Air Products provides the following feedback on the Preliminary Routing/Configuration, Franchise and Right-of-Way Analyses, Production Planning and Assessment, and Plan for Applicable Safety Requirements.

Preliminary Routing/Configuration, Franchise, and Right-of-Way Analyses

Air Products provides the following feedback on the April 2024 Preliminary Routing/Configuration Analysis, Including Right-of-Way and Franchise: Preliminary Data and Findings (Routing Analysis).

Though the Routing Analysis (p. 5) claims that the Analysis considered the ARCHES Initiatives, much of what is under development by the private sector for new hydrogen infrastructure does not align with the Link studies and proposed utility hydrogen pipelines, nor do the Link studies overlap with ARCHES published plans. The Link mapping proposal with routes from the Pacific Ocean to the eastern state border are designed to track the existing SoCalGas rights of way for current gas transmission and distribution lines, and not necessarily drawn to compliment or supplement long-term future potential delivery needs. Instead, the Link preferred routes appear to duplicate or compete with existing dedicated pipelines that have been in service for decades and have been identified for expansion in ARCHES and with end users in the Los Angeles basin. While some of the ARCHES production is generally shown along with end uses in the mapping and preferred routing for the Link, the preliminary findings slide deck did not make clear that some of these hydrogen consumers are already being serviced by existing hydrogen service providers with plans in place for buttressing existing hydrogen pipeline use and truck transport to support new users in the Los Angeles, Long Beach port complex and surrounding industrial areas. The Link PAG materials that map multiple pipeline segments into the Los Angeles coastal areas and weave throughout the California desert leave the PAG participants to assume that the SoCalGas Link is included in the ARCHES framework, when in fact it appears from public ARCHES documents and brief treatment during the presentation that only two small portions of the proposed Link have been identified as pipelines that may be located in the San Joaquin Valley and near Lancaster for longer-term potential development.

The ARCHES systems analysis on the other hand identifies production, end uses, and delivery points developed by a variety of ARCHES partners that will be the underpinning framework to support hydrogen market lift-off in California. There are more than 400 hydrogen entities in ARCHES working together to plan near term infrastructure investments to advance renewable hydrogen supply and delivery. The ARCHES systems plan is a living document borne out of a public-private partnership, supported by industry and academia, including the University of California Office of the President and Lawrence Livermore Labs. The United States Department of Energy recognized the ARCHES collective effort as one of the more advanced national hubs with more than 30 Tier 1 project proponents working diligently to finalize the $1.2 billion statewide award. These ARCHES partners include entities who have decades of hydrogen experience, who are actively advancing their projects, including new supply, new fueling stations, expanding existing dedicated hydrogen pipelines and hydrogen delivery fleets to serve new users statewide, including the Long Beach - Los Angeles port complex and regional industrial users including new electric sector users. The new green renewable hydrogen supply, new fueling (stationary and mobile) capability for maritime, ports, industrial and power needs are in various stages of development and permitting – well ahead of the timeline envisioned for the Link and SoCalGas' current process to move from studying and learning how hydrogen markets and systems work to requesting authority to transition to a hydrogen utility.

Air Products recommends that SoCalGas' withdraw the proposal to advance more than 400 miles of proposed hydrogen pipelines and limit review to the small segments referenced in the ARCHES framework, as 1) none of the proposed Link is needed in the near-term for hydrogen market lift-off, 2) SoCalGas studies released to date have flaws showing a lack of technical understanding and 3) the studies do not result in a demonstrated need for such a significant ratepayer investment in a major new hydrogen pipeline system.

Production Planning and Assessment

Air Products provides the following feedback on the April 2024 Production Planning & Assessment: Preliminary Data and Findings (Production Planning).

The Production Planning analysis assumes that approximately 240,000 acres will be needed to support the assumed throughput volume of 1.5 MMTPY, which is approximately 11% of the land identified as suitable for solar generation in the three production areas. On what data is SoCalGas relying upon in developing these assumptions and estimates? And does the land usage requirement include all land needed for power production and hydrogen production, or solely for the required solar panels?

While the 11% statistic makes this seem feasible, it should be noted that 240,000 acres is about 2/3rds the size of Los Angeles. Even if subdivided into three separate locations as proposed, this is a substantial amount of land. To enable better public understanding, the final report should provide a comparison to the largest solar farms that exist in California today and discuss what competition exists for this land relative to grid connected solar projects for SB 100 compliance or other uses.

The Production Planning assessment also makes no reference to battery energy storage systems. Do the space requirements account for energy storage needs, or are the electrolyzers assumed to only run intermittently based upon solar production? What utilization rates have been assumed for the electrolyzers and has this utilization been factored into the number of electrolyzers and solar needed, both of which factor into the acreage requirements?

The assessment also references the importance of hydrogen storage—do the acreage estimates include the land needed for aboveground hydrogen storage? For example, a working storage capacity of 0.125 MMT, the smallest estimate provided, would require approximately 360 of the largest proven spherical tanks (5,000 m3) for liquid hydrogen manufactured today. Are space requirements for tanks and related piping/liquefaction facilities included in the acreage estimates? If it is assumed to be underground storage, what storage locations have been evaluated for suitability? Aside from land requirements at the production sites, what land is needed for liquefaction and/or purification for end uses at customer sites?

The preliminary findings state that there will be no grid connection which further increases intermittency, production equipment cycling, which ultimately impacts reliability. The final report should detail what measures will be taken to ensure reliable supply of hydrogen to the proposed pipeline given this constraint.

Lastly, there is no discussion of the purity requirements (pipeline specification) for the 3rd-party produced hydrogen. Given the diverse set of end uses, including fuel cells, a tight purity specification would be required. This specification will dictate the types of production equipment required and a thorough discussion of this should be included in the final report.

<u>Plan for Applicable Safety Requirements</u>

Air Products provides the following feedback on the April 2024 Preliminary Data and Findings: Plan for Applicable Safety Requirements (Safety Plans).

The preliminary Safety Plan references the fact that odorization is feasible and features this as a safety measure to ensure detection of hydrogen leaks. To what extent has SoCalGas evaluated whether proposed end uses can tolerate odorants? For example, fuel cell applications require very high purity hydrogen. As mentioned above, the Safety Plan Study should set forth the purity specification that SoCalGas intends to maintain for production into the pipeline and explain how the purity required for each end user will be maintained if odorization is to be used for safety.

In addition, more details on what types of odorants are being contemplated and confirmation that there are no adverse reactions with either the hydrogen or the piping component materials needs to be provided in the final report. Lastly, the final report should include a discussion of the efficacy of various odorants given the more rapid diffusion of hydrogen relative to the odorant. It is possible that in a leak situation, the hydrogen diffuses faster than the odorant and could create a hazardous condition in an area before the odorant is detected.

Conclusion

Air Products appreciates the opportunity to provide this feedback concerning the Preliminary Routing/Configuration, Franchise and Right-of-Way Analyses; Production Planning and Assessment, and Plan for Applicable Safety Requirements.

Respectfully,

Miles Heller Director, Global Greenhouse Gas,
Hydrogen, and Utility Regulatory Policy

May 3, 2024

Informal Comments of the Public Advocates Office on Southern California Gas Company's Preliminary Routing/Configuration Analysis Findings and Preliminary Production Planning Findings for the Angeles Link Hydrogen Project

The Public Advocates Office at the California Public Utilities Commission (Cal Advocates) provides these comments on Southern California Gas Company's (SoCalGas) *Angeles Link Preliminary Production Planning Findings and Preliminary Routing/Configuration Analysis Finding* issued in April11, 2024.

The following comments are intended to provide direction on how the draft studies can be more informative for stakeholders and satisfy the intent of the Commission's decision. Currently the draft studies lack the detailed analysis needed for stakeholders to provide appropriate detailed analysis.

Preliminary Production Planning Findings

The Future Draft Production Study Should Clearly Describe and Analyze the Roles of Storage and Curtailed Renewable Generation.

The preliminary production findings indicate that curtailed renewable energy and storage also provide opportunities for hydrogen production, but the preliminary production findings do not provide any detailed or supporting information. The preliminary production findings only note that if production facilities are connected to the grid, "the curtailed renewable energy is expected to be used opportunistically to produce hydrogen."[1] However, that expectation is belied by the parenthetical comments which note that the Angeles Link design case is not considering production facilities connected to the grid. Even if production facilities are connected to the grid, it is not clear that grid energy can meet any of the definitions of green hydrogen. The preliminary production findings go on to claim that third-party storage "will play an important role to balance hydrogen supply with demand."[2] But there is no information about the type of third-party storage, the amount needed, the expected demand profiles, or how curtailment may impact storage needs. Essentially, as currently presented, the curtailment and storage claims are vague and contradictory. The draft production study should present

[1] Preliminary Production Findings at slide 6.
[2] Preliminary Production Findings at slide 6.

scenarios that clearly describe and analyze the respective roles of both storage and curtailed generation from the grid.

Consultations with the Counties of the San Joaquin Valley, California Energy Commission, and Bureau of Land Management are Necessary to Establish the Feasibility of Siting 240,000 acres of Solar Dedicated to Hydrogen.

The preliminary production findings identify the need for at least 240,000 acres of solar photovoltaics[3] (which equates to between 35-40 GW of generation capacity) to be identified, developed, and dedicated to hydrogen production in the regions of Blythe, Lancaster, and the San Joaquin Valley.[4] The preliminary findings lack critical information on the underlying definitions and assumptions, which makes it difficult to assess the feasibility of developing 240,000 acres.[5] Regardless, the feasibility assessment for siting 35-40 GW of solar in the San Joaquin Valley and the Mojave Desert must be based on the application of existing permitting authority, the regional tolerance for solar development, and existing land use management plans.

Permitting authority for the lands in question are primarily vested in the counties in these regions, the California Energy Commission (CEC), and the Bureau of Land Management (BLM). There are several different possible permitting strategies for developers that can involve varying combinations of local, county, state, and federal authorities. While some counties such as Kings County[6] are likely to regard solar development positively, others may not. By way of example, San Bernardino County placed a moratorium on development of solar in 2013, which was renewed in 2019.[7] Subsequently, as an alternative to the county permitting route, authority to permit solar PV was granted to the CEC by AB 205 in 2022.[8] Because of the varying tolerance for development, permitting strategies of developers will vary. It will be essential to consult with both the counties and the CEC to fully assess the feasibility of further solar development in both the Lancaster area and the San Joaquin Valley.

Similarly, the primary land manager for most of the land suitable for solar development near Blythe is BLM. BLM issued a Land Use Plan Amendment (LUPA) adopting the Desert Renewable Energy Conservation Plan (DRECP) in 2016.[9] The LUPA identifies 148,000 acres in Riverside County within which solar generation development is eligible for a streamlined permitting process.[10,11] This does not, however, mean that all 148,000

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[3] Preliminary Production Findings at slide 6.
[4] Preliminary Production Findings at slide 6.
[5] Preliminary Production Findings at slide 6.
[6] CalMatters - *Wrangling over renewables: Counties push back on Newsom administration usurping local control*. Accessed April 26, 2024, https://calmatters.org/environment/2022/08/renewable-energy-california-counties/
[7] Los Angeles Times - *California's San Bernardino County slams the brakes on big solar projects* February 28, 2019. Accessed April26, 2024, https://www.latimes.com/business/la-fi-san-bernardino-solar-renewable-energy-20190228-story.html
[8] Public Resource Code Sec. 25545.
[9] DRECP LUPA Record of Decision. September 2016.
Accessed: April 26, 2024, https://eplanning.blm.gov/eplanning-ui/project/66459/570
[10] Desert Renewable Conservation Plan Land Use Plan Amendment at 56.
Accessed April 26, 2024, https://eplanning.blm.gov/public_projects/lup/66459/133474/163144/DRECP_BLM_LUPA.pdf
[11] DRECP LUPA at 59.

acres can be developed.[12] The DRECP Environmental Impact Statement preferred alternative states that up to 38,000 acres of permanent disturbance is anticipated from solar projects (equivalent to about 6 GW).[13] To fully demonstrate the feasibility of developing solar dedicated to hydrogen production, it will be important to understand a) how much development has already been undertaken, and b) the implications of exceeding the levels of disturbance analyzed in the EIS. It is essential to understand whether exceeding these disturbance levels would be beyond the scope of the LUPA, and whether exceeding the scope would render any development infeasible.

The preliminary production analysis does not indicate whether consultation with permitting agencies and land use managers has been undertaken to assess the fundamental feasibility of putting solar facilities in the areas identified. Ultimately, the production study needs to identify whether there are any legal or land use policy limitations that would impact production and in turn inform the size and location of a transmission pipeline.

Preliminary Routing/Configuration Analysis Findings

Hydrogen Pipeline Corridors must be broad enough to enable significant variation from existing transmission pipeline routes.

SoCalGas states that it would evaluate "pipeline corridors or rights-of-way, other known existing rights-of-way, franchise rights, designated federal energy corridors or rights-of-way, and the need for new rights-of-way."[14] SoCalGas has an extensive network of rights of way and easements throughout its territory, which are necessary to serve its customers. However, the preliminary findings present a range of pipeline corridors that appear to be mostly identical to existing gas transmission pipelines.[15]

The focus on existing transmission lines means that the proposed corridors may be overly narrowed and are prematurely limiting alternative routes. In some locations the corridor is limited to a single option. For example, routing from the San Joaquim Valley south to central Los Angeles is limited to a single alternative adjacent to I5 freeway.

Routing is complex and the Commission has, in the past, modified proposed routes following community consultation; the Sunrise Power Link is a classic example of this scenario.[16] For a corridor to demonstrate that it is feasible it must be broad enough to enable the Commission to analyze potential alternatives that safely minimize impacts to communities, avoid environmental impacts, and serve future off-takers. This means that a corridor needs to be broad enough to support multiple variations on routes between suppliers and off-takers.

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[12] DRECP Proposed LUPA and Final EIS at II.3-4 Table II.3-1 fn4. Accessed April 26, 2024, https://eplanning.blm.gov/public_projects/lup/66459/20012404/250016892/II.3_Preferred_Alternative.pdf
[13] DRECP Proposed LUPA and Final EIS at II.3-82 Table II.3-5.
[14] Preliminary Routing Findings at slide 2.
[15] Preliminary Routing Findings at slide 8.
[16] Sunrise Powerlink Accessed: April 26, 2024, https://files.cpuc.ca.gov/Environment/info/aspen/sunrise/sunrise.htm

Narrow corridors run the risk of missing communities that may be impacted by routing decisions later in the siting and permitting process. Failure to engage all potentially impacted communities could result in an unforeseen and potentially inequitable siting decision that could delay the pipeline or lead to permit denial. Outreach reach by SoCalGas should be undertaken to the broadest range of communities that could be impacted by a pipeline from the earliest feasible moment.

SoCalGas should identify corridors that provide latitude to modify the pipeline routes and demonstrate that SoCalGas is systematically considering all potential corridors.[17] Therefore, the routing study should: a) identify all corridors that have been considered; b) demonstrate that multiple routes are feasible with a given corridor; c) clearly rank the suitability of corridors; and d) provide a clear explanation of the factors driving the ranking.

Conclusion

In summary, understanding and analyzing the roles of storage, and curtailed energy, will be essential in assessing the quantity of renewable generation that has to be dedicated to hydrogen production, which will influence the locations that can be developed and ultimately the production side location for any future pipeline. As such, the draft production study should clearly analyze the anticipated role and potential availability of both storage and curtailed energy in each production region.

Furthermore, the distribution of feasible solar development needed for hydrogen production will be vital when ranking the likely sequence of potential corridors for pipeline development. To demonstrate where 240,000 acres of solar can feasibly be permitted, it is essential that SoCalGas consults with the primary land use permitting authorities, to understand what development is already being undertaken and the limits in existing land use plans.

Finally, transmission corridors from the most eligible production locations must be broad enough to allow the Commission the ability to modify the routes without resulting in impacts to communities that have not been part of SoCalGas outreach. Overley narrow corridors, may result in late notification and inclusion of communities in the siting process, which makes siting harder and can result unnecessary delays. To ensure that the corridor is fit for purpose, multiple possible routes within each proposed corridor should be identified in the draft routing study.

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[17] Preliminary Routing Findings at slide 2.

COMMUNITIES FOR A BETTER ENVIRONMENT
established 1978

May 3, 2024

Southern California Gas Company
555 West Fifth Street
Los Angeles, CA 90013

Submitted via email to ALP1_Study_PAG_Feedback@insigniaenv.com.

Re: Feedback for Southern California Gas Company on Preliminary Findings Presentations

Communities for a Better Environment (CBE) submits this letter of feedback to Southern California Gas Company (SoCalGas) on the following matters and documents:

I. Updated Preliminary Findings Presentation Format;
II. Preliminary Data and Findings: Plan for Applicable Safety Requirements;
III. Preliminary Routing/Configuration Analysis, Including Right-of-Way and Franchise: Preliminary Data and Findings;
IV. Production Planning & Assessment Preliminary Data and Findings;
V. Preliminary Data and Findings: Workforce Planning & Training Evaluation; and
VI. Preliminary Data and Findings: High Level Feasibility Assessment & Permitting Analysis.

These comments specifically pertain to the preliminary findings presented in the abbreviated power point presentations provided on April 16, 2024. As CBE stated at the April 23, 2024 joint PAG and CBOSG meeting, CBE expects that a separate, complete draft of the data, analysis, and findings for these topics will be released at an unknown later date. These preliminary presentations lack basic data, let alone the analysis parties need to provide feedback, and these comments cannot, and do not, comprise the entire scope of feedback from CBE on any of the topics presented.

I. Updated Preliminary Findings Presentation Format

As an initial matter, the format and content of the above-listed preliminary findings are unusable, since they offer neither data nor analysis, and do not even allow a clear understanding of the methodological approach SoCalGas envisions undertaking to develop the data and analysis. The preliminary findings fail to include quantitative data and have little qualitative analysis. Each presentation file only has a few slides with substantive information, many slides include images with little to no explanatory text. Most of the presentations in their entirety contain less than two pages of bullet pointed text. Despite the presentations title identifying them as "data and findings," the presentations contain no data, or related analysis to support the findings presented therein. It is concerning that with the lack of data and analysis provided, these presentations, and the findings favorable to SoCalGas presented therein, more readily resemble PUC prohibited public relations materials than feasibility studies.[1] Further, SoCalGas's failure to provide data does not comply with the CPUC Decision D.22-12-055 (hereinafter "CPUC Decision"), part 7 which requires SoCalGas to "make the data, findings, and results of Phase One feasibility studies…available to the public and not redacted unless SoCalGas is granted confidentiality of data."[2]

Because the presentations do not include data or analysis, providing feedback on the findings presented is particularly challenging. The CPUC Decision emphasized the importance of stakeholder engagement to identify potential impacts of the project on disadvantaged and environmental justice communities.[3] Failing to provide data and analysis in the presentation of these findings stymies meaningful engagement—communities cannot interact with findings if we do not know the facts on which they are based. SoCalGas stated that the data and analysis for these topics will be released at an undisclosed later date when the draft studies are completed. This implies that the statements made in these presentations are presented entirely without completed research, despite the presentations being labelled as including both preliminary data and findings.

SoCalGas represented the presentation format as both an accessible means of further opportunity for community engagement, and a means by which SoCalGas can direct community members to targeted areas for feedback. CBE rejects this characterization; the accessibility of information does not equate to incomplete and unsupported presentations of facts. Further, meaningful community engagement should concern all matters and concerns that community members seek to engage in, not those directed by SoCalGas.

II. Preliminary Data and Findings: Plan for Applicable Safety Requirements

In the Preliminary Data and Findings: Plan for Applicable Safety Requirements ("Safety Plan Presentation") SoCalGas limits its scope of review to the topics of regulation, construction, and communication. The limited scope Safety Plan Presentation glaringly omits any kind of preliminary risk analysis. In contrast to the lack of risk analysis, the Safety Plan Presentation asserts that a comprehensive framework of safety requirements can mitigate risks. It is unclear how a comprehensive framework could be conceived of, let alone created without any form of risk analysis. Any comprehensive safety plan at base needs to address the risks of the Angeles Link Project in relation to associated safety requirements. Further, the Safety Plan Presentation does not mention safety considerations for the major risks of leakage, exposure, flammability,

[1] CPUC Decision D.22-12-055 (hereinafter CPUC Decision), pg. 38.
[2] CPUC Decision, Order No. 7 pg. 77.
[3] CPUC Decision, pg. 80. See also pg. 58 "Stakeholder engagement, including those from CBOs, ESJ groups, and disadvantaged communities (DAC) groups, are important to the planning process."

storage, explosion, and end-use related health risks posed by hydrogen use and transportation or safety risks associated with the use of hydrogen in existing methane gas systems.

The Safety Plan Presentation identifies only three study considerations, "1. Pipelines can be a safe and efficient method of transporting large volumes of gas over long distances 2. A comprehensive framework of safety requirements can mitigate hydrogen transport risks 3. SoCalGas has an existing safety framework" without providing any details regarding if or how pipelines can be safe or unsafe, what elements may be required in a comprehensive framework to mitigate risks, or the details of SoCalGas's existing safety plan and how it can or cannot extend to cover hydrogen transportation. Parties must have the opportunity to engage with a comprehensive safety analysis, which identifies all potential personal, community, and environmental health and safety risks associated with hydrogen and the steps necessary to mitigate these risks. Without providing a clear and transparent safety analysis it is impossible for SoCalGas to meaningfully engage with environmental justice communities on the impacts of the project.

The Safety Plan Presentation's assertions that "leak detection equipment is available and can be utilized for hydrogen detection" and "studies show odorization of pure hydrogen gas is feasible" are presented without any evidence. These are significant points of safety that should be thoroughly supported with research, especially at the preliminary, feasibility stage. Failing to provide support for these claims raises serious questions as to the validity of SoCalGas's feasibility studies, and research integrity generally, and the integrity of the Safety Plan Presentation.

The final slide, labeled "25" despite being ninth in a nine-slide deck, is perhaps most surreal. It purports to present "safety study preliminary findings." Instead, the slide shows a pyramid, listing what may be standards applied by different regulatory agencies. It does not show any findings or, on its face, appear to reference a safety study. This slide is emblematic of the flaws inherent in the new SoCalGas approach to engaging community.

III. Preliminary Routing/Configuration Analysis, Including Right-of-way and Franchise: Preliminary Data and Findings

The content in the Preliminary Routing/Configuration Analysis, Including Right-of-Way and Franchise: Preliminary Data and Findings ("Preliminary Routing Analysis") is vague and uninformative. One slide states: "Based on preliminary pipeline routing information, there are 60 municipalities with which SoCalGas has franchise agreements and approximately 50% of the potential routes are proximate to ROWs for existing facilities." This statement is probably the most 'specific' included in this slide deck since it at least includes a few numbers, but it still leaves the reader in the dark about specific names of municipalities and ROWs, however tentative they may be. The page about Evaluation Components merely lists several vague factors like "production," "demand," and "environmental" without elaborating on any of them.

IV. Production Planning & Assessment Preliminary Data and Findings

The Production Planning and Assessment Preliminary Data and Findings ("Production Presentation") fails to address significant environmental justice concerns relating to hydrogen production in heavily impacted communities. The three potential communities where production is being explored listed on seventh and final slide of the presentation include the San Joaquin Valley, Lancaster, and Blythe. The Production Presentation does not mention the environmental justice implications of production planning in these communities despite the communities at these potential sites of production ranking in the 80th to 100th percentile on CalEnviroScreen. The San Joaquin Valley is a region covering over 27,000 square miles of California from Bakersfield (138 miles from the port of Los Angeles) with census tracts that rank in the 100th percentile of CalEnviroScreen overall, 97th percentile in pollution burden, and 95th percentile in ozone.[4] Communities in and around Lancaster (98 miles from the port of Los Angeles) rank in the 89th percentile of CalEnviroScreen, with ozone in the 89th percentile.[5] Blythe (235 miles from the port of Los Angeles) is in the 92nd percentile overall for CalEnviroScreen, and 80th percentile in pollution burden.[6] The Production Presentation's failure examine the impact of production sites on these already impacted communities of the San Joaquin Valley, Lancaster, or Blythe, let alone begin outreach in these communities is unacceptable. The slide deck does not discuss any analysis of onsite or near-site production as an alternative to building massive pipelines connecting environmental justice production-hosting communities.

As mentioned in the CPUC Decision, significant water use is of particular concern in hydrogen production.[7] The only potential production method explored in the Production Presentation is solar powered electrolysis hydrogen production which SoCalGas identifies but does not commit to as a primary source of clean renewable hydrogen production. Despite solar electrolysis hydrogen production being known to require a significant amount of water, water use is not mentioned once in the Production Presentation. Nor is the fact that the San Joaquin Valley, Lancaster, and Blythe are water strapped communities.

V. Preliminary Data and Findings: Workforce Planning & Training Evaluation

The content in the Workforce Preliminary Data and Findings is too minimal to be useful. We strongly recommend that workforce studies and findings should include requirements for local hires, including members of disadvantaged communities and people of color. The preliminary data and findings make no mention of local hire preferences. Slide 6 refers to "Workforce training for safety and regulatory compliance." The Workforce Preliminary Data and Findings should include references to worker safety concerns related to transporting 100% hydrogen by pipeline like those in the Safety Plan Presentation discussed above.

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[4] See CalEnviroScreen 4.0, Census Tract 6029002500
[5] See CalEnviroScreen 4.0, Census Tract 6037900300 and Census Tract 6037900602
[6] See CalEnviroScreen 4.0, Census Tract 6065046200
[7] CPUC Decision, Order No. 6 Subd. (b), pg. 76.

VI. Preliminary Data and Findings: High Level Feasibility Assessment & Permitting Analysis

The High Level Feasibility Assessment and Permitting Analysis Preliminary Data and Findings ("Permitting Presentation") purports to be in alignment with the CPUC Decision "OP 6 (i)", a notation that may refer to part 6 subdivision (i) of the CPUC Decision Order beginning on page 73. However, more confusingly, part 6, subdivision (i) of the Order, requires SoCalGas to provide findings from its phase one feasibility studies for the purpose of "identification and comparison of possible routes and configurations."[8] The Permitting Assessment Presentation provides a rudimentary outline of likely necessary legal requirements broadly for Federal, State, and Local permitting and land use requirements but does not identify where any of these generalized permitting requirements may apply or on what timeline. The Permitting Presentation's main finding on slide seven states that "permitting timing assumptions range from months to several years." Without identifying any potential routes in relation to permitting, it is impossible to discern from the array of potential permitting and regulatory requirements which permitting requirements, constraints, and timing considerations will be significant factors in limitation of the project's development.

VII. Conclusion

CBE appreciates the opportunity to provide feedback on SoCalGas's new attempt at presenting information for feedback. Neither the format nor the extremely minimal substantive information allows CBE, or other interested stakeholders, to understand the many necessary studies SoCalGas must undertake if it intends to move forward the Angeles Link project.

Respectfully Submitted.

Lauren Gallagher & Jay Parepally

Communities for a Better Environment

CC:
Emily Grant, SoCalGas
Chester Britt, Arellano Associates
Alma Marquez, Lee Andrews Group
Angeles Link PAG Service List

[8] CPUC Decision, Order No. 6 Subd. (i), p. 76.

May 3, 2024

Submitted via email to ALP1_Study_PAG_Feedback@insigniaenv.com.

RE: Feedback on the Preliminary Findings of the Angeles Link Project and CBOSG Process

Food & Water Watch, as part of the Community Based Organization Stakeholder Group (CBOSG), submits this letter of feedback regarding the preliminary data and findings of the Angeles Link Project by the Southern California Gas Company (SoCalGas) and the CBOSG process.

The most recent documents sent to the CBOSG were insufficient to provide substantial feedback to and we hope that slide decks in place of findings reports will not become the norm from SoCalGas. This format and content, or rather lack thereof, offers no real analysis. Rather than expecting the CBOSG to submit feedback to a series of slide decks, SoCalGas should be sending us actual reports.

During the most recent meeting, held on April 23, 2024, representatives from SoCalGas stated that the reports would be available in a few months (no date of release was specified). In that same meeting, it was clear that SoCalGas has grossly misconstrued the criticism that groups in the CBOSG have been raising for the past year. The feedback windows should be extended, we need reports with detailed analysis along with detailed descriptions of the methodologies used, and SoCalGas should be providing evidence as to how stakeholder group feedback is being incorporated.

We also need an evaluation of alternative scenarios or options, and how those alternatives compare with the Angeles Link Project in terms of adhering to demand projections from state agencies like the California Energy Commission and the California Air Resources Board. Given that SoCalGas has a vested financial interest in this project, independent third-party research would provide an impartial analysis of the project.

We would also like to stress our concern over how a year into the project, SoCalGas has failed to engage with local tribal leaders and communities, which conflicts with the California Public Utilities Commission's emphasis on inclusive stakeholder engagement. This concern has been raised multiple times during the CBOSG meetings by multiple stakeholders.

We hope that all of these concerns will be taken into consideration and the necessary changes will be made.

Sincerely,

Andrea Vega
Southern California Senior Organizer
Food & Water Watch

May 1st, 2024
California Public Utilities Commission (CPUC)
505 Van Ness
Avenue San Francisco, CA 94102

RE: Protect Playa Now Feedback for Angeles Link and CBO Stakeholder Group

To the California Public Utilities Commission (CPUC),

I am writing to express Protect Playa Now's concerns and to provide feedback on the preliminary data and findings documents related to the Angeles Link project, as prepared and presented by SoCalGas. The documents we have reviewed have raised significant issues that we believe must be addressed to ensure the transparency, accuracy, and comprehensiveness of the ongoing evaluations of the Angeles Link project.

Preliminary Data and Findings Documents:

Lack of Detailed Analytical Content: The documents present high-level overviews without the necessary detailed analytical content, making it difficult for stakeholders to assess feasibility and impacts thoroughly.

Overuse of Promotional Language: The documents often use promotional language that seems aimed at advocating for the project rather than critically evaluating it.

Insufficient Data: There is a notable lack of specific data or detailed impact assessments for environmental considerations..

Maps and Visuals Lack Detail: Maps and other visual aids lack sufficient detail, such as labels and explanatory notes, hindering stakeholders' ability to fully understand the project's implications.

Absence of Methodological Transparency: There is an absence of detailed descriptions of the methodologies used for assessments, leading to doubts about the validity of the findings.

Confusing Comment Periods: The process includes two distinct periods for commenting, one for the executive summary and another for the detailed data, which can confuse and hinder comprehensive feedback.

Overall Process Feedback:

Inadequate Tribal and Community Engagement (Still): The lack of robust engagement with local tribal leaders and communities directly conflict with the CPUC's emphasis on inclusive stakeholder engagement and the need for consent from tribal communities for projects of this nature. This oversight undermines the trust and collaborative potential crucial for the success of projects with significant environmental and social footprints.

Discrepancies in Demand Projections: The demand projections by SoCalGas do not align with findings from authoritative bodies like the California Energy Commission and the California Air Resources Board, raising questions about the accuracy and reliability of SoCalGas's projections.

Limited Stakeholder Engagement Evidence: The documents do not clearly show how stakeholder feedback has been incorporated, indicating a gap between provided feedback and subsequent revisions.

Unclear Evaluation of Alternatives: The documents often fail to address or evaluate alternative scenarios or options sufficiently, a crucial aspect of feasibility studies to ensure all potential outcomes are considered.

Absence of Supporting Calculations: Critical spreadsheet calculations for key studies like the demand study and the NOx study have not been provided, preventing stakeholders from verifying the accuracy or reliability of the findings.

Need for Contract Transparency: Stakeholders have requested to see contracts with subcontractors and consultants to understand the scope of what SoCalGas has asked these external parties to provide, crucial for assessing the impartiality and depth of the studies conducted.

Concerns About Feedback Window Durations: Community concerns about the shortening of feedback windows may not provide sufficient time for thorough review and comprehensive feedback.

Demand for Public Accessibility of Documents: Court reporter documents and detailed analysis should be made publicly accessible to ensure transparency and facilitate community engagement in the review process.

Regarding April 23, 2024 Meeting:

I was unable to attend the SoCalGas Angeles Link PAG & CBOSG Joint Update meeting on April 23, 2024, and had an alternate representative attend in my place. After reviewing the report from my representative and watching the full meeting recording, I observed a notable lack of transparency and inadequate responses to feedback regarding the project. During the meeting, SoCalGas consistently defended their process choices and appeared dismissive of significant issues raised by stakeholders. There is a distinct difference between the challenge of balancing the needs of all members involved in this process and the failure to respond effectively to serious concerns and questions related to this project.

Conclusion:

In conclusion, the concerns raised by stakeholders regarding the Angeles Link project highlight a significant need for improved transparency and responsiveness from SoCalGas. Moving forward, we expect a more robust engagement strategy that not only listens to but also integrates stakeholder feedback into the project's planning and execution phases.

Sincerely,
Faith Myhra (she/they)
Member
Protect Playa Now
protectplayanow@gmail.com
Writing from the traditional, ancestral, and unceded territory of the Tongva, Kizh, and Chumash People.

May 30, 2024

Southern California Gas Company
555 West Fifth Street
Los Angeles, CA 90013

Submitted via email to: **ALP1_Study_PAG_Feedback@insigniaenv.com**

RE: Feedback for Southern California Gas Company on Preliminary Findings Presentations for June 2 Quarterly Report

The Green Hydrogen Coalition ('GHC') is appreciative of SoCalGas' effort to implement Angeles Link, the nation's first dedicated common carrier renewable hydrogen pipeline, as it is an essential component of California's goal of economy wide decarbonization and our transition away from fossil fuels. The GHC is a California educational 501(c)(3) non-profit organization that was formed in 2019 to recognize the game-changing potential of "green hydrogen" to accelerate multi-sector decarbonization and combat climate change. The GHC's mission is to facilitate policies and practices that advance green hydrogen production and use across all sectors of the economy to accelerate a carbon-free energy future and a just energy transition.

From 2020-2023 the GHC launched and completed HyBuild Los Angeles, a multi stakeholder independent system planning effort to determine if it is commercially and technically possible to create a mass-scale green hydrogen ecosystem to displace fossil fuels across multiple sectors. (final public report attached) This effort was geared toward first identifying potential multi-sectoral buyers/demand for the renewable hydrogen and then architecting the needed scaled production and transport infrastructure to serve that demand. Findings from this effort were highly encouraging. The GHC found that achieving a mass-scale green hydrogen economy to rapidly displace fossil fuels in several hard to abate sectors is indeed technically and commercially possible. It will require shared, scaled infrastructure; namely green hydrogen pipeline transport connected to underground geologic storage of hydrogen. This infrastructure combination affords the lowest cost pathway to achieving mass-scale supply assurance and low delivered cost to enable widespread adoption of GH2. The successful implementation of Angeles Link is thus a gating factor for Southern California's realization of a green hydrogen economy and a faster transition away from fossil fuels economywide.

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Key findings from HyBuild LA include:

1. LA can achieve $2.05/kg delivered green electrolytic hydrogen by 2030, and <$1/kg delivered with federal tax incentives. This forecast is based on a robust system plan to serve 1.4 million metric tons of demand per year and can only be achieved by reducing hydrogen transport cost via dedicated green hydrogen pipeline connected to underground geologic storage of hydrogen. The GHC system plan investigated an alternative GH2 local in-basin production option (that sited electrolysis production in the LA basin) but found that there was insufficient local renewable electricity resource/land availability and insufficient electric transmission capacity (now and in the future) for transporting the large quantity of renewable electricity that would be required to meet the forecasted demand for electrolytic green hydrogen.
2. At the $2.05/kg forecasted, at-scale delivered cost, green hydrogen will be highly competitive with fossil fuels in many applications, and will enable a faster, more accelerated energy transition away from fossil fuels. Widespread adoption requires that off-takers have certainty of supply and are able to sign long-term contracts. This is only possible with appropriate pipeline infrastructure to deliver mass scale, cost competitive green hydrogen.
3. Significant demand (1.4 MMT per year by 2030) was identified across a number of sectors in Southern California, including on/off-road heavy-duty vehicles/equipment, aviation, shipping, and the power sector. Specific off takers were interviewed, and many expressed an interest/willingness to convert from fossil fuels provided GH2 or its fuel derivatives could be procured at sufficient scale and prices competitive with fossil alternatives. Both of these conditions will ultimately require pipeline transport as there is simply not enough space/room or renewable electricity resource located in the LA basin to produce the quantities of green electrolytic hydrogen needed locally.
4. California has sufficient renewable resources and potential for recycled wastewater resources to produce electrolytically produce green hydrogen at the scale to meet the forecasted demand.

HyBuild LA findings are consistent with the preliminary findings from the Angeles Link work to date, including the Angeles Link forecasted demand scenarios for the pipeline sizing (0.5, 1.0 and 1.5 million metric tons per year). Additionally, the GHC found that there was significant renewable resource in the locations identified by Socalgas for third party clean renewable hydrogen production, including locations in the San Joaquin Valley, and near Lancaster CA. GHC also applauds SoCalGas' thorough evaluation of potential geologic storage options for green hydrogen, including not only commercially available salt dome storage but also the potential for hydrogen storage in depleted oil and gas fields.

HyBuild LA also identified significant air quality, public health and economic development opportunities that will result from a scaled green hydrogen economy for Southern California, largely due its ability to displace the combustion of diesel fuel. The impact of reduced emissions is significant - for a single winter month in 2045 the value of public health benefits exceeded $350 million for the LA Basin, representing 27 fewer premature deaths, 964 fewer hospitalizations for respiratory and cardiovascular illness and 7,500 fewer work loss days. GHC concurs with Socalgas that the NOx emissions reductions will largely be driven by conversion of medium to heavy duty trucks and other existing diesel-combustion equipment in the mobility and logistics sectors that cannot be converted to battery electrics due to their duty cycle and hauling loads.

Building a scaled GH2 economy for southern California will also generate diversely skilled jobs, exceeding the quantity of jobs from incumbent fossil fuel industries. The GHC looks forward to Socalgas's future workforce job estimates and encourages Socalgas to ensure that it is comprehensive in its job forecasts to include job creation possible from related infrastructure (eg wastewater treatment) and end use infrastructure (eg. fueling stations) that a common carrier pipeline such as Angeles Link will uniquely enable. Importantly, GHC views the establishment of a scaled green hydrogen economy for California as a key enabler to invest in and upgrade needed infrastructure in adjacent sectors, such as wastewater treatment. On their own, these needed public benefit infrastructure investments may be difficult to finance solely by taxpayers. Including these investments as part of a larger, highly valuable green hydrogen ecosystem can help enable these needed investments. Again, the key infrastructure that makes a green hydrogen ecosystem possible – to achieve mass scale, low delivered GH2 cost -- is shared pipeline transport and storage. Additionally, the GHC's HyBuild LA system planning study found that if California's geologic storage requires connection to out of state salt domes, this connection will need to occur through Southern California due to the difficulty of pipeline siting through the northern part of the Sierra Nevada mountain range. If Angeles Link is to be the first H2 pipeline to connect California to out of state salt dome H2 storage, it will also be critically important for balancing supply

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and demand to northern California as well. It is for this reason that Angeles Link is strategic and necessary for the entire state of California.

Finally, with regard to safety, the GHC applauds Socalgas' approach that includes ongoing collaboration with the Center for Hydrogen Safety. This work should also be closely coordinated with emerging new studies and approaches on the direct measurement of hydrogen leakage and potential solutions to mitigate its occurrence and risks, including potential new technological solutions to remedy these concerns as appropriate/ needed.[1] The GHC appreciates Socalgas' acknowledgement of work that EDF has been conducting with Aerodyne research to better understand the and quantify hydrogen emissions.

The GHC looks forward to participating in the June 21 Quarterly PAG meeting and to the opportunity to further comments as additional analyses are completed.

[1] One such example that is worth noting is "Safety Pipe" sweep gas technology: https://www.h2clipper.com/solutions/safety-pipe

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GREEN HYDROGEN COALITION

HYBUILD LOS ANGELES™ PHASE 2 REPORT

Architecting the Green Hydrogen Ecosystem Vision For a Deeply Decarbonized LA

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AUTHORS:

Janice Lin, Lily Backer, Dhruv Bhatnagar, Collin Smith, Nicholas Connell, Erin Childs, Hope Fasching, Maggie Field, Shawn Carr, Jennifer Gorman, Nina Hebel, Jordan Ahern

HyBuild Los Angeles is an initiative of the Green Hydrogen Coalition.

The Green Hydrogen Coalition (GHC) is a 501(c)(3) educational nonprofit organization dedicated to facilitating practices and policies to advance the production and use of green hydrogen in all sectors and in a technology-neutral manner, supporting the transition to a carbon-free energy system.

The ambitious scope of work undertaken in HyBuild LA Phase 2 was supported by a team of expert consultants:

ADVANCED POWER & ENERGY PROGRAM | ABS | CVA | Pacific Northwest NATIONAL LABORATORY | SheppardMullin | STRATEGEN

ACKNOWLEDGMENTS:

HyBuild Los Angeles brings together a diverse set of participants to collaborate, provide feedback, and guide the final deliverables of the effort. The recommendations in this report are those of the Green Hydrogen Coalition and do not necessarily reflect the views of specific individuals or organizations that participated in the effort.

The Green Hydrogen Coalition extends its deepest gratitude to all HyBuild Los Angeles platform participants, whose engagement and contributions made this effort possible. These participants include, but are not limited to:

ADVISORS:

The GHC appreciates our Advisors, who provided their unique subject matter expertise to support the mission of the initiative:

John Boesel
President and CEO, CalStart

Jack Brouwer
Director, National Fuel Cell Research Center, University of California Irvine

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Madeline Rose
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Keith Wipke
Laboratory Program Manager, Fuel Cell & Hydrogen Technologies, National Renewable Energy Laboratory

DONORS:

The efforts of HyBuild Los Angeles Phase 2 are funded by generous donations from industry participants and an anonymous philanthropic foundation grant. These industry organizations include:

- Airbus Americas, Inc.
- American Bureau of Shipping
- Avantus
- Bloom Energy
- Clearway Energy
- EDF Renewables
- Fortescue Future Industries
- Los Angeles Department of Water and Power
- Mitsubishi Power
- Sheppard Mullin
- SoCalGas
- SPEC Services

COMMUNITY STAKEHOLDERS:

The GHC appreciates all of the local stakeholder groups who provided their time and insights to this effort, either through participation in the Community Impacts Workstream convenings or through conversations with the Green Hydrogen Coalition.

- East Yard Communities for Environmental Justice
- Energy Transition: Tribal Energy Consulting
- International Longshore and Warehouse Union, Local 13
- Los Angeles/Orange Counties Building and Construction Trades Council
- Pacoima Beautiful
- United Steel Workers Local 675
- West Long Beach Neighborhood Association

Additionally, the GHC is thankful to the national and international environmental organizations that participated in the Community Impacts Workstream for their commitment to advancing a clean and just energy transition.

- NRDC
- EarthJustice
- Environmental Defense Fund
- Clean Air Task Force
- CalStart
- Pacific Environment

INTERVIEW PARTICIPANTS

The GHC is grateful for the time and expertise of all stakeholders who provided interviews to support the research process of the Offtake and Infrastructure Workstream.

- 174 Power Global
- AES
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- Avantus
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- Chevron
- Clearway Energy
- Fenix Marine Services
- FirstElement Fuels
- FortisBC
- Golden Empire Transit District
- Infinium
- Iwatani
- Joe Powell (independent expert)
- Kern River Gas Transmission Company
- Los Angeles Department of Water and Power
- Mærsk McKinney Møller Center for Zero Carbon Shipping
- Mitsubishi Power
- Mitsui
- Philipps 66
- Plug Power
- Port of Los Angeles
- Rhys Vigna (independent expert)
- Shell
- SoCalGas
- Somnath Basu (independent expert)
- SPEC services
- States Logistics
- Toyota
- United Airlines
- University of California Office of the President
- Veolia
- West Basin
- World Energy

OTHER OBSERVERS

Last – but certainly not least – the GHC would like to thank the variety of stakeholders who participated in HyBuild LA convenings to observe and learn. These attendees included investors, prospective green hydrogen end users, and representatives from policy and regulatory entities across the West.

1. EXECUTIVE SUMMARY AND KEY TAKEAWAYS

1.1 | INTRODUCTION

Green hydrogen (GH_2)[1] is an essential resource to mitigate climate change by decarbonizing hard-to-electrify sectors, such as maritime shipping, aviation, heavy-duty trucking, firm dispatchable power, high-heat industrial processes, and agriculture. In light of the current war in Ukraine and the surging fossil fuel energy prices around the world, GH_2 can also be a resource to support energy cost stability and greater global energy security. Moreover, GH_2 can support a just and equitable clean energy transition by helping to reduce environmental burdens, while creating family-sustaining job opportunities across sectors.

The United States has reached a pivotal moment for the GH_2 market. The federal government passed two landmark laws – the Infrastructure Investment and Jobs Act (IIJA) and the Inflation Reduction Act (IRA) – which together enable $479 billion in new climate and energy spending.[2] Near-term opportunities are driving swift action from the private and public sectors alike, including the $8 billion Department of Energy (DOE) funding opportunity for regional clean hydrogen (H_2) hubs. Beyond these near-term grants and incentives, driving a market for GH_2 production and use at scale will require unprecedented collaboration across sectors, innovation in technology and policy, new and expanded regulatory and permitting frameworks, and inclusivity.

HyBuild North America™ is the Green Hydrogen Coalition's (GHC) collaborative platform to architect mass-scale GH_2 hubs across the continent. Los Angeles was selected as the first focus region due to its abundance of large-scale offtakers, forward-thinking local leadership, robust decarbonization policies, and ample renewable energy resources for GH_2 production.

HyBuild Los Angeles™ brings together the GH_2 value chain and stakeholder ecosystem across the LA Basin, including GH_2 production, transport, storage, multi-sectoral offtakers, labor unions, environmental and environmental justice leaders, tribal nations, and other interested parties. The platform combines robust technical analysis and stakeholder engagement to facilitate alignment and identify key areas for action to advance a GH_2 economy at scale. Together, this collaborative group unlocked a vision to achieve $2.05/kilogram (kg) of delivered GH_2 by 2030, while identifying and maximizing community benefits from the clean energy transition.[3] Factoring in tax benefits from the recently enacted IRA, this delivered cost estimate is further reduced to $0.69/kg. This target is consistent with the DOE's Hydrogen Earthshot, which establishes a goal of achieving "$1 per 1 kilogram [$H_2$ produced] in 1 decade."[4]

HyBuild LA set out to determine if it is commercially and technically possible to create a mass-scale GH_2 ecosystem that displaces fossil fuels across multiple sectors.[5] The results of HyBuild LA represent a high-level vision and scenario, but the GHC recognizes that a variety of pathways may be pursued to achieve decarbonization in the future. The ultimate roadmap for LA and California will require significant additional research and stakeholder engagement with local communities.

1.2 | HYBUILD LOS ANGELES SCOPE

Over the past two years, HyBuild Los Angeles has focused on developing a mass-scale GH_2 ecosystem in the Los Angeles Basin. The GHC refers to "mass-scale" as the aggregation of a minimum of 0.3–0.5 million metric tons (MMT) GH_2 per year of multi-sectoral demand in targeted locations. Broader industry experience has demonstrated that these volumes are sufficient to take advantage of economies of scale – in particular, enabling establishment of dedicated (100%) GH_2 pipeline transport to significantly reduce the delivered costs for GH_2.[6] This demand would also significantly support the U.S. DOE's National Clean Hydrogen Strategy and Roadmap production target of 10 MMT per year by 2030, 20 MMT per year by 2040, and 50 MMT per year by 2050.[7]

1. The Green Hydrogen Coalition defines "green hydrogen" as hydrogen which is produced from non-fossil fuel feedstocks and has climate integrity. GHC supports a well-to-gate carbon intensity framework consistent with the International Partnership for Hydrgoen and Fuel Cells in the Economy to establish climate integrity.
2. Tom Baker, et al., "US Inflation Reduction Act: Clean Tech Growth Opportunities & Value Pools," Boston Consulting Group, October 2022.
3. This LCOH represents the estimated cost per kilogram delivered to the pipeline backbone. The cost includes electrolytic production of GH_2, wastewater treatment infrastructure, compression, transportation of GH_2 via dedicated (100%) GH_2 pipeline, and mass-scale storage.
4. Hydrogen and Fuel Cell Technologies Office, "Hydrogen Shot," Office of Energy Efficiency & Renewable Energy, Accessed February 8, 2023.
5. In HyBuild LA, technically feasible refers to only utilizing GH_2 production, transport, and storage technologies that are commercially available today.
6. Based on Corporate Value Associate's modeling and interviews with industry stakeholders, transport and distribution become significant cost drivers for GH_2 at delivery volumes under this threshold.
7. U.S. Department of Energy, "DOE National Clean Hydrogen Strategy and Roadmap," September 2022.

The platform focused on the following areas of GH_2 hub ecosystem development:

System Plan Design	• Establish an end-to-end system vision, including qualified annual demand, transportation, storage, and upstream production sources • Develop a levelized cost of GH_2 based on a mass-scale, full system cost • Perform a focused assessment on potential water resources for electrolytic GH_2 production
Community Impacts Analyses and Stakeholder Engagement	• Engage directly with key ecosystem stakeholders, including environmental justice groups, labor unions, and tribal representatives • Assess some of the impacts of a GH_2 economy at scale, including job creation potential and pollution reduction (for the entire South Coast Air Basin and specifically within Disadvantaged Communities)
Policy and Regulatory Innovation	• Develop a suite of policy and regulatory solutions that address key barriers to a scaled GH_2 hub, promote innovation, and reduce costs • Conduct a GH_2 "readiness assessment" of state and local H_2 regulation and oversight applicable to GH_2 systems in California
Contracts and Bankability	• Establish high-level contract terms and conditions to underpin large-scale investments

Due to funding and capacity constraints, the scope and scenarios evaluated in HyBuild LA were limited. For this reason, the analysis does not include the following topics:

- Non-electrolytic pathways for producing GH_2, such as organic waste-to-GH_2
- Environmental impacts related to construction of any portion of the ecosystem
- Potential for and impacts of fugitive H_2 leakage

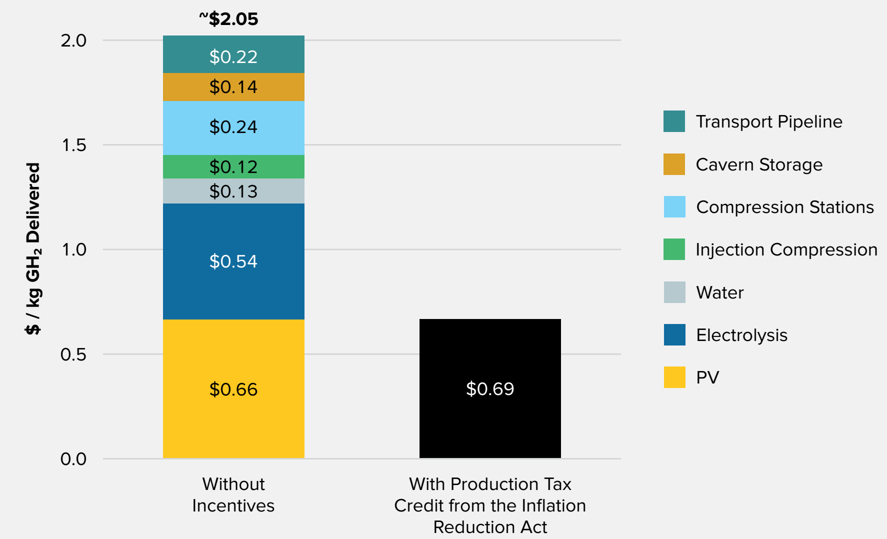
Any infrastructure investments should be evaluated in accordance with federal, state, and local regulatory and permitting requirements, including a full evaluation of potential safety and environmental impacts, alongside meaningful engagement of communities that would be impacted.

1.3 | KEY TAKEAWAYS

Los Angeles (LA) can achieve $2.05/kg delivered GH_2 by 2030, even without incentives. With the tax benefits from the recently enacted IRA, LA's cost of delivered GH_2 can drop to $0.69/kg.
Based on a total demand scenario of 1.4 million metric tons of annual GH_2 demand (roughly 3,836 tons/day), HyBuild LA finds that the LA Basin can achieve a cost of $2.05/kg delivered by 2030 without financial incentives. This levelized cost of delivered hydrogen (LCOH) would make GH_2 competitive with fossil fuels, enabling cost-effective adoption across many hard-to-abate sectors.[8] For example, at this LCOH, the total cost of ownership for heavy duty fuel cell trucks would be cost-competitive with diesel trucks, even after factoring in incremental costs to establish local GH_2 fueling infrastructure.

8. The energy in 2.2 pounds (1 kilogram) of H_2 gas is about the same as the energy in 1 gallon (6.2 pounds, 2.8 kilograms) of gasoline. See: U.S. Department of Energy, "Hydrogen Basics," Alternative Fuels Data Center, Accessed February 8, 2023.

Figure 1 | HyBuild LA levelized cost ($/kg) of delivered GH_2 in 2030, broken down by value chain element. Based on a total estimated demand of 1.4 MMT annually.



Source: Corporate Value Associates Analysis for HyBuild LA, 2022

When factoring in the Clean H_2 Production Tax Credit (PTC) from the IRA, the levelized cost of GH_2 has the potential to reach $0.69/kg.[9] At this price, fuel cell trucks would be highly competitive with diesel alternatives as soon as 2026, substantially accelerating market uptake.

This levelized cost of GH_2 represents an end-to-end system vision for the LA region and includes the following system elements:

Figure 2 | Key infrastructure parameters of the HyBuild LA GH_2 system plan included in the levelized cost of GH_2.

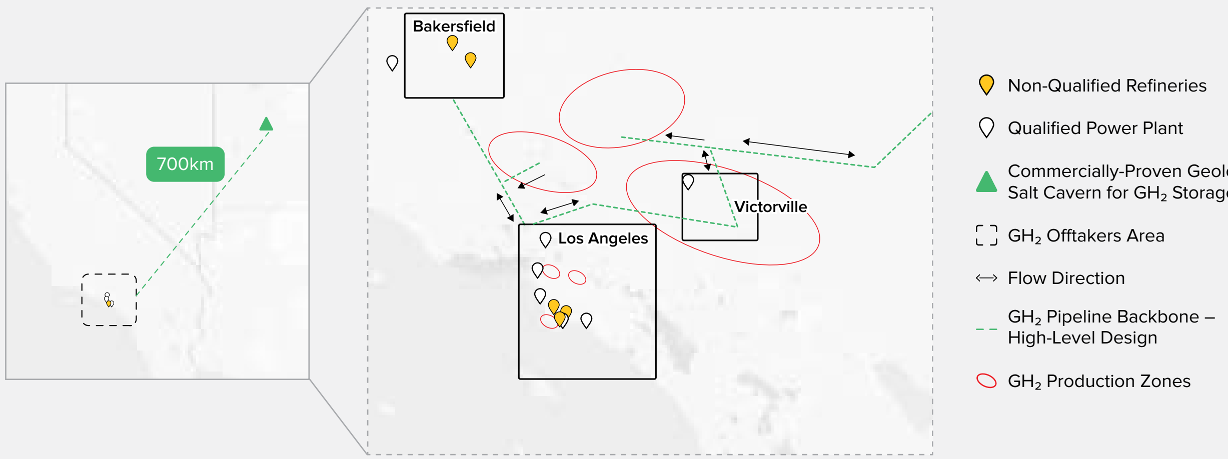
Upstream	**Solar PV Installations**	**28 GWp** – Combined plant capacity **75 TWh** – PV electricity produced per year
	Electrolyzers	**22 GWe** – Combined electrolyzer size **37%** – Average load factor **1.4Mt GH_2** – Annual production of GH_2
	Compression at Injection	**310 MW** – Cumulative compressor capacities **445t GH_2/h** – Max flow
Midstream	**Compressor Stations**	**620 MW** – Cumulative capacities of all compressor stations
	Underground Storage	**130kt GH_2** – Effective maximal capacity **1430M Nm^3** – Effective maximal volume
Downstream	**GH_2 Transport Pipelines**	**1,300 miles** – GH_2 pipeline backbone

9. This analysis assumed that all GH_2 producers would meet the workforce development and other relevant requirements need to receive the full tax credit of $3.00/kg GH_2.

Shared, scaled infrastructure – namely, a dedicated GH_2 pipeline connected to a geologic salt cavern storage resource – is essential to achieving low delivered cost and widespread GH_2 adoption.

A key driver to achieving low delivered cost of GH_2 is shared infrastructure, including transportation via a dedicated (100%) GH_2 pipeline and access to underground geologic salt cavern storage.[10] The HyBuild LA scenario includes a bidirectional transmission pipeline connection with the closest commercially proven salt caverns to California, located in central Utah.[11,12]

Figure 3 | HyBuild Los Angeles Illustrative System Plan.



Note: Electrolytic GH_2 can be produced in Southern California and along the pipeline route. This map is illustrative and does not include all potential offtakers. Refineries and power plants are shown as sample potential offtakers.
Source: Corporate Value Associates Analysis for HyBuild LA, 2021

The end-to-end system vision from HyBuild LA – including the infrastructure required to produce, transport, store, and deliver mass-scale GH_2, and the local liquefaction and fueling infrastructure needed for mobility applications – is estimated to cost about $34 billion over 10 years. It is expected that this infrastructure investment will be stimulated by regional and federal government investment alongside significant private sector investment, helping to support regional economic growth.

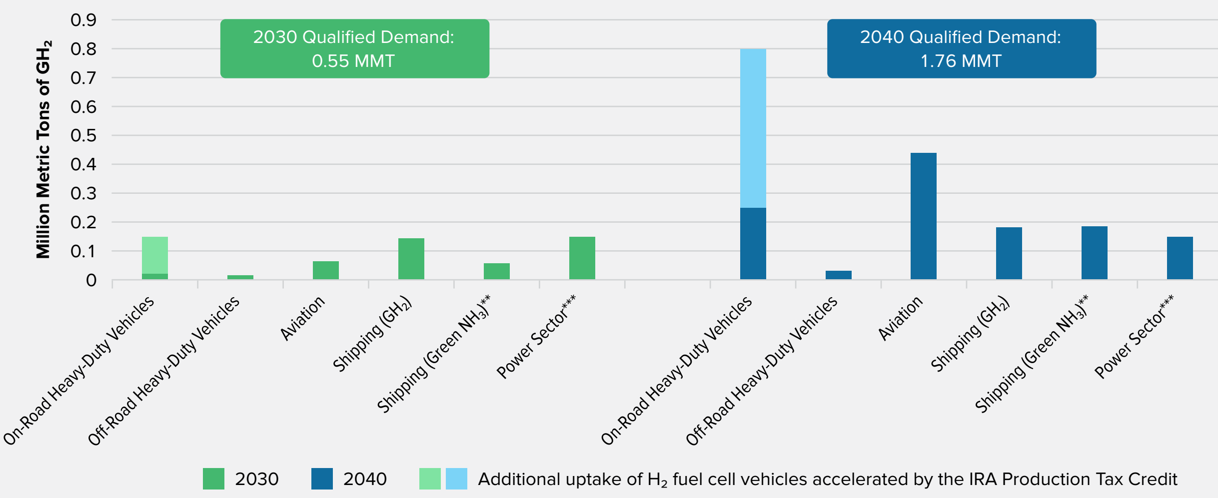
The power sector's use of GH_2 as a clean, firm dispatchable power resource is a strategically important step to jumpstart a GH_2 economy in LA.

Los Angeles is home to a variety of industries that can utilize large quantities of GH_2, including a maritime shipping sector that serves the largest port in the nation, a significant transportation sector for heavy-duty vehicles (e.g., heavy-duty trucks, long-distance coach buses), and a power sector with demand for a clean, firm dispatchable resource to support local electric reliability.

In total, HyBuild LA identified 0.54 MMT of "qualified demand" in 2030.[13] Importantly, this demand is part of a larger, system-wide demand forecast of 1.4 MMT of GH_2 per year in 2030. The 1.4 MMT total demand estimate includes potential "unqualified demand" of 0.85 MMT of GH_2 per year in refineries, which assumes that a portion of fossil-fuel derived H_2 utilized today would be replaced with GH_2.[14]

10. An appropriate tracking and accounting system will need to be established to ensure the carbon intensity of GH_2 in the pipeline system.
11. Aces Delta, "Advanced Clean Energy Storage Hub," Accessed February 8, 2023.
12. Multiple underground salt caverns for H_2 storage are already operational in United States, such as the Linde facility which has been operating for over a decade in Texas. See: Linde Hydrogen, "Storing Hydrogen in Underground Salt Caverns," Accessed February 8, 2023.
13. "Qualified demand" refers to potential demand that was validated through industry interviews or public announcements confirming a future interest or intention to purchase GH_2 if it becomes cost-competitive with existing fuels.
14. HyBuild LA outreached to multiple oil refineries in the LA Basin and were not able to obtain confirmation of plans to switch from grey to green H_2.

Figure 4 | Qualified GH_2 demand in the LA Basin projected for 2030 and 2040, by sector.*



*Potential refinery demand has not been qualified, but may represent up to 0.85 million metric tons of demand annually.
**Due to safety concerns, green NH_3 is unlikely to be produced in the LA Basin from local GH_2 feedstocks.
***2040 Power sector demand was not formally analyzed. However, it is not expected to grow at the same rate as mobility applications.
Source: Corporate Value Associates and American Bureau of Shipping Analysis for HyBuild LA, 2022

Most of the end uses shown in Figure 4 will require an assured, consistent supply of low-cost GH_2 throughout the year. As noted in section 1.3.2, HyBuild LA found that shared infrastructure (transportation via a dedicated GH_2 pipeline and mass-scale underground geologic salt cavern storage) provides the most cost-effective pathway to achieve a stable supply of GH_2 at a low-delivered cost.

To jumpstart the ecosystem and attract the necessary capital investments for shared infrastructure, LA will need visibility into bankable, large-scale offtakers. As a point of reference, the world's largest clean H_2 hub in Europe was enabled by offtake commitments from steel and fertilizer makers, which can utilize large volumes of GH_2 in the near-term. HyBuild LA interviewed and researched a variety of potential "first-movers," and a number of industrial end users.

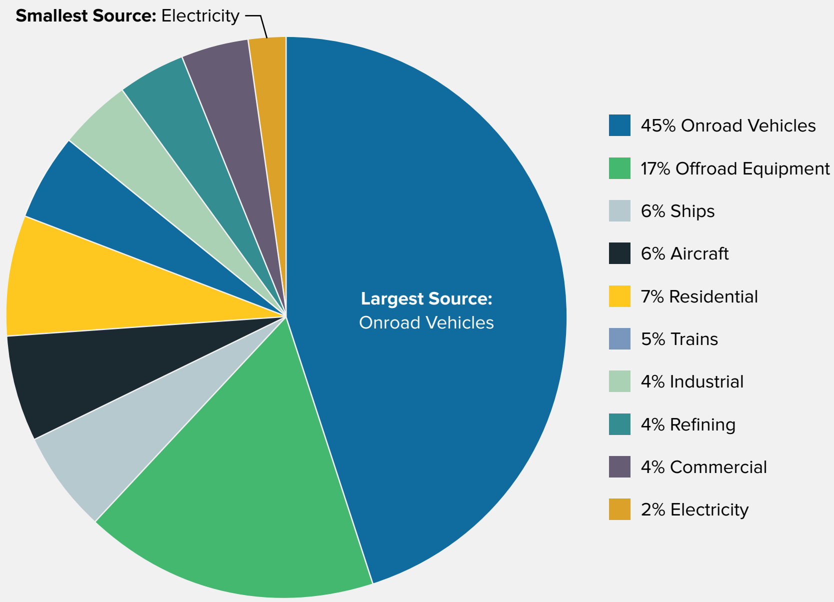
Among those potential applications evaluated, the power sector's need for clean, firm power resources was identified as a key application that requires large quantities of GH_2 near-term, satisfying the City of LA's mandate to achieve 100% renewable energy in the power sector by 2035. Modernization of existing power plants needed for grid reliability (i.e., converting natural gas turbines to greenhouse gas-free GH_2-fueled turbines) enables development of scaled GH_2 supply infrastructure while reusing existing power sector infrastructure, helping the LA Basin to achieve 100% affordable, resilient, and reliable clean energy.

Stable, low-cost supply of GH_2 will enable nearby mobility sectors – which are still heavily reliant on fossil fuels – to transition to GH_2-fueled equipment. Displacing fossil fuels for hard-to-electrify mobility end uses is critical to improve air quality in the region, as combustion of fossil fuels from these sectors (i.e., on-road mobility, materials handling, maritime shipping, and aviation) is collectively responsible for more than 75% of total NOx emissions in Southern California.[15] Interviews from HyBuild LA indicated that fleet owners and operators will not transition to fuel cell equipment until mass-scale, lower cost GH_2 is available. In this regard, power sector applications are highly strategic to launching LA's scaled GH_2 economy to achieve economy-wide decarbonization and pollution reduction.

Although the power sector represents a relatively small share of the region's total nitrogen oxides (NOx) emissions today (<2%), it is critically important that any power plant conversion from natural gas to GHG-free GH_2 combustion undergo environmental review and permitting. This should include permitting that requires NOx emissions from GH_2 combustion to remain at or below all applicable state and local emissions requirements for power plants.

15. California Air Resources Board, "Emissions Projections by Summary Category."

Figure 5 | Existing Southern California NOx emissions by source.

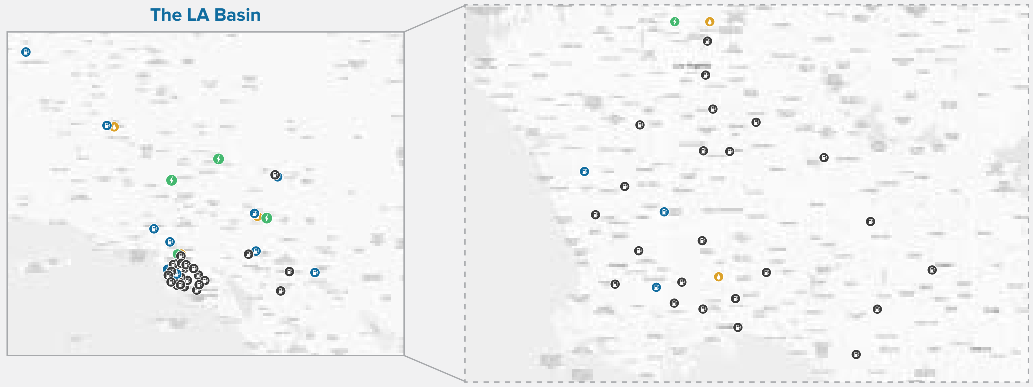


Source: California Air Resources Board.

Serving heavy-duty mobility end uses in the LA Basin will require additional infrastructure, such as local GH_2 compression and liquefaction. Additionally, aviation and maritime shipping sectors will require infrastructure for the production of GH_2 derivative fuels. GH_2 is key to displacing fossil fuels in a variety of difficult-to-electrify mobility sectors such as heavy-duty trucking, offroad equipment with long duty cycles, maritime shipping, and aviation. To ensure a realistic GH_2 adoption scenario, the HyBuild LA demand assessment only considered end uses where GH_2 was considered more cost-effective than alternate decarbonization pathways, such as battery electric options.

By 2040, heavy-duty mobility (including drayage trucks and long-distance buses) is projected to require close to 0.8 million tons of GH_2 per year. To meet this demand, GH_2 fueling stations that are not located near a pipeline are predicted to be served with liquid GH_2 via truck delivery. Liquid GH_2 was selected for the system plan due to its volumetric density for efficient delivery and the maturity of related technologies.

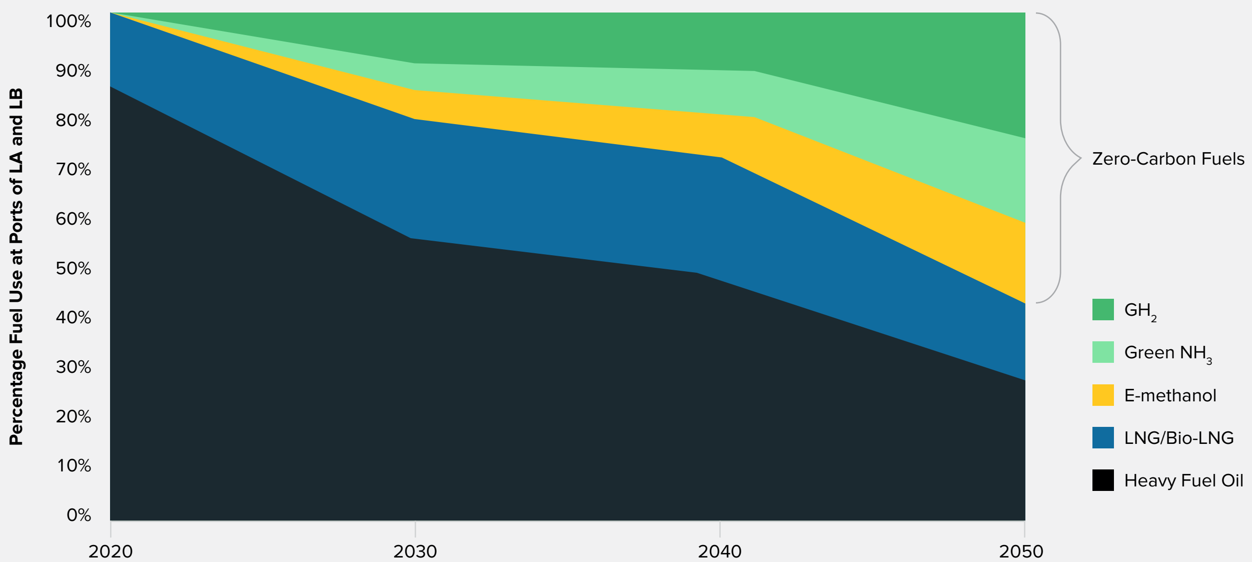
Figure 6 | Illustrative high-level GH_2 system design for mobility applications in 2030.



Note: This map is illustrative. Final location of liquefaction stations and other infrastructure may be impacted by final location of pipeline infrstructure.
Source: Source: Corporate Value Associates for HyBuild LA, 2022

By 2050, over half of the ships entering into the Ports of LA and Long Beach will be powered by zero-carbon fuels, according to the American Bureau of Shipping's analysis for HyBuild LA. GH_2 will play a crucial role in the overall fuel mix, both as a direct fuel and a decarbonized resource to create green ammonia (NH_3) and e-methanol. This transition will be accelerated by already enacted resolutions from both the Cities of Los Angeles and Long Beach, calling on major importers to commit to achieving 100% zero-emissions shipping by 2030.[16]

Figure 7 | Potential adoption of zero carbon fuels in the maritime shipping sector by percentage of total fuel use at the ports of Los Angeles and Long Beach.



Source: American Bureau of Shipping Analysis for HyBuild LA, 2022

16. Ship It Zero Coalition "Setting Sail on a Zero-emissions Shipping Industry by 2030," Accessed February 8, 2023.

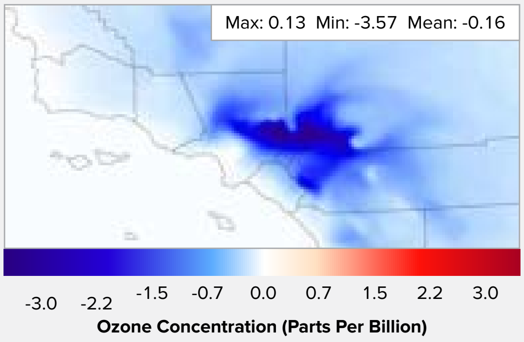
By 2040, aviation will represent the second-largest sector of demand in the LA Basin. GH_2 will primarily be utilized to produce sustainable aviation fuel (SAF) for domestic and international flights departing from Los Angeles International Airport (LAX). SAF is a drop-in fuel for low-carbon aviation that can be blended into fossil jet fuel. Direct use of GH_2 to power short-range flights via fuel cells or combustion may also begin as early as 2035,[17,18] although industry stakeholders expect that this application of GH_2 will ramp up post-2040.

GH_2 use in mobility and materials handling applications will yield significant air quality improvements, resulting in measurable public health benefits.

The use of GH_2 in fuel cells can directly displace fossil fuel use in many hard-to-electrify applications that cause significant pollution (e.g., heavy-duty trucking, port operations equipment with long duty-cycles, and aviation). Since the only emission from GH_2 usage in fuel cells is water vapor, the adoption of GH_2 fuel cell equipment can greatly reduce harmful local pollutants such as NOx and dramatically improve air quality for residents of LA and the greater South Coast Air Basin.

HyBuild LA evaluated the impacts of using GH_2 fuel cell technology in place of diesel combustion equipment for specific hard-to-electrify end uses (heavy-duty trucks, drayage trucks, port equipment forklifts with long duty cycles, and long-distance buses) via an atmospheric modeling study with the University of California, Irvine (UCI). It should be noted that the air quality analysis only modeled emissions reductions associated with mobility use cases where GH_2 in fuel cells was found to be more competitive on a total cost of ownership basis than battery electrification. The figure below demonstrates that the substantial impact the GH_2 adoption scenario (in place of fossil fuel combustion) can have to reduce pollution from these end uses regionally, resulting in benefits such as improvements in ground-level ozone, a pollutant which is caused by NOx and is a key component in smog. The improvements shown in Figure 8 can reduce 23% of ozone non-compliance events with state and federal clean air standards, which is significant given that portions of the region studied (Los Angeles-Long Beach; Bakersfield) experience some of the worst ozone pollution in the United States.[19]

Figure 8 | Improvements in maximum daily 8-hour average ozone (ppb) in July 2045 due to the GH_2 deployment scenario analyzed.



Source: University of California, Irvine Advanced Power and Energy Program for HyBuild LA, 2022

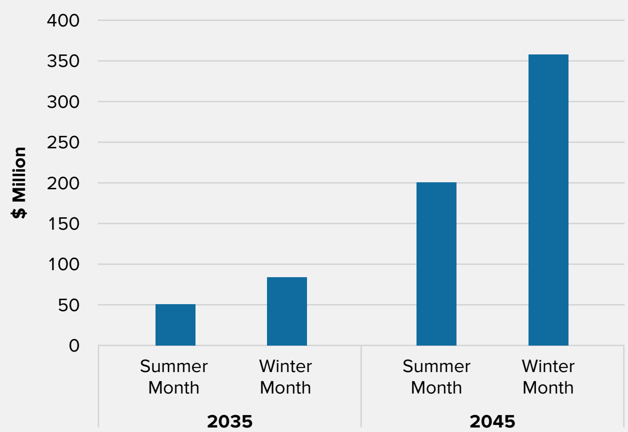
17. Airbus, "ZEROe: Towards the world's first zero-emission commercial aircraft," Accessed February 8, 2023.
18. Some technology providers, such as Zeroavia, have indicated potential for this technology to be commercialized sooner. See: ZeroAvia, "About us," Accessed February 8, 2023.
19. American Lung Association, "Most Polluted Cities," Accessed February 8, 2023.

In total, the improvements in air quality from reduction of the pollutants modeled (ozone and $PM_{2.5}$) would result in measurable public health benefits. Due to computational limitations of the atmospheric model, the UCI analysis measured the impacts during four sample months, one winter month and one summer month in 2035 and 2045.[20] The modeled data for only these four months found that communities in the South Coast Air Basin would experience public health improvements, including:

- 27 fewer premature deaths
- 964 fewer hospitalizations for respiratory and cardiovascular illness
- 7,500 fewer work loss days

For the months modeled, these quality-of-life improvements translate into values exceeding $689 million.

Figure 9 | Estimated value of health benefits for one summer and one winter month associated with the GH_2 adoption scenario modeled in 2035 and 2045.



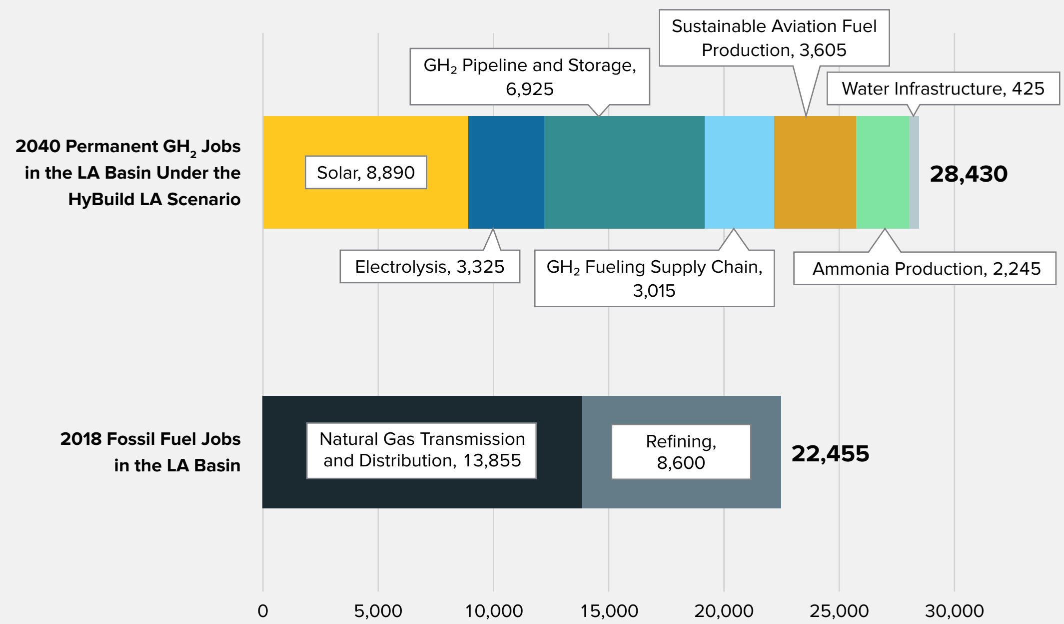
Source: University of California, Irvine Advanced Power and Energy Program for HyBuild LA, 2022

The GH_2 economy will generate diversely skilled jobs, exceeding the quantity of jobs from the incumbent fossil fuel industries in Southern California.

The vision established in HyBuild LA has the potential to create over 28,430 high-quality, full-time jobs to support the range of activities across the value chain needed to serve the LA Basin's GH_2 demand.

20. Given the highly computational nature of these models, the study evaluates one summer month (July) and one winter month (January) for both 2035 and 2045 to demonstrate the effect of seasonal variation.

Figure 10 | 2040 full-time employment in the LA Basin resulting from the HyBuild LA system plan scenario.



Source: University of California, Irvine Advanced Power and Energy Program for HyBuild LA, 2022

More than 65% of these jobs will be in sectors requiring similar skills to incumbent fossil energy jobs,[21] which will create opportunities for workers to transition into the clean energy economy. With the incumbent fossil fuel industry providing over 22,400 jobs in 2040 – many of which are family-sustaining, union jobs – the GH_2 industry can provide meaningful preservation and creation of high-quality jobs and economic development.

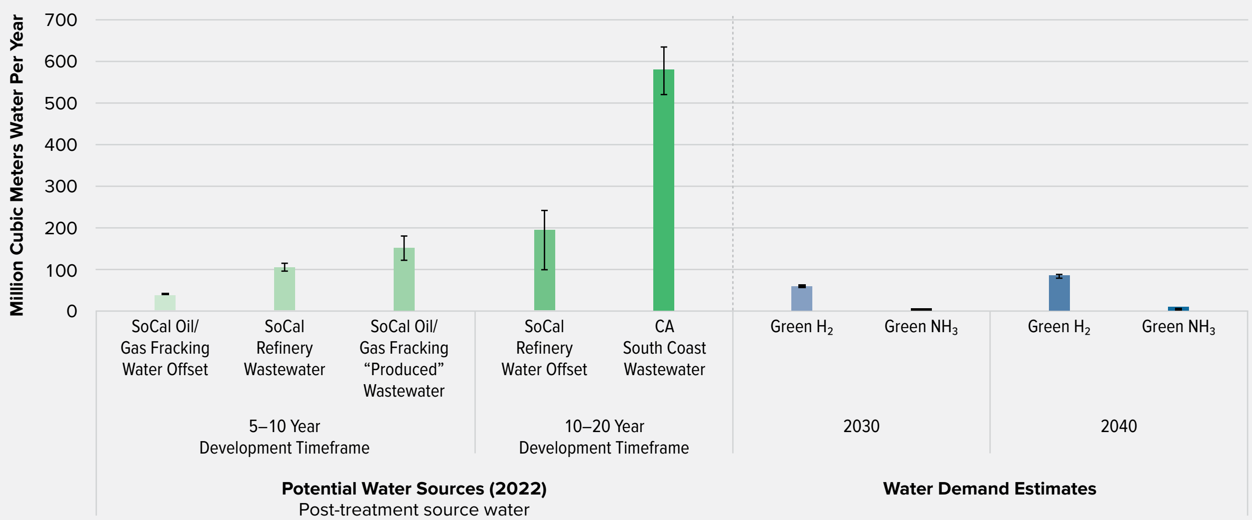
> **"GH_2 is a key technology for both deep decarbonization and the preservation and creation of high-quality, family-sustaining jobs. H_2 can reduce emissions while leveraging both our existing infrastructure and the skills that exist in the current workforce."**
>
> **Brad Markell**
> Executive Director,
> AFL-CIO

21. Jobs considered similar include: GH_2 pipeline and storage; GH_2 derivative fuel production (i.e., green NH_3, e-methanol, SAF); GH_2 fueling supply chain; water infrastructure.

Water needs for electrolytic GH_2 production in the LA Basin can be fully met from wastewater sources for approximately $0.07 – 0.13/kg of GH_2. Demand for recycled or repurposed water for GH_2 production can help accelerate needed investments in wastewater treatment infrastructure.

Considering the severe drought conditions across the Western United States, HyBuild LA modeled the feasibility of utilizing recycled or repurposed water for electrolytic GH_2 production to meet anticipated demand in the LA Basin. The study, conducted by Pacific Northwest National Labs (PNNL), found ample potential sources for recycled wastewater and repurposed water for GH_2 production. Further, the infrastructure required to supply recycled wastewater will only marginally impact delivered GH_2 delivered cost (total water and associated infrastructure costs amount to $0.07–$0.13/kg).[22]

Figure 11 | Potential sources of recycled or repurposed water compared to the water demand of the HyBuild LA scenario.



Note: Error bars represent ranges in model inputs from data sources.
Source: Pacific Northwest National Laboratory for HyBuild LA, 2022

Looking forward, growing demands for recycled wastewater for GH_2 production can help drive private sector investment in water infrastructure that can benefit all Angelenos. It will be critical to further evaluate how water infrastructure needs identified in the water analysis can be supportive of the City of LA's existing plans to recycle 100% of its wastewater by 2035 to reduce reliance on imported water.[23] Notably, any private sector investments from the GH_2 sector into wastewater infrastructure may effectively reduce the cost burden on customers/ratepayers of meeting recycled wastewater goals.

22. Municipal water costs were estimated based on an average of residential rates in California during HyBuild LA Phase 1, which was calculated to be around 3.70 USD / cubic meter (~$10.00 per 100 cubic feet). See: UNC School of Government, "California Small Water Systems Rates Dashboard," July 1, 2020. The incremental cost of utilizing wastewater would increase costs by $0.04 - $0.10/kg GH_2.

23. Los Angeles Department of Water and Power, "Mayor Garcetti: Los Angeles Will Recycle 100% of City's Wastewater by 2035," February 2019.

Expanding the HyBuild LA vision to serve demand in Northern California yields important statewide system benefits. HyBuild LA analyzed a scenario that extends its Southern California GH_2 system vision to serve large-scale demand for GH_2 in Northern California. The analysis identified key synergies that may be realized from a dedicated GH_2 pipeline that connects Southern and Northern California. This system:

- **Enables Northern California to connect to out-of-state geologic salt cavern resources for storage**
  Direct connection to out-of-state geologic salt caverns from Northern California is likely infeasible, as the route would cross the national forests in the Sierra Nevada Mountains. By following existing rights-of-way to establish a connection with Southern California, Northern California can share the link to out-of-state storage resource needed for system balancing.

- **Lowers the cost of electrolytic GH_2 in Northern California by taking advantage of Southern California's solar resources**
  If connected to GH_2 supply from Southern California, Northern California can access its high-yield solar resources, lowering the upstream costs of electrolytic GH_2 by around 15%.

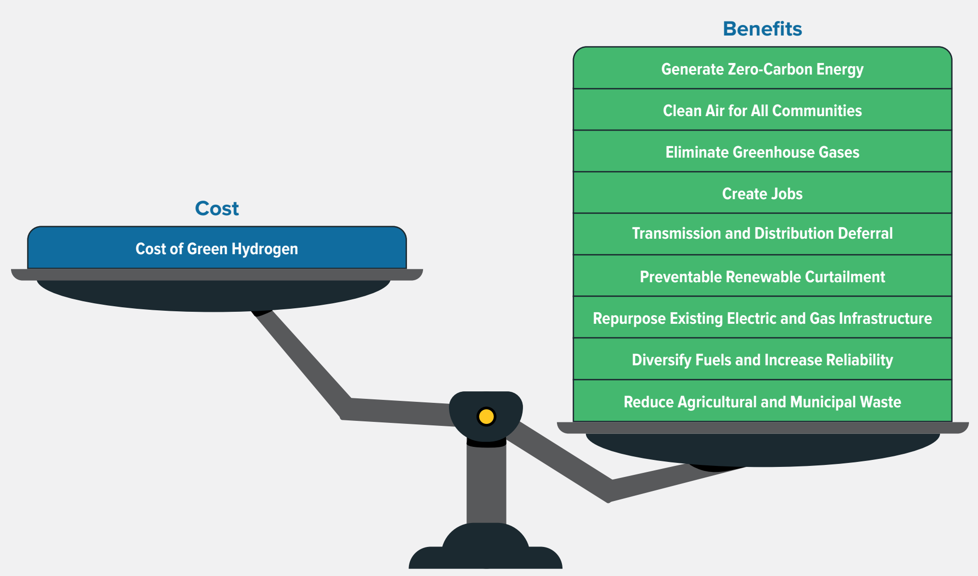
  This connective infrastructure may also unlock potential GH_2 production from organic waste sources throughout the Central Valley. Waste-to-GH_2 pathways, such as gasification of agricultural waste via pyrolysis, can reroute waste streams that have historically been open burned, a process that contributes significantly to local pollution and will be banned by 2025.[24]

- **Enables cost-competitive production of green ammonia (NH_3) for decarbonized shipping and agriculture**
  Once connected to stable GH_2 supply via access to geologic salt cavern storage, green NH_3 can be produced in Northern California and utilized to eliminate the carbon footprint of the fertilizer industry, reduce reliance on NH_3 imports, and power the clean maritime shipping industry.

1.4 | NEXT STEPS: POLICY & REGULATORY INNOVATION

California must accelerate state policy and regulatory innovation to remove implementation barriers and make California the model market for GH_2. Significant policy and regulatory actions are needed to enable private sector investments and jumpstart the state's GH_2 economy.

Figure 12 | Valuing stacked benefits of GH_2.



24. San Joaquin Valley Air Pollution Control District, "Agricultural Burning," Accessed February 8, 2023.

The GHC has developed a suite of policy and regulatory solutions that address barriers to a mass-scale GH_2 hub, promote innovation, and drive down the cost of GH_2 in recognition of its benefits. While the recommendations are written from a California perspective, many are applicable in jurisdictions throughout the United States.

To support the HyBuild LA vision, the GHC recommends the following enabling actions:

Policy and Regulatory Objective	Motivation	Key Actions
Adopt a Statewide Green or Renewable H_2 Definition	Today, each relevant California agency utilizes a different definition for green and/or renewable H_2. Without a common, established definition, it is challenging to establish GH_2 eligibility for compliance with existing state policy and programs. It is also challenging to make efficient, coordinated progress on the development of needed policies and programs to accelerate progress.	Direct state agencies to adopt a universal definition of "renewable H_2" so that eligibility for existing and future state programs, incentives, mandates, and procurement opportunities is clear. The GHC also recommends adopting an internationally recognized well-to-gate lifecycle carbon intensity (CI) framework for green and renewable H_2, which will enable consistency with federal CI requirements for tax incentive eligibility.[25]
Clarify GH_2 Infrastructure Permitting and Siting	The development of GH_2 infrastructure (e.g., production, storage, transport, and dispensing facilities) in California is challenging as a result of complex state and local permitting requirements, differing requirements across local jurisdictions, and insufficient opportunities for community engagement with respect to implementing new infrastructure. Limited understanding of existing standards for GH_2, along with complex permitting and siting requirements, will increase project costs and the timelines required for development.	Direct state agencies to jointly develop a permitting guidebook for the GH_2 supply chain (e.g., production, storage, transport, dispensing, facilities) to help stakeholders – including municipalities – responsibly navigate and safely implement GH_2 projects and infrastructure. As H_2 is already a globally traded commodity, this guidebook may also compile existing safety guidance and best practices from around the world. This guidebook should include optimal locations for permitting and siting GH_2 infrastructure based on: existing local, state, and federal regulation, and the lowest possible burden and risk to local communities.
Conduct a Water Regulation Assessment for GH_2 Production	There is not yet a sufficient understanding of water use regulations by local jurisdiction across the state, particularly for electrolytic GH_2 production. Lack of such knowledge could impact the ability to optimize GH_2 production facility siting.	Assess water use regulations and identify the pros, cons, and implications of using different water resources (e.g., municipal and industrial recycled waste water) for GH_2 production in different regions of the state, based on existing regulations. Publish and clarify findings for all stakeholders.
Certify Technology-Agnostic Renewable H_2 Eligibility in California's Renewable Portfolio Standard (RPS)	Currently, fuel cells are the only RPS-eligible technology that utilize renewable H_2. As a result, California's RPS Eligibility Guidebook does not allow other commercially available and environmentally responsible renewable H_2 technologies – such as combustion turbines and linear generators – to participate in the RPS program.[26] Such technologies can provide clean, firm dispatchable power for grid reliability and resiliency benefits.	Modify the RPS Eligibility Guidebook to ensure all environmentally responsible renewable H_2-capable technologies can participate in the RPS program.[27] Ensure that if the facility uses a combustion process to generate electricity, the combustion process must be appropriately controlled and regulated to meet all required emissions requirements.
Develop A Vision For A 100% GH_2 Pipeline Network in California, WhichWould Eventually Be Interconnected with Other Hubs Emerging Through DOE's Regional Clean H_2 Hubs Program	Coordinated planning is essential to accelerate the development of needed GH_2 infrastructure for California and the broader U.S. Without a plan for a statewide 100% GH_2 pipeline backbone and distribution network, GH_2 transportation will have to occur via truck or rail, which would dramatically increase the final delivered cost of GH_2 and limit scalability. Additionally, the lack of a statewide long-term gas planning strategy prevents important discussions – regarding, for example, the appropriate way to repurpose pipelines – which will impede GH_2 pipeline development.	Require state agencies to jointly develop a statewide vision for establishing a regionally-interconnected California GH_2 backbone. This vision would augment long-term gas system planning to include the evaluation and development of a transition plan to retrofit or replace existing natural gas pipelines with a 100% dedicated GH_2 pipeline backbone and distribution network, analogous to what is being done in Europe via the European H_2 Backbone Initiative.[28]

25. Green Hydrogen Coalition, et al., "IIJA 'Clean Hydrogen' Carbon Intensity Framework," March 14, 2022.
26. Lin, Janice, "RPS Eligibility of Renewable Hydrogen Gas Turbines," The Green Hydrogen Coalition, October 5, 2021.
27. Ibid.
28. European Hydrogen Backbone, "The EHB initiative," Accessed February 8, 2023.

Clarify Jurisdictional Authority for Interstate Dedicated GH_2 Pipelines	Ambiguity exists regarding the entity that has interstate regulatory authority over 100% dedicated GH_2 pipelines. If left unresolved, uncertainty around jurisdictional authority will impede project development, regional pipeline infrastructure progress, access to out-of-state geologic salt caverns for GH_2 storage, and California's ability to achieve mass-scale GH_2 at low delivered cost.	Collaborate with neighboring states and other regional/national institutions to develop the appropriate regulatory or legislative pathways. This is needed to clarify the appropriate regulatory authority to approve and regulate interstate 100% dedicated GH_2 pipelines.
Establish a Safe GH_2 Blending Standard in the Natural Gas Network	Today, transporting GH_2 via truck and rail makes delivered GH_2 unnecessarily expensive. The most cost-effective way to transport GH_2 is via pipeline. While it is estimated to take several years to develop and deploy dedicated GH_2 pipelines, existing natural gas pipeline infrastructure may be able to catalyze progress by storing and transporting GH_2 at certain blending percentages. However, current policy does not allow for this opportunity, from the recent UC Riverside Study, which demonstrated that GH_2 can be safely blended into the existing natural gas grid at fractions at or below 5%.[29]	Establish an interim GH_2 blending standard at a volume fraction of 5% to begin moving GH_2 molecules through California's natural gas pipeline network to catalyze market development in the near-term. The standard should prioritize blending GH_2 into the natural gas system for hard-to-electrify sectors that require an alternative to electrification. While the GHC supports blending as a near-term solution to catalyze the GH_2 ecosystem, blending alone will not achieve the mass-scale vision established by HyBuild LA. Because of the scale, this vision requires dedicated 100% GH_2 pipeline infrastructure connected to out-of-state underground GH_2 storage in commercially-proven geologic salt caverns.
Expand California's Renewable Gas Mandate to Include GH_2	The CPUC, under the direction of Senate Bill 1440 (2017-2018),[30] approved biomethane procurement targets (72.8 billion cubic feet of biomethane by 2030) for gas utilities to meet the broader goal of reducing methane and other short-lived climate pollutants (SLCP) by 40% by the end of the decade.[31] However, GH_2 is not explicitly included in this mandate. As a result, this limits California's ability to support further methane and SLCP reductions from this scalable alternative fuel.	Through legislative direction, require the CPUC to open a new proceeding, or a new phase of an existing proceeding, to consider establishing procurement goals for GH_2 and require each gas investor-owned utility to annually procure a proportionate share of GH_2 to meet those goals.
Develop A Contracts For Difference (Cfd) Program To Accelerate GH_2 In New End Uses Outside Of The Transportation Sector	GH_2 is currently more expensive than incumbent fossil fuels for end users, particularly since the shared 100% GH_2 pipeline transport and geologic salt cavern storage infrastructure has not yet been built. Even after applying the Production Tax Credit in the federal IRA, some applications – such as process heat applications in the industrial sector – still cannot bridge the cost difference that end users may face between GH_2 and incumbent fossil fuel use, particularly in early GH_2 market development stages.	Direct the creation of a state agency-led CfD program that is aimed at reducing the cost gap between GH_2 and incumbent fossil fuels for specific end use applications where needed (e.g., certain industrial process heat applications). The program should aim to provide GH_2 buyers with price certainty for a set period of time, or until GH_2 delivered \$/kg market price is equal to or less than the incumbent fossil fuel market price for the same quantity of energy.
Support GH_2 Refueling Infrastructure for Medium- and Heavy-Duty Vehicles, Ocean-Going Vessels, Harbor Crafts, and Off-Road Equipment	California's H_2 refueling infrastructure system is currently limited to light-duty on-road passenger vehicles. This approach restricts California's ability to fully support decarbonization of other fossil-fueled mobility applications, where low-cost GH_2 can accelerate the transition away from diesel and gasoline. The GHC supports battery electrification where possible; GH_2 will be particularly important for applications with long range or high daily utilization that are difficult to electrify.	Expand the state's H_2 refueling infrastructure credit through the Low Carbon Fuel Standard (LCFS) for medium- and heavy-duty vehicles,[32] ocean-going vessels, harbor crafts, and off-road equipment.

29. Arun Raju, et al., "Hydrogen Blending Impacts Study," University of California, Riverside, June 18, 2022.
30. See SB1440.
31. CPUC, "Decision Implementing Senate Bill 1440 Biomethane Procurement Program," January 25, 2022.
32. See GHC's Joint Letter on Updates to the Low Carbon Fuel Standard (LCFS) Regarding Heavy-Duty (HD) Hydrogen Refueling Infrastructure (HRI).

Develop a Vision for GH_2 Long-Duration Energy Storage (LDES) To Meet Reliability Needs	The state's Integrated Resource Planning (IRP) does not properly plan for the inclusion of GH_2 LDES for electric sector balancing and reliability. As a result, the state may unnecessarily rely on the continued use of fossil-fueled generation to achieve system balancing and reliability, while valuable renewable electricity curtailment increases. Electrolytic GH_2 is a commercially viable resource to achieve multi-day, weekly, and ultimately seasonal storage of low-cost renewable energy.	Consistent with Senate Bill 1369 (2017—2018), direct state agencies to plan and coordinate the procurement of electrolytic GH_2 as LDES through the state's IRP process. This planning process should also consider how to repurpose existing infrastructure to accommodate GH_2 to ensure a clean, reliable fossil-free electric system portfolio that is also affordable for all ratepayers.
Develop Electrolytic GH_2 Tariffs That Recognize the System Benefits of Electrolysis Equipment as a Demand Response Resource	California's grid needs greater flexibility and reliability, as exemplified by recent flex alerts and power outages. It is possible to electrolytically produce and store large amounts of energy for a significant period of time (e.g., days, weeks, or seasons) with GH_2. As a backup energy source for grid resilience, GH_2 energy storage systems can be used in combination with fuel cells, combustion turbines, or linear generators to convert the GH_2 back into electricity. This solution can be used as a demand response resource since it can provide system load when needed, and can also be curtailed during times of grid congestion. Today, no such pricing mechanisms are in place to support this opportunity.	Develop an electrolyzer tariff or demand response program that allows California's load-serving entities to create a "system-beneficial electrolytic GH_2 load." Require these load-serving entities to facilitate the delivery of green electricity to electrolytic GH_2 producers, while also enabling GH_2 producers to access and monetize the system benefits provided by demand-responsive electrolysis production.
Create A Framework to Prioritize Community Impacts in GH_2 Policy Making	Historically, the planning and siting of fossil fuel infrastructure has not sufficiently included the needs and concerns of frontline communities. These communities have been disproportionately harmed by the effects of fossil fuel production and use. The final vision and roadmap for a clean energy transition enabled by GH_2 must equitably include the needs, concerns, and interests of frontline communities through an equitable, transparent, and co-creative process.	As a first step toward a co-creative process, the State, in partnership with communities and environmental justice groups, should develop a community impacts framework that outlines a vision and tangible goals to be incorporated into GH_2 policy development. This framework should include guidance to policymakers and other stakeholders on best practices – such as guiding principles for improving equity, environmental, and energy justice – and a baseline for mitigating, tracking, monitoring, and remedying impacts.

2. WHY LOS ANGELES?

As the first regional initiative in the GHC's HyBuild North America platform, HyBuild LA is intended to be a model for rapid acceleration of additional GH_2 ecosystems throughout the nation. Los Angeles was selected as the first regional focus due to its abundance of potential scaled offtakers, forward-thinking leadership, decarbonization policies,[33,34] and strong renewable resource potential.[35] Once a mature GH_2 industry is developed, California – with its coastal position and many deepwater ports – also has the potential to serve as a net exporter of GH_2 and its derivatives to regions with limited renewable resource capacity. Large scale global procurement opportunities have already begun; for example, in 2022, Japan's largest power generation company issued a global request for proposals (RFP) to procure clean NH_3.[36]

2.1 | THE POLLUTION-REDUCTION POTENTIAL OF GREEN HYDROGEN IN LA'S MOBILITY SECTOR

The Los Angeles Basin currently suffers from some of the poorest air quality in the U.S., ranking highest in the country for ozone pollution.[37] In fact, 75% of the city's NOx emissions, a pollutant which leads to the formation of ozone, comes from diesel and gasoline combustion in mobility applications.[38]

Low-cost, mass-scale GH_2 can rapidly displace diesel and fossil fuels in difficult-to-electrify mobility applications, significantly improving air quality and public health. As home to the largest port in North America, multiple airports, and hundreds of thousands of heavy-duty, fossil fuel-powered trucks,[39] Los Angeles has abundant opportunities to lead the nation and demonstrate the potential benefits of GH_2 at scale.

> **"Access to predictable, large volumes of green hydrogen at less that $3/kg is a gamechanger. If this were the case, we would more rapidly accelerate transition from diesel to green hydrogen fuel cell-based equipment."**
>
> **Scott Schoenfeld**
> Former General Manager,
> Fenix Marine Services

With strong political and industry leadership, LA is already driving momentum for GH_2 in mobility applications. In the maritime shipping sector, the Los Angeles City Council and Long Beach City Council adopted a *Ship it Zero* resolution to support the transition to 100% zero-emission shipping in the San Pedro Bay by 2030.[40] The resolution calls on major global shippers to transition their fleets to zero-carbon fuels. In the aviation sector, World Energy has announced plans to expand their sustainable aviation fuel (SAF) production facility in Paramount by 700% and to transition to GH_2 feedstocks, making it one of the world's biggest SAF producers when work is completed in 2025.[41,42] In the on-road transportation sector, Los Angeles County currently has more H_2 fueling stations than any other county in the nation.[43] Given existing progress at the city and county levels, Los Angeles is well-positioned to lead the nation in GH_2-fueled mobility.

33. Office of Mayor Eric Garcetti, "L.A.'s Green New Deal," 2019.
34. California Senate Bill 100, 2018.
35. U.S. Energy Information Administration (EIA), "Where Solar is Found," Accessed February 8, 2023.
36. JERA Co. Inc., "JERA to Conduct International Competitive Bidding for the Procurement of Fuel Ammonia," February 18, 2022.
37. American Lung Association, "Most Polluted Cities," Accessed February 8, 2023.
38. California Air Resources Board, "Emissions Projections by Summary Category."
39. Quantity of trucks is extrapolated from data on truck registrations in CA and population distributions across the state (). HyBuild LA estimated that 50% of those were heavy-duty and might rely on GH_2 to decarbonize. See: U.S. department of Transportation Federal Highway Administraition, "Truck and Truck-Tractor Registraitions – 2019," November, 2020.
40. Ship it Zero Coalition, "L.A. City Council adopts Councilmember Raman's resolution calling for transportation to 100% zero-emission shipping at port of Los Angeles by 2023," November 9, 2021.
41. Curt Epstein "World Energy To Upgrade Sustainable Fuel Refinery," Aviation International News, April 25, 2022.
42. World Energy "World Energy Secures Permits; Will Completely Convert Its Southern Calif. Refinery to Create North America's Largest, World's Most Advanced Sustainable Aviation Fuel Hub," April 22, 2022.
43. Hydrogen Fuel Cell Partnership, "Station Map," Accessed February 8, 2023.

2.2 | LA'S COMMITTED ANCHOR OFFTAKER

Launching a mass-scale GH_2 hub requires a bankable offtaker to attract investment capital. The Los Angeles Department of Water and Power (LADWP), the nation's largest publicly owned utility,[44] is already demonstrating leadership as a first mover GH_2 offtaker. LADWP will be the largest offtaker of power from the Intermountain Power Project (IPP),[45] North America's largest GH_2 project under development today and the world's first combined cycle gas turbine intentionally designed and built to operate on 100% carbon-free GH_2.[46]

LADWP has also emphasized the role of GH_2 to help them achieve their commitment of 100% carbon-free energy by 2035.[47] This was a key finding in the National Renewable Energy Laboratory's (NREL) 2021 "Los Angeles 100% Renewable Energy Study" (LA100 Study), which is the most robust 100% renewable energy study undertaken to-date.[48] After millions of simulations, the landmark LA100 Study concluded that all paths to 100% renewable energy in the power sector will require thousands of megawatts of firm and dispatchable in-basin capacity to ensure system reliability.[49] The study identifies GH_2 as a leading scalable option to affordably provide electric system reliability and seasonal renewable energy storage.[50]

> **"There is no way to get to 100% renewable energy that I can see right now without hydrogen in the mix. It doesn't exist."**
>
> **Martin Adams**
> Chief Engineer and General Manager,
> Los Angeles Department of Water and Power (LADWP)

44. Jacquelin Cochran, et al., "The Los Angeles 100% Renewable Energy Study," National Renewable Energy Laboratory, NREL/TP-6A20-79444, March 2021.
45. Intermountain Power Agency, "IPP Renewed," Accessed February 8, 2023.
46. Jared Anderson, "Industry consortium pushing to commercialize green hydrogen in California by 2030," S&P Global Commodity Insights, May 17, 2021.
47. Emma Penrod, "As momentum for hydrogen builds, electric utilities chart multiple paths forward," Utility Dive, August 18, 2021.
48. Jacquelin Cochran, et al., "The Los Angeles 100% Renewable Energy Study," National Renewable Energy Laboratory, NREL/TP-6A20-79444, March 2021.
49. Ibid.
50. Ibid.

3. HYBUILD LA VALUES AND PRINCIPLES

HyBuild LA is a collaborative platform that brings together a diverse array of stakeholders that will be impacted by the GH_2 economy. The GHC developed and adheres to a set of values and principles for this initiative, which are intended to provide a framework to facilitate an inclusive and just clean energy transition:

- **Fight climate change and advance energy justice.**
  HyBuild LA's aim is to advance a clean and just energy transition. The vision for GH_2 in LA must prioritize restoration to those who have suffered the most from fossil fuel pollution and emissions, and ensure that these communities have first access to the benefits of clean energy. In identifying pathways forward, it is critical to listen to and respect the historical context of issues elevated by stakeholders.

  In recognition of the urgency of the climate crisis and the adverse health impacts faced by communities across the LA Basin today due to fossil fuel use, HyBuild LA should seek to create near-term, actionable roadmaps that can yield measurable progress to reduce emissions and mitigate climate change.

- **Build community and trust.**
  Creating a resilient and inclusive vision requires engagement from a diverse group of stakeholders and a safe space to express differences of opinion. To create this space, participants must be prepared to listen deeply and with empathy.

- **Employ a transparent and inclusive process that fosters co-creation and shares power and recognition.**
  HyBuild LA is committed to working inclusively with community stakeholders to jointly study and explore questions, areas of interest, or concerns related to GH_2, developing science-based guidance to identify pathways forward. To increase transparency, efforts should have measurable and trackable impact.

- **Foster competition to encourage innovation and reduce cost.**
  The GH_2 economy will require investment throughout the value chain and across sectors. Fostering competitive, technology-agnostic outcomes and a range of business models will help ensure that innovation and investment continue long-term, lowering the burden of the clean energy transition on ratepayers.

- **Cultivate and support champions for change.**
  Positive impacts can be exponentially multiplied by the success of individual champions. A key function of the GHC is to help identify, support, and empower these champions so they can inspire others to advance a clean and just energy transition.

- **Establish a sustainable underlying business and community value proposition.**
  A sustainable business and community value proposition is critical to establishing a cost-effective and self-sustaining infrastructure vision. Any proposed investments must achieve sustainable financial returns that can support private business investors and developers, while creating community benefits that sustain healthy, safe, vibrant local communities.

4. SCOPE AND APPROACH

In Phase 2, HyBuild LA provided a detailed view into GH_2 adoption and infrastructure scenarios in mobility sectors (e.g., aviation, shipping, heavy-duty trucking, and offroad equipment) in collaboration with Corporate Value Associates (CVA) and the American Bureau of Shipping (ABS). Once a 2030 baseline of 1.4 million metric tons of GH_2 demand per year across sectors (both qualified and unqualified) was established, HyBuild LA completed a first-of-its-kind water analysis with Pacific Northwest National Labs (PNNL), evaluating prospective recycled or repurposed water sources and related infrastructure to serve the demand for electrolytic GH_2 in the LA Basin.

Further, HyBuild LA worked with the UCI to analyze some of the quantifiable community impacts of the envisioned GH_2 ecosystem. Specifically, these studies demonstrated significant improvements in air quality and their subsequent public health impacts, as well as the tens of thousands of jobs that will be created to support the development of a GH_2 ecosystem. HyBuild LA hosted four listening sessions with community stakeholders, including environmental justice groups, labor organizations, and tribal nations, to gather input on these analyses and further assess their areas of interest in the GH_2 economy. Taking the learnings from the aforementioned efforts, LA provided policy and regulatory recommendations to enable the vision established in this initiative and provide innovative pathways for benefits. Finally, HyBuild LA worked with Sheppard Mullin to develop a “readiness assessment” of state and local (i.e., California and Los Angeles) regulation and oversight applicable to GH_2 systems.

This work was organized into three core workstreams (Figure 13): (1) Offtake and Infrastructure, (2) Community Impacts, and (3) Policy and Regulatory. The workstreams were managed and coordinated by Strategen, with analytical support from additional expert consultants.

Figure 13 | HyBuild LA Phase 2 scope of effort organized across three core workstreams.

Offtake and Infrastructure

Goal: Understand the demand for GH_2 in the LA region and identify a low-cost scenario for needed infrastructure required to meet demand.

Activities:

- Update regional GH_2 offtake potential, system infrastructure needs
- Explore water needs, potential sources, and infrastructure
- Update cost scenarios to include mobility infrastructure, updated water costs, IRA tax credit opportunities

Community Impacts

Goal: Co-create the vision and roadmap forward with key community stakeholders (including labor, environmental justice, and tribal stakeholders); work together to understand the community value proposition of GH_2.

Activities:

- Engage with key stakeholders to solicit input on areas of interest, opportunity, and concern
- Assess the air quality and public health impacts
- Assess economic development and job creation impacts

Policy and Regulatory

Goal: Identify and prioritize key policy and regulatory recommendations to realize a GH_2 economy at scale.

Activities:

- Identify policy and regulatory barriers and funding opportunities
- Develop innovative policies and programs to value and compensate GH_2
- As relevant, engage with local, state, and regional governments (incl. coordination with the Green Hydrogen Coalition's Western Green Hydrogen Initiative)

Expert Consultants

The following sections provide a detailed overview of each workstream, including their respective key findings and methodologies, to provide greater depth to each topic area synthesized in the Executive Summary.

5. OFFTAKE AND INFRASTRUCTURE WORKSTREAM

The HyBuild LA Phase 2 Offtake and Infrastructure Workstream included three tasks: (1) an assessment of GH_2 adoption by sector, with a focus on heavy-duty mobility and materials handling applications, (2) an analysis of potential sources of water, including recycled or repurposed water resources, to meet the water needs for electrolytic GH_2 production, and (3) an analysis of the levelized cost of GH_2 and capital expenses associated with the HyBuild LA vision.

The following sections delve into these areas in greater detail. Each section will provide an overview of the methodology for the related analyses. HyBuild LA also undertook dozens of interviews over the past two years that underpin all analytical efforts. These expert interviews (detailed in the Appendix) helped to identify the potential for GH_2 adoption in each end use, review and validate assumptions, and provide feedback on the system design.

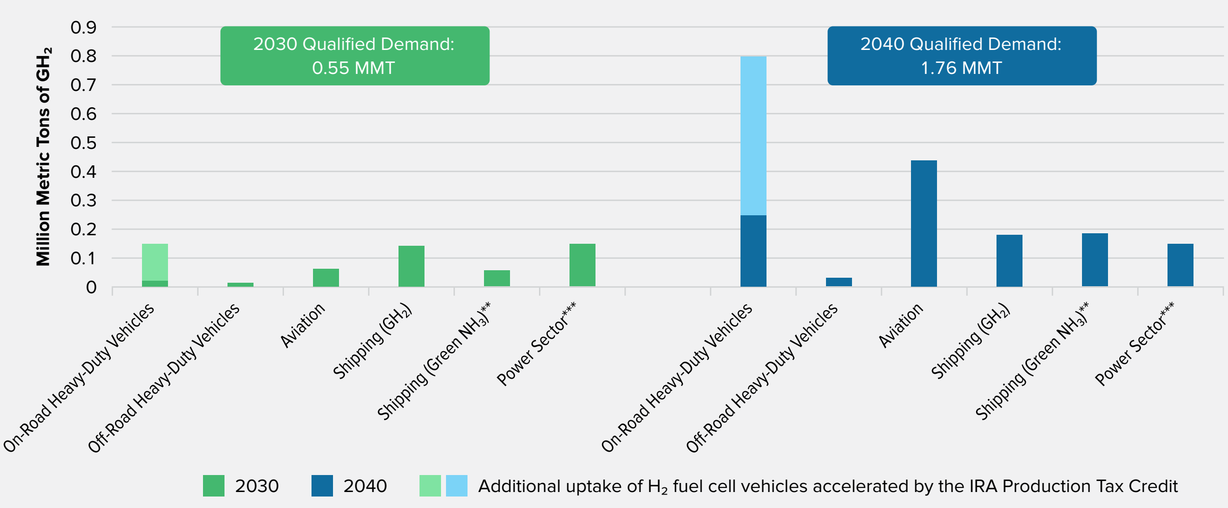
5.1 | GREEN HYDROGEN OFFTAKE ASSESSMENT

The Phase 2 offtake assessment builds upon the estimates of regional GH_2 offtake developed in HyBuild LA Phase 1, which identified a total qualified demand of 0.13 million metric tons (MMT) in 2030 in the power sector.[51] "Qualified demand" refers to potential demand that was validated through industry interviews or public announcements confirming a future interest or intention to purchase GH_2 if it becomes cost-competitive with existing fuels.

Phase 2 qualified an additional demand of approximately 0.43 MMT in 2030 from mobility sectors, including maritime shipping, aviation, and heavy-duty trucking. This estimate includes potential demand for GH_2 to produce derivative fuels, such as sustainable aviation fuels and green NH_3. The demand analysis was led by CVA with support from ABS, who led the maritime shipping demand analysis.

The figure below details the sources of qualified demand identified in HyBuild LA.

Figure 14 | Qualified GH_2 demand in the LA Basin for 2030 and 2040, by sector.*

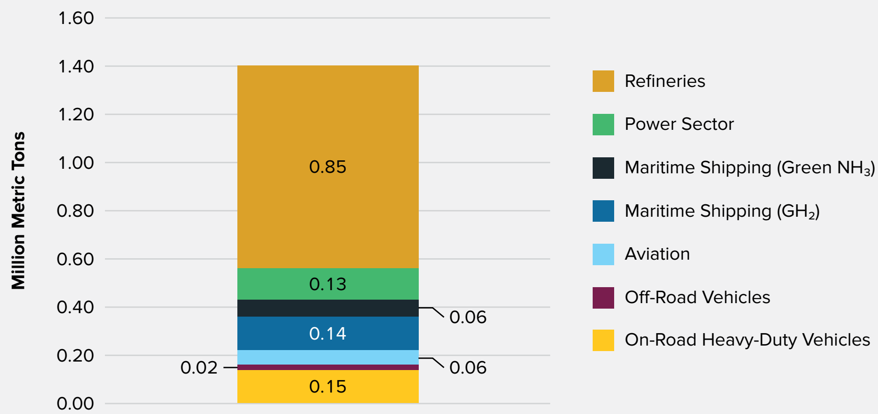


*Potential refinery demand has not been qualified, but may represent up to 0.85 million metric tons of demand annually.
**Due to safety concerns, green NH_3 is unlikely to be produced in the LA Basin from local GH_2 feedstocks.
***2040 Power sector demand was not formally analyzed. However, it is not expected to grow at the same rate as mobility applications.
Source: Corporate Value Associates and American Bureau of Shipping Analysis for HyBuild LA, 2022

51. Qualified demand is defined as demand confirmed through interviews with potential off-takers in the LA Basin. Non-qualified demand is an estimate based on energy and fuel use which could be replaced by green hydrogen or its derivatives, but could not be confirmed during interviews.

Importantly, several of the analyses within the HyBuild LA initiative (water analysis, jobs study, and the system plan) are based upon a GH_2 demand estimate of 1.4 million metric tons of GH_2 per year in 2030. This includes a potential unqualified demand of 0.85 million metric tons of GH_2 per year in refineries, which was assessed in HyBuild Phase 1 and assumes that a portion of fossil fuel-derived H_2 utilized in refineries today would be replaced with GH_2 as it scales and becomes available at a competitive cost. The total potential demand of all major offtake sources in the LA Basin is provided in the figure below.

Figure 15 | Total GH_2 demand in 2030 by sector.



As indicated previously, Phase 2 focused on developing a detailed characterization of mobility demand. The next sections provide a deeper dive into the methodology and findings for the following Phase 2 analyses: (1) land-based mobility, (2) aviation, (3) maritime shipping, and (4) stationary applications.

5.1.1 | Land-Based Mobility

Key Findings

The analysis shows that by 2040, heavy-duty trucks will represent the largest source of GH_2 demand. The associated GH_2 demands for land-based mobility in 2030 and 2040 by sector are identified in Table 1. The analysis only considers end uses that were more cost-effective to decarbonize with GH_2 rather than electrification, which was determined by calculating and comparing the relative costs of GH_2 use vs. electrification for different end uses on a total cost of ownership (TCO) basis (see Figure 16).

Figure 16 | Projected timing for GH_2 cost competitiveness in land-based mobility applications based on total cost of ownership.

Heavy-Duty Trucks

Fuel cell trucks with an operating range up to 400 miles from LA are competitive by **2026**.

Fuel cell drayage trucks operating near the ports are also competitive by **2026**.

Buses & Coaches

Fuel cell coaches for intrastate, long distance trips (ex: Greyhounds from LA to SF) are competitive by **2031**.

Forklifts

~45% of the fuel cell forklifts operating in the LA Basin will be competitive by **2024** (others are expected to be electrified).

Port Material Handling

Rubber-tired gantry cranes, yard tractors, and top-handlers in the Ports of LA and Long Beach will be mostly fuel cell-powered by **2035**, due to zero-emission targets and end user technical requirements.

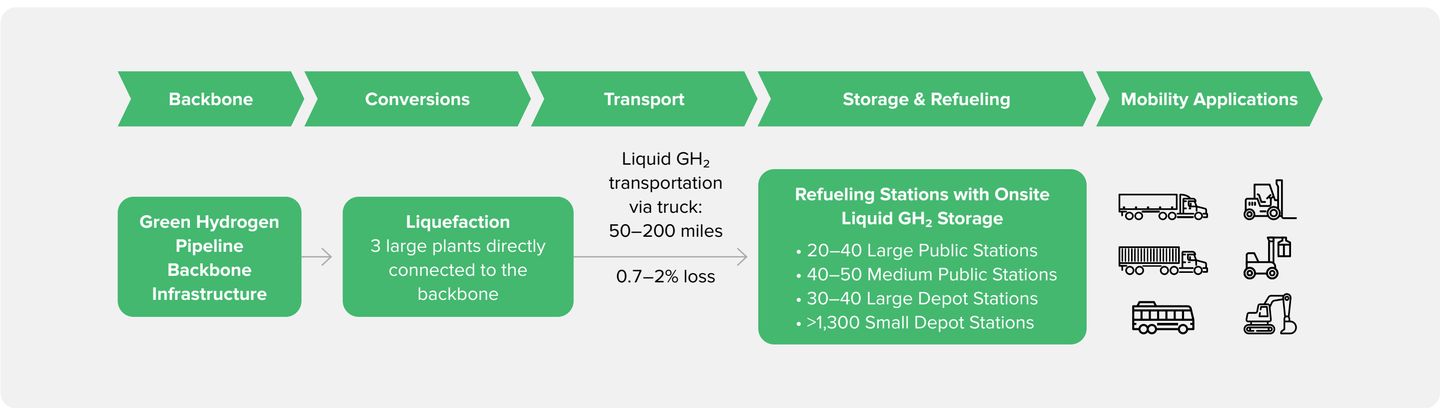
Table 1 | HyBuild LA estimated GH_2 demand from land-based mobility in 2030 and 2040.

Sector	2030 (kt)	2040 (kt)
Heavy-duty trucks	135	705
Drayage trucks	10	77
Forklifts	8	9
Coaches	3	10
Port material handling	7	24
Total	**163**	**825**

HyBuild LA also assumes that GH_2 will be transported in liquid form to supply fueling infrastructure for heavy-duty trucks, long-range buses and coaches, forklifts, and port material handling equipment that are not located close to the GH_2 pipeline backbone. Even though liquid GH_2 requires additional infrastructure compared to gaseous GH_2 (e.g., liquefaction, cryogenic pumps, evaporators, compressors, and buffer storage),[52] its energy density leads to significantly higher carrying capacity for trucks transporting it from the pipeline backbone, resulting in higher delivery capacities and lower overall delivered cost.

The selected delivery scenario assumes a few large liquefaction plants are situated along the pipeline backbone and are located as close as possible to trucking routes, the ports, and the city center. Within the LA Basin, refueling stations (both public and privately-owned) could be supplied with liquified GH_2 via truck delivery within a 50–200-mile radius from the liquefaction plants. Truck delivery of liquid GH_2 may be feasible for dispersed refueling infrastructure that is located beyond 200 miles from the GH_2 pipeline backbone, particularly if located along major transit corridors. However, if sufficient demand can be aggregated to justify implementation of a distribution pipeline, distribution pipeline delivery will be more cost-effective than truck delivery of liquid GH_2. Figure 17 walks through the GH_2 delivery flow for land-based mobility end uses.

Figure 17 | HyBuild LA 2030 high-level flow for GH_2 serving land-based mobility end users.



Methodology

HyBuild LA first developed an overview of potential GH_2-fueled mobility end uses and then identified an estimated total demand based on a realistic technology adoption scenario. To estimate demand, CVA and Strategen conducted over a dozen interviews with potential offtakers within the LA Basin, including fleet operators, fuel station owners, and OEMs to (1) qualify their energy transition strategies and willingness to shift towards low-carbon powertrains, (2) verify their fleet size and use profiles to assess their potential GH_2 demand, and (3) determine the economics that would make GH_2 competitive with alternative low-carbon technologies. Insights from these interviews, coupled with supplementary research, were used to develop a GH_2 demand estimate for land-based mobility end uses for 2030 and 2040.

52. Mario Conte, et al., "Hydrogen as Future Energy Carrier: The ENEA Point of View on Technology and Application Prospects," Energies, March 24, 2009.

In order to identify the most impactful mobility end uses that warranted further analysis, these end uses were prioritized based on (1) potential emissions reduction from GH_2 use, (2) the maturity of required technology, and (3) competitiveness of GH_2 with other decarbonization options. To ensure that HyBuild LA was only considering end uses that were least likely to be electrified, CVA calculated the relative costs of GH_2 use versus electrification on a TCO basis. Any end uses where electrification was a more cost-effective option were excluded from the demand analysis. As a result, estimates for HyBuild LA's demand estimates only include demand from end uses where GH_2 emerged as the more cost-effective decarbonization pathway.

The methodology for assessing this is the same across land-based use cases, with four main components:

1. **Development of route profiles to determine where and how far vehicles travel, as well as what share of fleet vehicles engaged in different types of trips.** These route profiles were created based on public sources and CVA case experience. Interviews were conducted to validate mileage, profiles, and locations.

2. **Analysis of refueling or recharging setup.** The refueling system was assessed using hypothetical scenarios based on benchmark data and trip modeling. The feasibility of the approach was validated through interviews. If no significant GH_2 application was evident after these first two steps, the third and fourth steps were not completed.

3. **Total cost of ownership analysis.** This was carried out to determine whether GH_2 is cheaper to operate than the alternatives (battery electrification), as well as the year in which GH_2 would become cost competitive. The TCO was modeled through a discounted cash-flow approach at each potential year, solving for a net present value of zero with a weighted average cost of capital of 6%. The model also incorporated future changes in vehicle prices and fuel costs (e.g., GH_2, electricity, diesel).

4. **Fleet penetration model.** This model determined the quantity of GH_2 vehicles in use in LA at different times and helped to identify drivers of demand. Cost- and regulation-driven demand for GH_2 vehicles was used to model fleet penetration of these vehicles, based on expected fleet growth and replacement rates. This fleet penetration assessment was then used to calculate total GH_2 demand.

CVA utilized the outputs from steps 1 – 4 as data points to estimate quantities of GH_2-powered vehicles, the annual GH_2 demand, the type and number of refueling stations required, the vehicle's TCO, and the constraints and conditions driving penetration of GH_2-fueled mobility. Applications that were projected to be unlikely candidates for GH_2 adoption include diesel trains, city buses, local and last-mile delivery trucks, light-duty vehicles, and construction equipment.

The analysis considered several potential GH_2 transport methods to determine the infrastructure needs to fuel land-based mobility applications. Ultimately, the analysis modeled two primary potential pathways to transport GH_2 from the GH_2 pipeline backbone to a fueling station:[53]

A. Gaseous GH_2: GH_2 can be compressed and then loaded onto a truck for delivery to compressed GH_2 storage. Trucks carrying gaseous GH_2 were assumed to have a capacity of approximately 160 to 300 kg.

B. Liquid GH_2: Once converted into a liquid via liquefaction, GH_2 can be delivered via truck, with a capacity between 2,000 and 6,000 kg per truck, to liquid GH_2 storage. From there, the GH_2 travels through a cryogenic pump, an evaporator, a compressor, and then into buffer storage.[54]

Ultimately, local GH_2 transport via truck as liquid GH_2 was determined to be the only commercially viable technology that could transport the required volumes of GH_2 from a pipeline to distributed fueling stations, so it was selected over gaseous GH_2 delivery for the purposes of the analysis.

53. Other pathways considered, such as transport via liquid organic hydrogen carriers (LOHCs), were excluded due to their pre-commercial status.
54. Mario Conte, et al., "Hydrogen as Future Energy Carrier: The ENEA Point of View on Technology and Application Prospects," Energies, March 24, 2009.

5.1.2 | Aviation

Key Findings

HyBuild LA estimates that starting in 2030, GH_2 will be utilized to produce SAF for domestic and international flights departing from Los Angeles International Airport (LAX). SAF is a drop-in fuel for low-carbon aviation that can be blended into fossil jet fuel (JET). Expected demand for SAF is identified for 2030 and 2040 in Table 2. By 2040, aviation is expected to represent the second largest source of GH_2 demand in the LA Basin.

Table 2 | HyBuild LA estimated GH_2 demand from the aviation sector in 2030 and 2040.

GH_2 Demand for Aviation (input to SAF production)	
2030	62 kt
2040	440kt

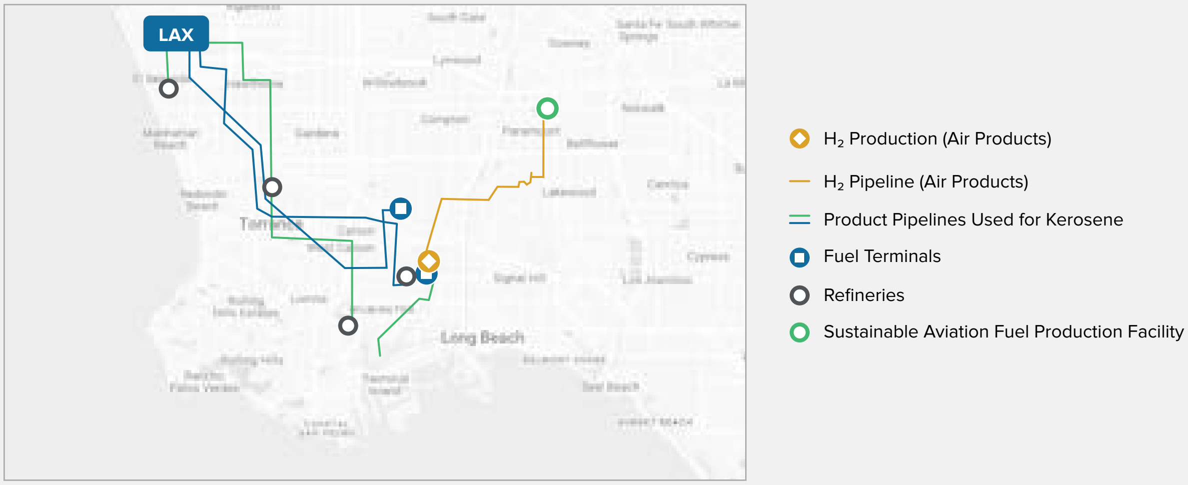
The estimate considers factors such as public corporate commitments that are likely to drive the demand for SAF, binding requirements for SAF and E-Kerosene adoption in Europe, subsidies, and more. The demand estimate also incorporates current regulatory limits on the blending of SAF into fossil JET. While the cost of SAF will not be competitive with fossil-derived JET in the evaluated timelines, cost competitiveness is not a primary driver of adoption; rather, local regulations, blending commitments and mandates, and limited availability of other low-carbon feedstocks contribute to increasing demand. Prices are anticipated to decrease with the technological maturity of GH_2 and carbon captured fossil fuels, both of which are feedstocks of the SAF process.

Figure 18 walks through the GH_2 delivery flow scenario for aviation in the LA Basin.

Figure 18 | HyBuild LA 2030 high-level flow for GH_2 serving the aviation sector, including sustainable aviation fuel production.

In the HyBuild LA adoption scenario, SAF would be supplied to LAX via a dedicated pipeline from Paramount, CA, which is home to a renewable fuels production facility operated by World Energy. Currently, existing JET pipelines run from nearby refineries to LAX; this infrastructure is shown in Figure 19. The HyBuild LA scenario envisions new pipeline capacity to connect additional production at the World Energy facility with this system.

Figure 19 | Current fuel terminal and product (kerosene) pipelines serving LAX.



Source: Corporate Value Associates for HyBuild LA, 2022

Methodology

Several aviation decarbonization solutions were evaluated for maturity via interviews and a review of relevant literature, with the results summarized in Table 3 below.[55] The maturity assessment concluded that SAF is the most mature and potentially competitive pathway for decarbonizing aviation compared to other alternatives. While green ammonia and GH_2 propulsion show exciting promise, they are unlikely to influence significant GH_2 demand before 2040.

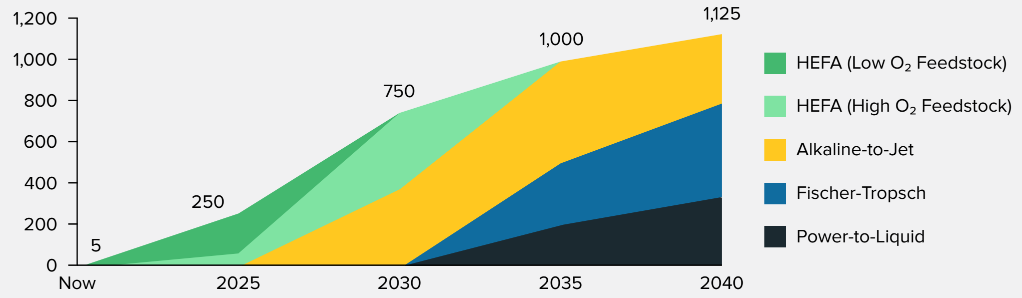
Table 3 | Sustainable aviation fuel maturity assessment summary.

Fuel Vector	Propulsion Technology	Fuel Storage	Maturity Phase	Commercial use in US
Drop-in SAF from organic feedstock	Jet engine (existing technology)	Existing JET storage (blended)	Mature Pilot Phase: Already blended across US; LAX and SFO have pilots	Current
Drop-in E-Kerosene SAF (Power-to-Liquid)	Jet engine (existing technology)	Existing JET storage (blended)	Pilot Phase: Small scale pilots currently underway	2025 (uncertain)
Direct GH_2 Use in Internal Combustion Engine or Fuel Cell	GH_2 turbo-jet, GH_2 or electric turbo-fan	Cryogenic GH_2 with special airframe design	Pilot Phase: Initial pilot flights planned, commencing 2025 with greater adoption after 2035	Pilots starting by 2025 with greater adoption >2040

55. Kristi Moriarty, "U.S. Airport Infrastructure and Sustainable Aviation Fuel," National Renewable Energy Laboratory, NREL/TP-5400-78368, 2021.

The HyBuild LA SAF demand analysis anticipates a shift of SAF production from hydrotreated esters and fatty acids (HEFA) feedstocks into more advanced and GH_2-intensive production pathways, based on technology maturity and feedstock availability, as indicated in Figure 20. The SAF production in 2025 is projected to utilize HEFA feedstocks, but by 2040, HEFA use is projected to be replaced by an even distribution between Alkaline-to-Jet, Fischer-Tropsch, and Power-to-Liquid production methods. All of these pathways require GH_2 as an input, increasing demand.

Figure 20 | Estimated SAF production quantities in the LA Basin by production pathway.



Source: Corporate Value Associates Analysis for HyBuild LA, 2023

Table 4 | GH_2 requirements of sustainable aviation fuel production pathways.[56]

SAF Production Route	Product	GH_2 demand (kg GH_2 / gallon SAF)	Other Feedstock
HEFA	Synthetic Paraffinic Kerosene	~0.13-0.37	Vegetable or animal oils
Alcohol-to-Jet	Synthetic Paraffinic Kerosene	~0.04	Iso-Butanol or Ethanol e.g., from ligno-celluloses[57]
Fischer-Tropsch	Synthetic Paraffinic Kerosene	~0.5-1.0	Ligno-celluloses
Upgrading Pyrolysis Oil	Synthetic Paraffinic Kerosene	No Data	Ligno-celluloses
Power-to-Liquid	E-Kerosene	~1.6	CO_2 from direct air capture

Source: Corporate Value Associates Analysis for HyBuild LA, 2023

56. Ausilo Bauen, et al., "Sustainable Aviation Fuels: Status, challenges and prospects of drop-in liquid fuels, hydrogen and electrification in aviation," John Maatthey Technology Review, 2022.
57. Ligno-celluloses may include agricultural or forestry waste.

5.1.3 | Maritime Shipping

Key Findings

HyBuild LA projects that GH_2 will be utilized to power transoceanic and port vessels directly and as a feedstock for green NH_3 and e-methanol, reaching a cumulative GH_2 demand of 260 kt by 2040 (see Table 5).

Table 5 | HyBuild LA estimated GH_2 demand from the maritime shipping sector in 2030 and 2040.

GH_2 Demand for Transoceanic and Port Vessels[58] (Includes GH_2 for direct use and as a feedstock for green NH_3)	
2030	196 kt
2040	360 kt

Green NH_3 can be produced by combining GH_2 with nitrogen via the Haber-Bosch process. This fuel is discussed as an option for shipping decarbonization as it does not emit any CO_2, has high energy density, and (unlike liquid GH_2) does not require cryogenic storage.[59] The largest use of NH_3 today is to create fertilizer, a process which currently utilizes H_2 made from fossil fuels. If GH_2 is used in this process instead, the produced ammonia is considered zero-carbon or "green."

E-methanol is typically produced by combining GH_2 and CO_2. If the CO_2 utilized is captured directly from a neutral source (e.g. direct air capture), e-methanol is considered a net-carbon-neutral fuel when combusted. It is viewed by the international shipping community as an accessible step towards zero-carbon shipping, as fossil-fuel based methanol is already available and utilized as a shipping fuel today.[60] Demand for e-methanol as a decarbonized shipping fuel was not included in the GH_2 demand assessment as the required quantities of GH_2 in e-methanol production are not as significant as for green NH_3, and the impact on the demand estimate would have been minimal.

The analysis estimates the end user cost for GH_2 supplied to ships in the Ports of LA and Long Beach will be $5.35 – $5.85/kg in 2030, assuming that a "base" delivery price of $2.05/kg delivered to the pipeline backbone in the LA Basin is achieved.[61] The incremental cost ($3.30 – $3.80 in addition to the cost at the pipeline backbone) accounts for the cost of liquefaction, local storage, and dispensing equipment. Liquefaction makes up the majority of these costs and is assumed to occur at a system located close to the ports, operating at a capacity of 400 tons of GH_2 per day with 90% utilization. For reference, GH_2 used in fuel cell-powered cargo ships would likely need to be priced around $5.40 to be cost-competitive against bunker fuel.[62] Additional details on end-user costs in the Ports of LA and Long Beach are provided in Appendix A.

Based on stakeholder feedback, the HyBuild LA scenario assumes that green NH_3 is unlikely to be produced or dispensed in the densely populated areas near the Port of Los Angeles and Long Beach. As such, it should be noted that the demand for GH_2 to produce green NH_3 may occur outside of the LA Basin. An alternative scenario detailing the potential of green NH_3 production in Northern California can be found in Section 6.

Methodology

The demand forecast is derived from the ABS' "Zero Carbon Outlook" report, which identified expected demand for low-carbon fuels across the global shipping industry out to 2050.[63] The viability of identified zero-carbon fuels (e.g., clean H_2, NH_3, methanol) are also supported by a report from the Ocean Conservancy.[64] The forecasts from the ABS report were adjusted for the HyBuild LA scenario, accounting for the ambitious emission reduction commitments that the Cities of LA and Long Beach have made for their ports, which indicate that they would be adopting zero-carbon fuel alternatives more rapidly than the global average. Specifically, the demand estimate assumed that the "Green Shipping Corridor" between LA and China would be decarbonized by 2030, primarily through the use of GH_2-powered ships.[65,66]

58. Regional best case with 10% of energy delivered from GH_2 and 3.5% from green ammonia.
59. Charles Haskell, "Decarbonizing shipping – could ammonia be the fuel of the future," Lloyds Register, May 6, 2021.
60. Dolf Gielen, et al., "Methanol as a scalable zero emission fuel," Global Maritime Forum," March 21, 2022.
61. Factoring in the Clean H_2 Production Tax Credit from the IRA would further decrease costs.
62. Assumptions based on American Bureau of Shipping analysis and professional opinion. Hydrogen fuel cell efficiencies based on: Elise Georgeff, et al., "Liquid hydrogen refueling infrastructure to support a zero-emission U.S.-China container shipping corridor," International Council on Clean Transportation, Working Paper 2020-24, October 2020.
63. American Bureau of Shipping (ABS), "Setting the Course to Low Carbon Shipping: Zero Carbon Outlook," 2022.
64. University College London, "Green hydrogen is the best option to transition the shipping industry away from fossil fuels," April 19, 2022.
65. ABS was an active participant in the O&I workstream and led this analysis.
66. Elise Georgeff, et al., "Liquid hydrogen refueling infrastructure to support a zero-emission U.S.-China container shipping corridor," International Council on Clean Transportation, Working Paper 2020-24, October 2020.

The adjusted forecast was applied to the expected demand for bunkering fuel in the Ports of LA and Long Beach. Expected demand was calculated by applying a 2.5% annual scaling factor to existing demand, which was based on ABS's forecasted growth in the maritime shipping industry. This yielded estimates for direct use of both GH_2 and green NH_3 in ships in both ports. The estimated demand and adoption rates were refined and validated according to the maritime shipping industry's asset investment forecasts and current demonstration projects.

These inputs and assumptions were used to create a "regional best case" estimate for shipping fuel demand, which was the basis for the overall regional demand used to develop a GH_2 infrastructure system plan (see Table 6).

This best-case scenario estimates that 10% of energy to fuel transoceanic and port vessels in the Ports of LA and Long Beach will be delivered from GH_2 and 3.5% from green NH_3 in 2030, based on expected use of each fuel. The results from this assessment indicate a demand of 315 kt/year of GH_2 as a feedstock for green NH_3 and 140 kt/year of GH_2 for direct use in 2030. By 2040, GH_2 as a feedstock for green NH_3 and direct GH_2 demand is expected to increase to 800 kt annually and 210 kt annually, respectively.[67] A conservative global forecast was also developed as a comparison point, based exclusively on the fuel allocations forecasted in the "Zero Carbon Outlook" report (see Appendix A).[68]

Table 6 | Regional best-case estimate for maritime shipping fuels.[69]

Regional Best-Case Estimate (Million Metric Tons)	2019	2030	2040	2050
Heavy Fuel Oil (HFO)	2.84 (86%)	2.47 (57%)	2.66 (48%)	1.85 (26%)
Liquid Natural Gas (LNG)/Bio-LNG	0.38 (14%)	0.88 (27%)	1.13 (25%)	0.87 (15%)
E-Methanol	0 (0%)	0.50 (6%)	0.86 (8%)	2.20 (16%)
Green NH_3	0 (0%)	0.31 (3.5%)	0.80 (7%)	2.65 (18%)
GH_2	0 (0%)	0.14 (10%)	0.21 (12%)	0.58 (25%)

67. Ibid.
68. American Bureau of Shipping (ABS), "Setting the Course to Low Carbon Shipping: Zero Carbon Outlook," 2022.
69. Elise Georgeff, et al., "Liquid hydrogen refueling infrastructure to support a zero-emission U.S.-China container shipping corridor," International Council on Clean Transportation, Working Paper 2020-24, October 2020.

5.1.4 | Stationary Applications: Power Sector and Refinery Operations

Key Findings

HyBuild LA estimates that power generation and refinery operations may represent significant sources of near-term aggregated demand by 2030, reaching 130 kt of demand per year in the power sector and an estimated 850 kt (unqualified) of demand per year in refinery operations.

Table 7 | HyBuild LA estimated GH_2 demand from stationary applications in 2030 and 2040.

	Demand in Stationary Applications	
	Power Sector	**Refinery Operations** (Not Qualified)
2030	130 kt	850 kt
2040[70]	Unknown	Unknown

While 2040 demand for GH_2 from these stationary applications is not shown in this report, demand for GH_2 from the power sector and refinery operations is not expected to grow at the same rate as other end uses (e.g., mobility). In the power sector, the analysis assumes that GH_2 will serve the need for clean, firm power to support electric sector resiliency and accommodate peak demands. Given this role, power plants are expected to have much lower utilization in the future. In refinery operations, GH_2 demand is expected to decrease by 2040, assuming that the global transition to renewable energy and California's bans on internal combustion engine vehicle sales will decrease demand for fossil fuels and refinery operations.

The power sector is considered a near-term offtaker for GH_2 because most gas turbines, both combined cycle and simple cycle, can already operate on a blend of GH_2 and natural gas and could transition to the utilization of 100% GH_2 with turbine upgrades.[71] Concentrated, predictable demand for GH_2 in the power sector can support investment in GH_2 transport and storage infrastructure, driving economies of scale and fostering accelerated GH_2 adoption in other, highly-polluting sectors in the region, such as heavy-duty trucking, materials handling equipment, maritime shipping, and aviation.

Today, oil and gas refinery operations represent the largest use of H_2 in the region.[72] This sector has the potential to be a near-term offtaker because GH_2 can be utilized as a direct replacement for the fossil fuel-derived H_2 used in refining, without additional end user equipment investments. However, it is important to note this demand is not considered "qualified" since multiple interviews with refineries during Phase 1 of HyBuild LA did not indicate plans to incorporate GH_2 or transition to low-carbon options.

Assumptions and Methodology

GH_2 demand in the power sector is based upon data from current and expected natural gas demand in LA Basin gas turbine power plants. Interviews were conducted with specific power plant owners and operators to validate assumptions and estimates around future GH_2 consumption in power plants in the LA Basin.

The demand assessment also incorporates information from the National Renewable Energy Laboratory's (NREL) LA100 study, which found that at least 2,400 MW of firm, dispatchable capacity within the LA Basin will be required under all potential scenarios to achieve 100% renewables in the power sector by 2035 and maintain local electric sector reliability. The LA100 study further identified GH_2 as a potential resource to meet this need.[73]

Table 7 above provides an estimated demand for GH_2 use at power plants in 2030. The demand estimates align with the City of LA's objective of achieving 100% zero-carbon electricity for LA by 2035.[74] Notably, the HyBuild LA demand estimates factored in expected reductions in run times for gas turbines in a high-renewable future where power plants would be utilized only for reliability.[75]

70. Demand for GH_2 in stationary applications was estimated in Phase 1 of HyBuild LA. The assessment did not quantify 2040 demand.
71. Mitsubishi Heavy Industries, "Decarbonizing Power Generation with a Minimum of Modifications," Accessed February 8, 2023.
72. Jose M Bermudez, et al., "Hydrogen," International Energy Agency, 2022.
73. The LA100 Study from NREL identified green hydrogen as the key pathway to reliably meeting LA's 100% renewable energy target. See: Jaquelin Cochran, et al., "The Los Angeles 100% Renewable Energy Study," National Renewable Energy Laboratory, NREL/TP-6A20-79444, March 2021.
74. City of Los Angeles, LA's Green New Deal Annual Report 2021 - 2022.
75. Jaquelin Cochran, et al., "The Los Angeles 100% Renewable Energy Study," National Renewable Energy Laboratory, NREL/TP-6A20-79444, March 2021

The HyBuild LA demand assessment for refining operations assumes that GH_2 will replace approximately half of the grey H_2 currently used in refining operations in the LA Basin. These quantities were estimated based on the capacity of refineries located in the LA Basin (i.e., barrels of crude processed per year)[76] and H_2's role in general refinery processes (primarily hydrotreating and hydrocracking).[77]

5.2 | WATER DEMAND AND SOURCES ANALYSIS

Electrolytic GH_2 production has a very low carbon intensity and is therefore the preferred GH_2 production pathway for many local advocates, environmental organizations, and policymakers in the LA Basin. This process requires high-quality water as a feedstock and, in recognition of water scarcity concerns in Southern California, HyBuild LA worked with the Pacific Northwest National Laboratory (PNNL) to explore potential resources to responsibly meet the water needs of the envisioned scaled GH_2 system plan.

The findings also explore the incremental water needs to produce green NH_3, due to stakeholder feedback expressing a desire to understand the separate process requirements of a potential green NH_3 industry.

Based on stakeholder feedback, the study evaluated sources of wastewater that can be recycled from other sectors to avoid drawing on the region's already stressed freshwater resources. In addition, the analysis also considered the opportunity to repurpose water that is currently used in the local oil and gas sectors, assuming that operations may ramp down in accordance with a statewide clean energy transition.

The table below shows the considered water sources. While not a recycled or repurposed water source, desalination was also discussed as an alternative option. However, it was ultimately not included in the proposed system vision due to stakeholder concerns about the feasibility of permitting and developing desalination projects.

Table 8 | Water sources evaluated in PNNL's water analysis for HyBuild LA.

Water Source	Definition
CA South Coast Wastewater	Wastewater currently sent to water treatment plants in the CA South Coast region (e.g., raw sewage)
SoCal Fracking Demand Offset	Water currently used in oil and gas fracking operations that can be diverted to other uses if fracking operations are reduced
SoCal Fracking Wastewater	Wastewater "produced" from fracking processes (e.g., flowback from fracking wells)
SoCal Refinery Water Demand Offset	Water currently used in oil and gas refining that can be diverted to other uses if refinery operations are reduced
SoCal Refinery Wastewater	Wastewater from refinery processes
Desalinated Water	Seawater that has been treated for commercial use

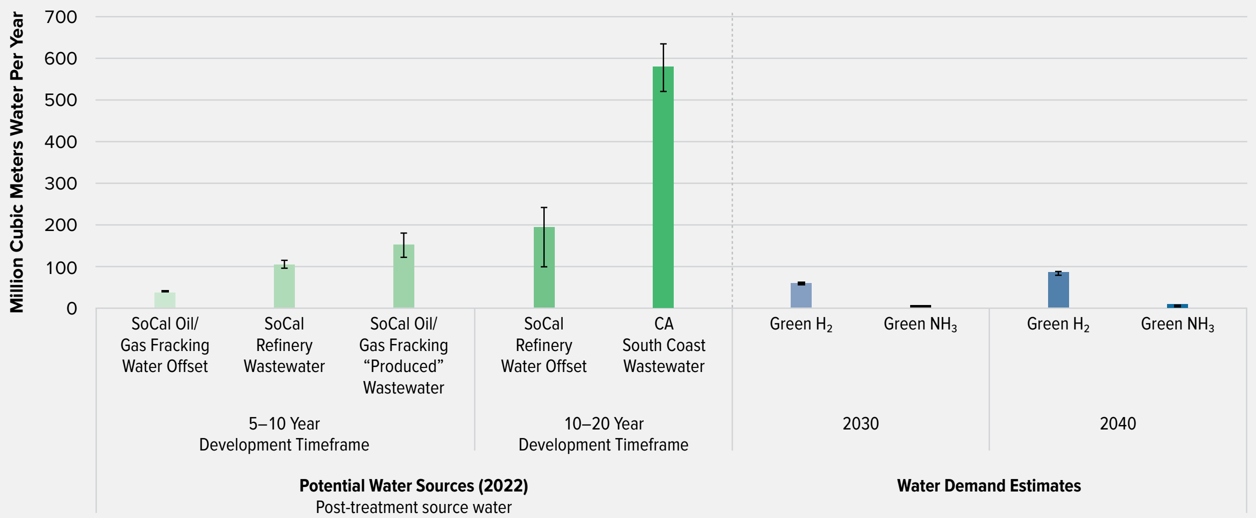
Key Findings

HyBuild LA found that the water needs for GH_2 and green NH_3 production can be fully met from ample recycled or repurposed water sources. The graph below shows the total water demand alongside the total volumes of water that may be available from each of the identified sources, accounting for any losses from water treatment processes. The study assumes that the treatment of recycled wastewater has a 50% yield (meaning 2 units of wastewater are required to produce 1 unit of recycled water that can be used for electrolysis), which is a relatively conservative estimate – stakeholders' feedback indicates that the industry often targets yields up to 85%.[78]

The green NH_3 water demands shown in Figure 21 represent the additional water that would be required to turn GH_2 into NH_3 after the GH_2 feedstock has been produced.

76. California Energy Commission, "California Oil Refinery History," January 2023.
77. Luigi Bressan, et al. , "Hydrogen generation in modern refineries," Digital Refining, January 2009.
78. Interview with David Schneider, Veolia.

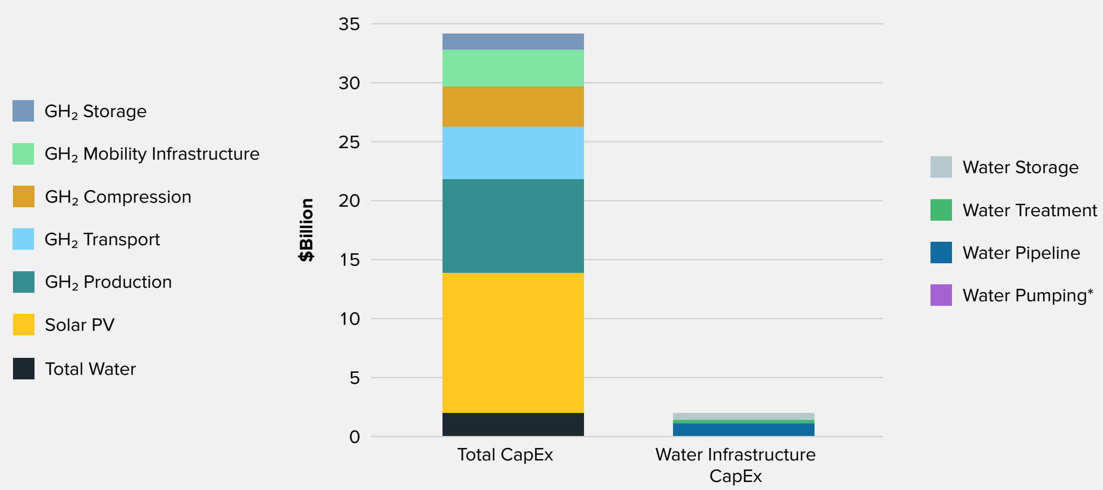
Figure 21 | Available quantities of potential water sources and estimated HyBuild LA water demands.



Note: Error bars represent ranges in model inputs from data sources.
Source: Pacific Northwest National Laboratory for HyBuild LA, 2022

Capital costs for the infrastructure to treat, transport, and store recycled or repurposed water for GH_2 and green NH_3 in 2040 amount to $3.3 billion in a high-cost scenario. This capital expenditure accounts for a relatively small portion of the total investments needed for the HyBuild LA vision (see Figure 22 below). The analysis found that the cost of recycled or repurposed water and the related infrastructure contributes $0.07 – $0.13/kg to the levelized cost of GH_2, depending on the infrastructure scenario. For reference, HyBuild LA estimates that the cost of utilizing municipal freshwater (rather than recycled or repurposed water) would cost approximately $0.03/kg of GH_2, if available.[79]

Figure 22 | Water infrastructure CapEx relative to total HyBuild LA CapEx.

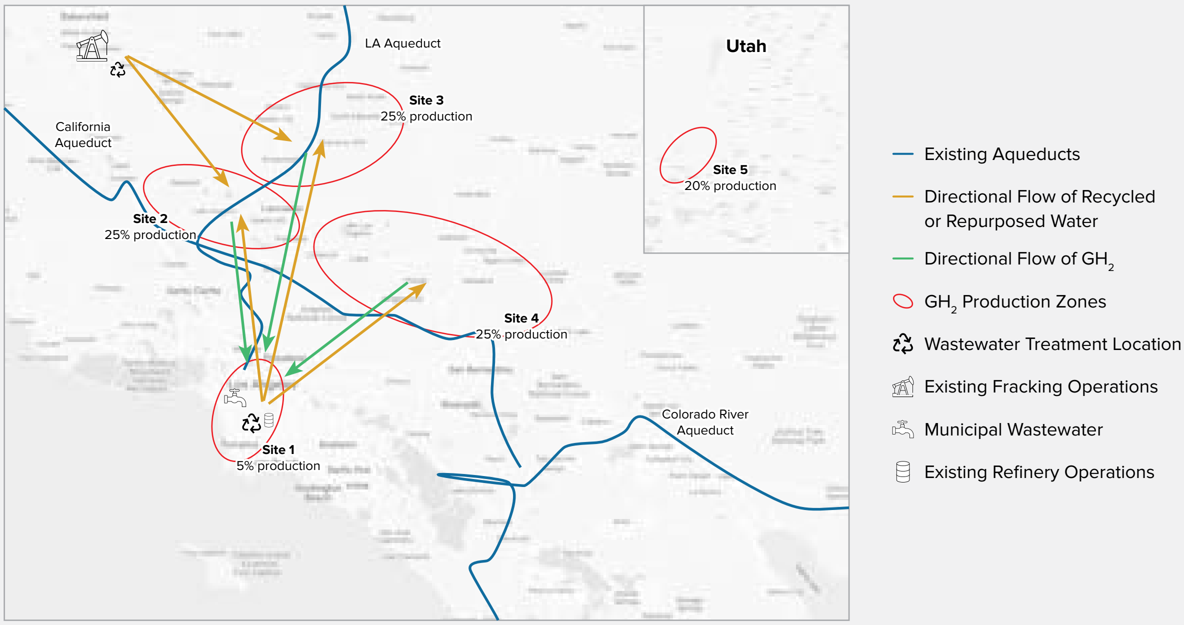


*Water pumping accounts for only 0.25% of total water capital costs, and is not visible on the chart.
Source: Pacific Northwest National Laboratory for HyBuild LA, 2022

79. Municipal water costs were estimated based on an average of residential rates in California during HyBuild LA Phase 1, which was calculated to be around 3.70 USD / cubic meter (~$10.00 per 100 cubic feet). See: UNC School of Government, "California Small Water Systems Rates Dashboard," July 1, 2020.

The majority of wastewater and repurposed water sources considered are located within the LA Basin, whereas GH_2 production is anticipated to occur closer to GH_2 production zones with high solar yield outside of the LA Basin. The highest-cost scenario includes water pipeline infrastructure to connect wastewater treatment sites to GH_2 production zones. This system plan is reflected below in Figure 23, resulting in all-in water costs of $0.13/kg of GH_2. This higher-cost scenario is reflected in the HyBuild LA LCOH of $2.05/kg GH_2.

Figure 23 | HyBuild LA scenario for supplying sources of recycled or repurposed water to electrolytic GH_2 production zones.



Note: HyBuild LA system plan assumes dedicated GH_2 pipeline connection with Central Utah.
Note: This map is illustrative and is not representative of planned infrastructure.
Source: Pacific Northwest National Laboratory for HyBuild LA, 2022

A lower-cost scenario eliminates the need for water pipeline transportation, resulting in an all-in water cost of $0.07/kg GH_2.[80] In this scenario, GH_2 producers could “swap” water rights with other entities, providing their treated wastewater resources to municipal water users in LA in exchange for access to water in the regional aqueducts that run close to the GH_2 production zones. It should be noted that this lower-cost scenario is conceptual and would require innovative policy and permitting solutions to be feasible. However, if enabled, this scenario could reduce water evaporation, system costs, and infrastructure requirements.

80. The LCOH referenced throughout the report reflects the higher-cost scenario of $0.13/kg GH_2.

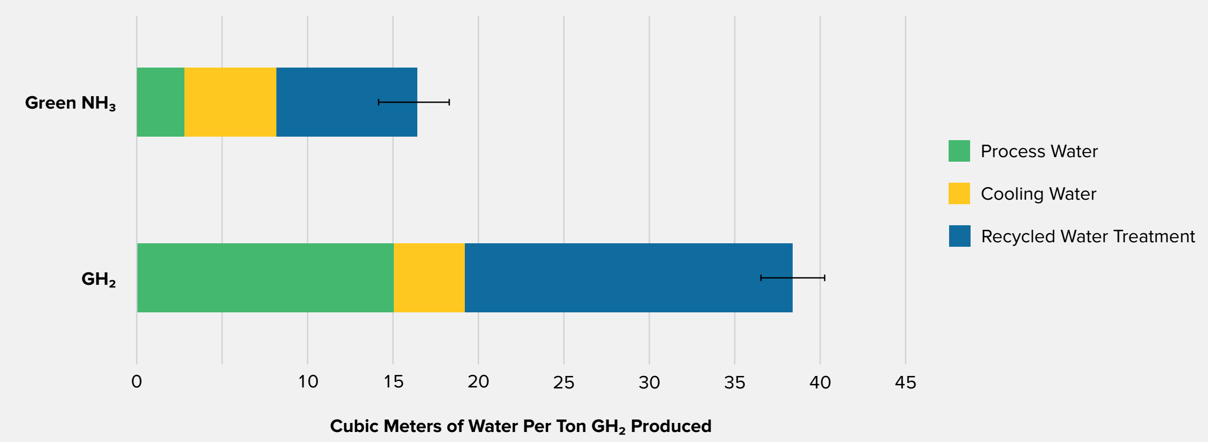
Assumptions and Methodology

PNNL utilized the total GH_2 and green NH_3 demand assessment (conducted by CVA) to evaluate water demand and associated infrastructure. Cost estimates from the water analysis were then incorporated into the levelized cost of GH_2 and total capital expense estimates for HyBuild LA overall.

Water demands for GH_2 and green NH_3 production include stoichiometric and process water demand, cooling water requirements, losses from the water treatment process, and potential water loss from leakage. PNNL collected data from literature and manufacturer specifications and conducted subject matter expert interviews to determine water demand for both GH_2 and green NH_3.[81] Manufacturer specifications for electrolysis process water range from 10.0 to 22.4 kg of H_2O required per 1 kg of H_2 produced.[82] Incorporating losses from evaporation and leaks, and cleaning needs, the total process input water was estimated at 15 kg H_2O/kg GH_2.[83] Cooling water adds about 4.2 kg of H_2O per 1 kg of H_2 produced.[84,85,86]

To meet water quality requirements for electrolysis, reverse osmosis (RO) and deionization (DI) treatment are required. Using a conservative assumption of 50% water loss associated with treating highly contaminated water, the total estimated water demand is 38.4 kg H_2O/kg H_2 produced. Water use per kg of green NH_3 is estimated to be less than half that of GH_2, due largely to reduced process water and water treatment requirements (see Appendix B for more details).

Table 9 | Breakdown of water use for GH_2 and green NH_3 production.



81. As alkaline electrolysis is the most widespread of the current hydrogen electrolysis technologies it was used as the baseline for water demand estimates for hydrogen production. However, water demands for proton exchange membrane (PEM) hydrogen electrolysis are similar.
82. Sofia Simoes, et al., "Water availability and water usage solutions for electrolysis in hydrogen production," Journal of Cleaner Production, 315, 128124, September 15, 2021.
83. Brophy, Brenor. Interview. Conducted by T. M. Harris. 2022.
84. Lampert, David et al., "Development of a life cycle inventory of water consumption associated with the production of transportation fuels," Argonne National Lab (ANL), ANL/ESD-15/27 121551, October 1, 2015.
85. Brian Boyd, et al., "Water Savings Potential and Energy Impact of Implementing Alternative Cooling Technologies in Commonwealth Edison's Service Territory," Alliance for Water Efficiency, August 2021.
86. Brian Boyd, er al., "Taking Inventory: A Guide for Identifying Cooling Towers and Estimating Water Use," Alliance for Water Efficiency, 2022.

Table 10 | Water requirements of the HyBuild LA system plan.

Resource	Unit	2030 Demand	2040 Demand
GH_2	MT GH_2/ year	1.43	2.17
Water for GH_2 Production	Mm^3 H_2O/ year	54.4	82.9
Green NH_3	MT Green NH_3/ year	0.38	1.03
Water for NH_3 Production	Mm^3 H_2O/ year	11.7	13.3

Three primary water source types were considered: surface water, groundwater, and alternative water.[87] Due to drought and water supply challenges in the Southwest, PNNL restricted its analysis to alternative water sources. These included recycled wastewater (e.g., sewage and stormwater runoff), recycled process water (e.g., fracking-produced water and refinery wastewater), and desalinated sea or brine water.[88] The analysis also considered water that could be diverted from the oil and gas sector, assuming those operations will be reduced.

The primary costs associated with water delivery are transportation, storage, and treatment. This assessment considered conservative estimates for each cost area based on known technology, resource requirements, and business conditions. The study considered two elements of water transportation cost: infrastructure (pipelines and pump stations) and electricity demand for pumping water from sources to GH_2 production sites. Capital costs for pipelines account for the largest capital expense, totaling $1.40 billion by 2040.[89] Annual maintenance costs are estimated at 4% of these initial capital costs.

Because the HyBuild LA system plan assumes GH_2 will be produced via solar PV, GH_2 production will fluctuate with solar availability. As a result, water demands for electrolysis will also fluctuate depending on the GH_2 production profile, requiring water to be stored so that it is available during periods of high demand (such as the peak solar summer season). PNNL modeled hourly demand for source water based on the hourly GH_2 production profile over a year to determine water storage sizing requirements. The analysis indicates 39.7 days of water storage would be required at a cost of $513.9 million and $629.3 million for capital expenses and $1.5 million/year and $2.5 million/year for operational expenses for 2030 and 2040, respectively.

This analysis assumes that RO, one of the most common technologies to treat water to the high purity levels needed for electrolysis, is utilized. Costs for RO are well-established. PNNL assumed a linear cost relationship based on a 36.5 Mm^3/year RO system at an average capital cost of $165.4 million and an average operating cost of $10.1 million/year, assuming an average energy demand of 3.0 kWh/m^3 treated. These assumptions lead to capital costs for RO water treatment of $276.1 million and $454.1 million and annual operating costs of $28.9 million/year and $47.5 million/year. This water system would require annual energy demands of 182.8 and 300.6 GWh/year in 2030 and 2040, respectively.[90]

It should be noted that the HyBuild LA study used a conservative assumption for water yield of 50%. As such, the cost estimates for RO will also be conservatively high. Higher water yield rates would decrease water treatment equipment needs, reducing overall cost.

Additional details on the methodology are available in the Appendix.

87. Alternative water refers to sustainable sources of water that can help to reduce reliance on fresh surface and groundwater resources. See "Best Management Practice #14: Alternative Water Sources," Office of Energy Efficiency & Renewable Energy, accessed January 20, 2023.
88. As recent efforts to establish large seawater desalination facilities in Southern California have failed due to social and political resistance, desalination was not considered as a primary potential source.
89. U.S. Bureau of Reclamation (USBR), "Southern California Comprehensive Water Reclamation and Reuse Study Phase II Final Report," July 2002.
90. Linares, R. V., et al., "Life cycle cost of a hybrid forward osmosis–low pressure reverse osmosis system for seawater desalination and wastewater recovery," Water Research, 88, 225-234, January 1, 2016.

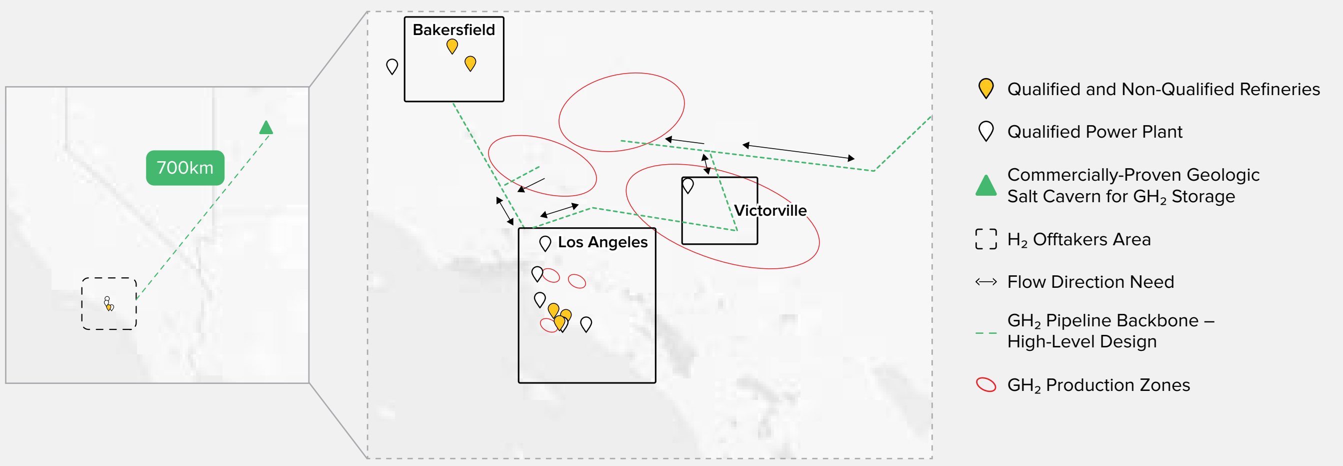
5.3 | SYSTEM PLAN

The HyBuild LA system plan, which was established in Phase 1, provides a lowest-cost scenario to serve the anticipated mass-scale demand in the LA Basin. This end-to-end system plan includes upstream production sources, midstream transportation and storage scenarios, and downstream infrastructure for select end uses.[91]

This analysis identified that the lowest-cost scenario would produce GH_2 via renewable electricity from dedicated photovoltaic solar systems in resource-rich regions, identified as "Production Regions", located outside of the LA Basin. These renewable energy resources would be co-located with electrolysis infrastructure and would deliver GH_2 to offtakers in the LA Basin via dedicated pipelines. To accommodate and balance seasonal variability in both production and demand, the GH_2 would be stored in an out-of-state geologic salt cavern site, which would be connected to the system via dedicated GH_2 pipeline. The aforementioned pipeline infrastructure is referred to as the "pipeline backbone" throughout the report. Other pathways for production, transportation, and storage explored in HyBuild LA (including rooftop solar and electric transmission) can be found in the High-Level Methodology section below.

The system plan developed in Phase 1 is represented in Figure 24 below.

Figure 24 | HyBuild Los Angeles System Plan.



Note: Electrolytic green hydrogen can be produced in Southern California and along the pipeline route.
Note: This map is illustrative and does not include all potential offtakers. Refineries, power plants, and cement plants are shown as sample potential offtakers.
Source: Corporate Value Associates Analysis for HyBuild LA, 2021

High-Level Methodology

Prior to undertaking this system plan analysis, a demand assessment was completed to understand the profile of offtake in the LA Basin. The demand assessment from HyBuild LA Phase 1 determined potential demand for GH_2 was sufficiently large and stable enough to require the development of mass-scale transportation and storage infrastructure. Three different scenarios were assessed for production, storage, and transportation of GH_2 to aggregated offtakers within the LA Basin:

1. GH_2 is produced in close physical proximity to large-scale renewable energy feedstocks outside of LA and transported to offtakers via a GH_2 pipeline backbone;
2. Renewable energy is transported from outside of LA Basin via electric transmission lines and GH_2 is produced in closer proximity to offtakers; and
3. GH_2 is produced near offtakers, utilizing rooftop solar production.

91. HyBuild LA Phase 2 considered infrastructure to support some mobility sectors (i.e., liquefaction and heavy-duty fueling stations).

The assessment concluded that the first scenario would enable the lowest delivered cost of GH_2. The second scenario of transportation via electric transmission was found to be more expensive per kg GH_2. The third scenario uncovered that rooftop solar would be insufficient to meet the scale of demand for GH_2 from potential offtakers.

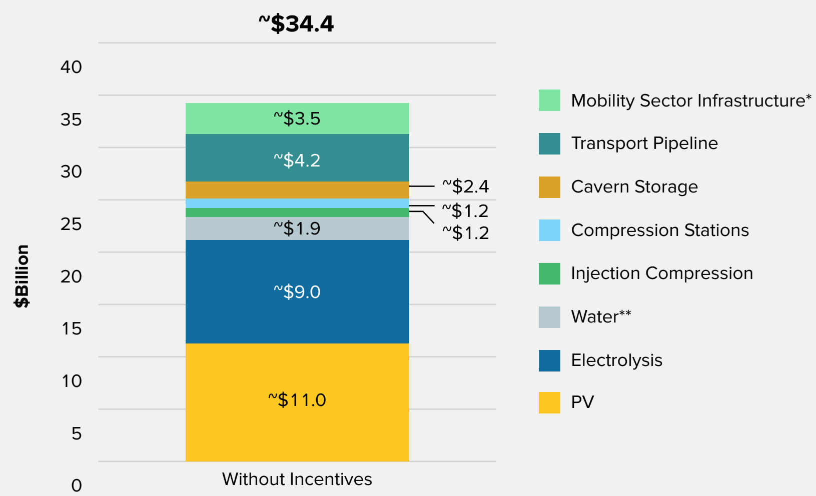
The analysis also identified the need to connect the system to geologic salt cavern storage to balance this mass-scale system, and determined that the closest commercially-proven geologic salt cavern site is located in Delta, Utah. These findings were carried forward as assumptions into the analyses of HyBuild LA Phase 2.

5.4 | HYBUILD LA CAPITAL EXPENDITURE AND LEVELIZED COST OF GREEN HYDROGEN

Findings

The HyBuild LA system plan,[92] which is designed to serve a total demand of 1.4 MMT GH_2, is estimated to require a total capital expenditure (CapEx) of $34 billion through 2030. The allocation of this cost by type of capital expenditure is shown in Figure 25.

Figure 25 | Capital expenditure estimate for the HyBuild LA 2030 system plan. Costs exclude development, land lease, and decommissioning costs.



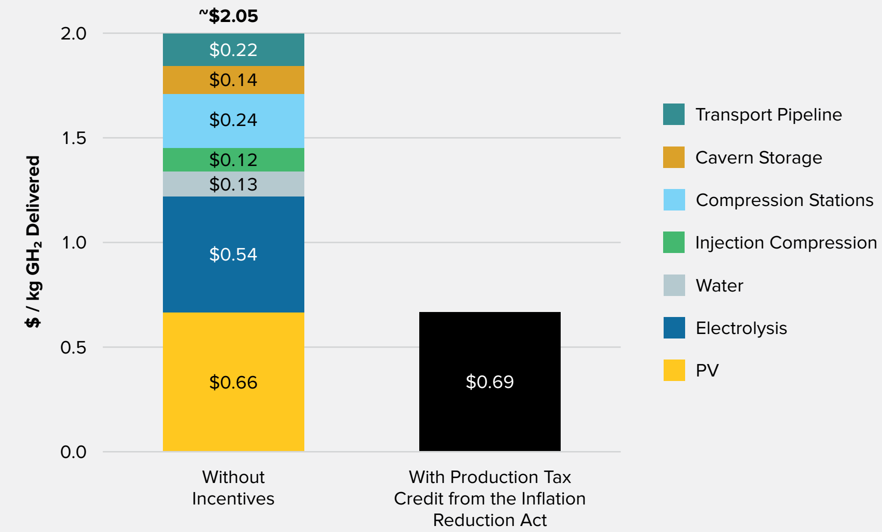
*Liquefaction, delivery, fueling
**Represents the higher-cost scenario for water
Source: Corporate Value Associates Analysis for HyBuild LA, 2022

This CapEx estimate was translated into a delivered LCOH of $2.05. The allocation of this cost by type of expenditure is shown in Figure 26.[93]

It should be noted that, while the total CapEx shown in Figure 25 includes additional downstream infrastructure for mobility applications (liquefaction, delivery of liquid GH_2 from the pipeline backbone via truck, heavy-duty fueling stations), these costs are not reflected in the LCOH of $2.05/kg GH_2.

92. Based on a total demand of 1.4 MMT of GH_2 per year.
93. Assumes that all producers generate $3/kg GH_2 produced over a period of 10 years and can sell all excess tax credits successfully on the market.

Figure 26 | Estimated levelized cost ($/kg) of delivered GH_2 in 2030, broken down by value chain element. Based on a total estimated demand of 1.4 MMT annually.



Source: Corporate Value Associates Analysis for HyBuild LA, 2022

Methodology

The HyBuild LA GH_2 system plan includes all components indicated in Figure 27 below.

Figure 27 | Key infrastructure parameters of the GH_2 system plan for the HyBuild LA vision.

Upstream	**Solar PV Installations**	**28 GWp** – Combined plant capacity **75 TWh** – PV electricity produced per year
Upstream	**Electrolyzers**	**22 GWe** – Combined electrolyzer size **37%** – Average load factor **1.4Mt H_2** – Annual production of GH_2
Upstream	**Compression at Injection**	**310 MW** – Cumulative compressor capacities **445t H_2/h** – Max flow
Midstream	**Compressor Stations**	**620 MW** – Cumulative capacities of all compressor stations
Midstream	**Underground Storage**	**130 kt H_2** – Effective maximal capacity **1,430M Nm^3** – Effective maximal volume
Downstream	**H_2 Transport Pipelines**	**1,300 miles** – GH_2 pipeline backbone
Downstream	**Distribution**	**10–15** – Number of major offtakers connected via distribution pipes **320 kt** – Cumulative annual production of liquid GH_2 for mobility **>1,000** – Number of public and private GH_2 refuelling stations

The system design developed for HyBuild LA utilized an LCOH tool created by CVA. The components for calculating LCOH include the cost per kg of GH_2 for electricity, electrolysis, GH_2 compression, storage, and transport to the LA Basin. The model assumes that all GH_2 is produced using solar energy from dedicated solar installations that are not connected to the electric grid, but rather produce GH_2 directly onsite to be transported to offtaker regions via a dedicated GH_2 pipeline.

The first model in the LCOH tool calculates the required capacity of GH_2 production and delivery equipment based on an annual GH_2 offtake target, which is used as an input to the cost model. Extensive solar and electrolysis plant data from both external sources and internal modeling are used to create 8,760 hours, or yearly, generation profiles to determine the quantity of energy available for GH_2 production via electrolysis at different times throughout the year. The model then estimates GH_2 storage and transportation infrastructure needs, considering the availability of storage options, GH_2 demand profiles for different offtakers, and the equipment required for storage (e.g., compressors, wells, and boosters). The analysis also determines the necessary GH_2 compression capacity and infrastructure size requirements for transport through pipelines to offtaker delivery sites, including the pipeline system connection to geologic salt storage in Delta, Utah. The required infrastructure components and their sizes are then passed to the cost model.

HyBuild LA defines "levelized cost of GH_2" as the lowest price point at which the system could deliver GH_2 considering all capital, operational, and maintenance costs for GH_2 production and delivery infrastructure.

The cost model conducts a discounted cash flow analysis of revenues, as well as capital and operating costs over the economic life of the project. Cost estimates for each component of the system are sourced from external references and internal expertise within CVA. The costs are projected over the lifespan of the project, which is assumed to be 35 years. The model calculates the GH_2 price that would provide sufficient revenue for the project to be economically viable (e.g., to have a net present value (NPV) of zero while realizing a return on capital of 6%).[94] This GH_2 cost is established as the "levelized cost of GH_2," defined as the lowest price point at which the project could deliver GH_2, considering all capital, operational, and maintenance costs for GH_2 production and delivery infrastructure.

94. Expected return on capital was based on discussions with stakeholders in other GH_2 hub projects, as well as in reference to developer bids for such projects in Europe and elsewhere.

6. COMMUNITY IMPACTS

The Community Impacts Workstream centered around two interrelated tasks: (1) engaging directly with community stakeholders and (2) conducting analyses to define the quantifiable impacts of the envisioned HyBuild LA end-to-end system plan on local communities, while focusing on communities that have historically been disproportionately burdened by negative environmental impacts and placement of energy infrastructure. For the second task, the GHC worked with UCI to conduct two studies assessing (a) the impacts of GH_2 adoption on air quality and public health, and (b) job creation that would be enabled by the proposed GH_2 system.

6.1 | STAKEHOLDER ENGAGEMENT

HyBuild LA engaged directly with key community stakeholders to build awareness of the emergent opportunities for GH_2 and to develop a co-creative space for identifying areas of interest and concern that could be carried forward into the GHC's market development activities. Additionally, this Workstream provided a forum for stakeholders to inform the technical analyses and system design of the HyBuild LA effort. These key stakeholders included environmental justice and environmental advocates, tribal communities, and union and labor representatives.

It should be noted that the efforts of HyBuild LA are not intended to replace the stakeholder engagement process used to develop projects; rather, these efforts are intended to elevate community questions and perspectives as the region pursues a GH_2 economy and associated infrastructure development.

Key Findings

HyBuild LA Phase 2 hosted four listening and educational sessions with the goal of creating a platform for stakeholder dialogue, covering the following four topics:

- Introduction to GH_2 – including information on the global GH_2 market, production pathways, and carbon intensity – and an overview of electrolyzer technology, GH_2 storage and transport mechanisms, and potential end-use applications.
- Federal, state, and local level GH_2 activities and opportunities, featuring speakers from the California Governor's Office of Business Development and the Port of Los Angeles.
- Impacts of GH_2 on air quality and public health, featuring speakers from the Advanced Power and Energy Program at UCI.
- Impacts of GH_2 on local job creation, featuring speakers from the Advanced Power and Energy Program at UCI.

These discussions created space for stakeholders to express questions, concerns, and areas of interest regarding a potential at-scale GH_2 ecosystem.

Through this process, the Community Impacts workstream identified that many community groups are experiencing lack of bandwidth to engage fully in GH_2-related processes, as GH_2 is often one topic among many important priorities. If not addressed, these capacity constraints may inadvertently prevent various community stakeholders from participating in the fast-moving GH_2 and energy infrastructure development processes and related market development processes. Investments into key stakeholders' bandwidth and capacity to engage on GH_2 is of critical importance, and must be considered prior to other ecosystem investments.

Table 11 provides a summary of the questions raised by stakeholders and initial actions taken or that need to be taken to address the questions.

Table 11 | Questions, areas of interest, and areas of concern raised by stakeholders in the Community Impacts Workstream of HyBuild LA Phase 2.

Area of Interest	Specific Questions	Initial Actions Taken
GH_2 infrastructure	• What would GH_2 infrastructure look like in LA, in the port, and in my own community? • What is the development process? How can stakeholders weigh in on projects? • Where will projects and infrastructure be sited? • What are the localized impacts of GH_2 infrastructure, including safety impacts, leaks, and health impacts?	The GHC offered all interested stakeholders access to a facilitated tour of GH_2 pilot equipment at the Port of LA's Fenix Marine Services Terminal. Further engagement with communities will be needed by developers and California's hub coalition, ARCHES, regarding individual projects as they are planned.
NOx and Air Quality Impacts	• What are the localized impacts of GH_2 combustion? • Would combustion operate on pure GH_2 or a GH_2 blend? What are the tradeoffs of each? • How will GH_2 displacement of diesel and natural gas impact NOx emissions and air quality? • How will GH_2 use impact NOx emissions and local air quality? • What is the impact of derivative fuels, such as ammonia, on air quality and NOx?	The Community Impacts Workstream provided stakeholders with a Q&A session with atmospheric scientists from UCI to discuss questions around emissions related to GH_2.
Fugitive GH_2 and Leakage	• What is fugitive GH_2, what is its impact on climate change, and how can it be managed? • What the impact of fugitive GH_2 on the safety of my neighborhood?	The GHC is collaborating on an ongoing basis with environmental stakeholders around further understanding fugitive GH_2 and ensuring strong climate integrity and safety standards of any resulting GH_2 projects.
Jobs and Safety	• What types of jobs, education, and skillsets would be needed in the GH_2 economy? • How will we ensure that workers maintain the family-sustaining wages they've worked hard to achieve in the oil and gas industries? • What will be the associated training and workforce development needs? • What safety standards and codes exist for GH_2? What still needs to be established to ensure GH_2 equipment is safe?	The Community Impacts Workstream collaborated with interested stakeholders on the jobs study to further understand GH_2 workforce opportunities. Further safety education and workforce transition work will be needed to ensure a just and inclusive energy transition.
Water Usage	• How can water be sourced sustainably?	Based on stakeholder feedback, the Pacific Northwest National Laboratory study for HyBuild LA considered only recycled or repurposed water (no freshwater sources).
Ammonia	• Where would infrastructure for green ammonia as a maritime shipping fuel be located? • How can we ensure it is safe? • Even if green ammonia is made, stored, and used elsewhere, how can Angelenos ensure community safety in other regions? • What are the health, safety, and environmental impacts of ammonia production, transport, storage, and combustion?	Based on stakeholder feedback, the HyBuild LA removed the assumption that any ammonia would be produced locally or bunkered in the Port of LA or Long Beach. Continued collaboration and knowledge sharing with international ports that are advancing green NH_3 as a shipping fuel is recommended.

While the HyBuild LA platform sought to address some of these questions (e.g., water usage), the GHC recommends that further work be done in each of these areas, in close collaboration with community stakeholders.

Methodology

The Community Impacts Workstream served as an avenue to increase transparency of HyBuild LA's efforts, and to create opportunity for local community stakeholders to access information regarding GH_2. The participants had full access to convenings and activities of all other workstreams, weekly update communications on platform activities, and access to a web-based portal containing materials from each analytical study.

Given HyBuild LA Phase 2's emphasis on end uses in and around the ports, outreach to prospective community participants started with stakeholder groups around the Ports of LA and Long Beach. The GHC first reached out to relevant contacts, including regional environmental justice groups focused on air quality, labor unions working with heavy-duty equipment in the ports, labor unions from local refineries, and more. The GHC then connected with additional stakeholders based on group recommendations.

This process was open to all representatives from the priority stakeholder groups (environmental advocates and environmental justice organizations; union and labor organizations; tribal nations) who wished to participate in this effort. Throughout the duration of this effort, the HyBuild LA webpage on the GHC website contained a form for stakeholders to indicate their interest to get involved in these activities.

To engage participants, the Community Impacts Workstream hosted four listening and educational sessions.[95] For transparency, sessions were recorded and the materials were distributed to the group. Each meeting allowed stakeholders time for questions and discussion with presenters.

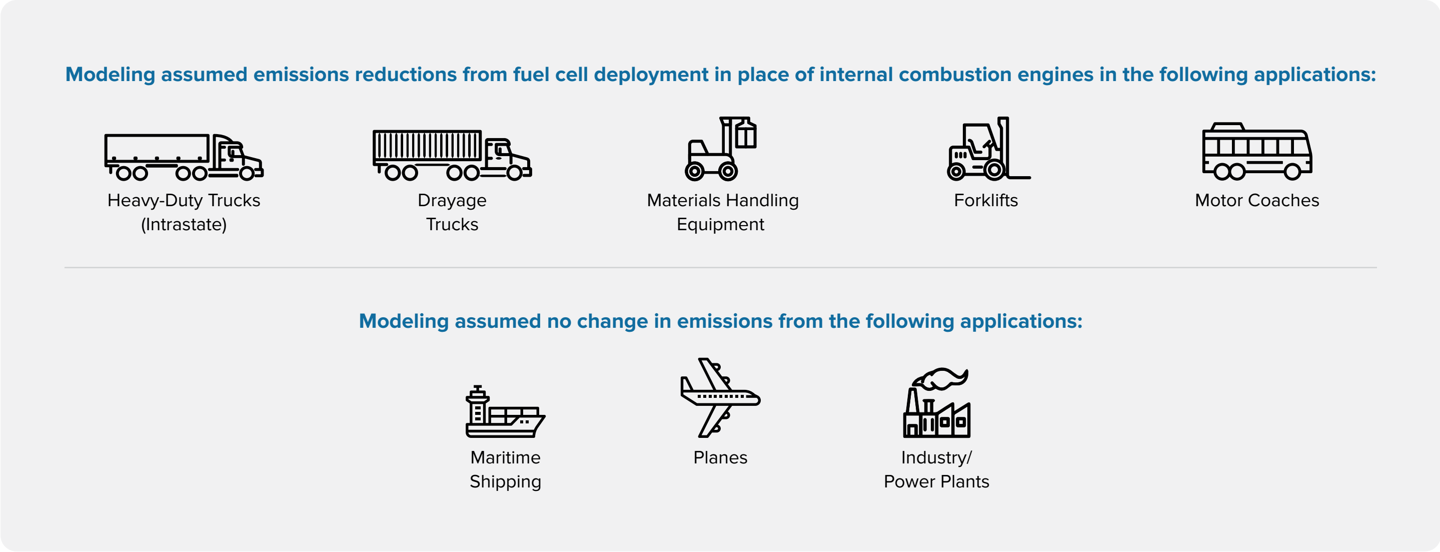
6.2 | AIR QUALITY ANALYSIS

HyBuild LA assessed the impacts of replacing fossil fuel combustion technology with GH_2 fuel cells in a variety of land-based mobility sectors, analyzing the impact this would have on pollutant emissions, air quality, and public health. This analysis also provided a specific view into the public health impacts from this scenario on disadvantaged communities (DACs) in the South Coast Air Basin.

The air pollution portion of the study specifically assessed three air pollutants: ozone, $PM_{2.5}$, and NOx. The study accounted for primary pollutants that are emitted directly from tailpipes, as well as secondary pollutants that are formed indirectly from chemical reactions in the atmosphere. These pollutant levels were used to develop the public health portion of the study, which specifically considered the human health impacts of $PM_{2.5}$ and ground-level ozone (caused by NOx). These pollutants are associated with negative health consequences in exposed populations and are commonly included in similar health impact assessments. This assessment studied the impacts of pollution reduction within the South Coast Air Basin – which includes Los Angeles County, Orange County, and the coastal (i.e., non-desert) portions of San Bernardino and Riverside Counties – and is not compliant with State and Federal health-based standards for ozone or $PM_{2.5}$.

The analysis considered the impacts of fuel cell deployment in place of fossil fuel combustion technology in the following applications:

Figure 28 | End uses considered in the HyBuild LA air quality assessment.



95. As listed previously, the sessions were: (1) Introduction to GH_2, (2) federal, state, and local level GH_2 activities, (3) Impacts of GH_2 on air quality and public health, and (4) Impacts of GH_2 on local job creation.

The study evaluated one summer month (July) and one winter month (January) for both 2035 and 2045. The years of 2035 and 2045 were selected because it enabled the study to align with the Reference Scenario in the California Air Resources Board's Scoping Plan, a reputable process which maps to the State's climate objectives. Annual modeling was not possible for this study given time constraints and the intensive computational requirements to run the models, so January and July were selected for analysis to demonstrate seasonal variation in air pollution caused by differences in meteorology and other factors. Notably, the months of January and July often have high pollutant formation periods, potentially resulting in higher pollutant differences from the Reference Scenario. As such, the results of both the air quality and health benefit assessments should not be multiplied directly to determine annual changes.

Findings

Results of the HyBuild LA analysis show notable air quality and public health benefits from reduced fossil fuel combustion, enabled by the use of GH_2 in zero-emission fuel cell electric technology.

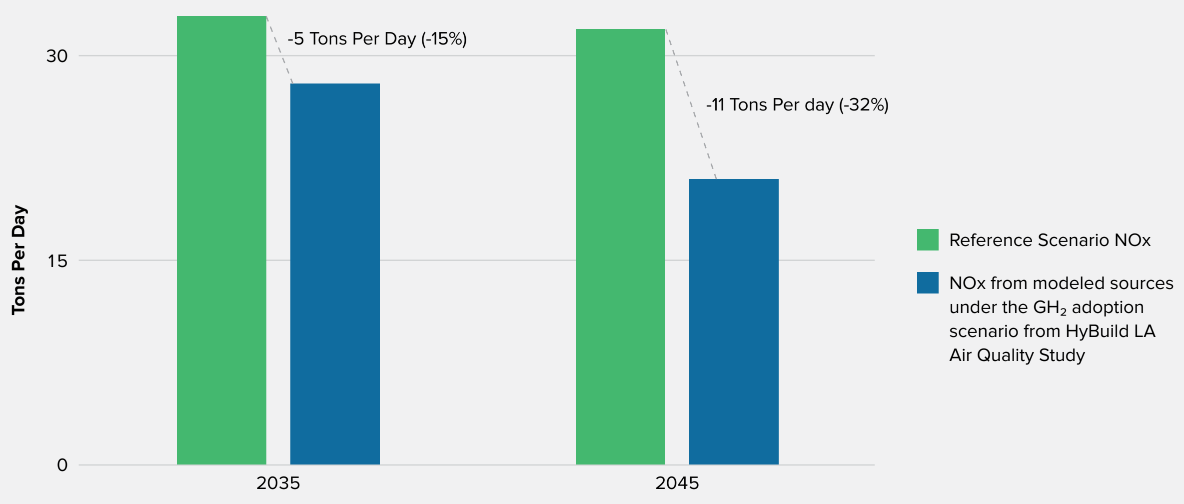
In reviewing the following public health benefits, it is important to note that the GHC recognizes that the value of human health and livelihood is much more complex than the dollar amounts shown in the findings below. This modeling exercise estimates public health benefits by determining the number of avoided incidence of harmful health endpoints (e.g., missed days of work, hospitalizations) in the study population due to air pollution improvements. From here, the model provides an economic valuation of those avoided health endpoints. The valuation includes both direct cost of illness for some endpoints, such as the average cost of a hospitalization, and willingness-to-pay for avoided incidence (e.g., premature mortality is measured through the value of statistical life). It should be noted that the value of statistical life represents a commonly-used statistical value that a group of people are willing to pay to avoid the risk of one death, and in no way attemts to represent an estimate of the value of a human life.

Finally, it should be noted that this analysis only evaluated two months out of each year (January and July 2025; January and July 2035), and that health benefits would be much higher on an annual basis. Further modeling, including annual air quality simulations, should be considered as a part of further community impact assessments.

NOx and Ozone

The use of GH_2 in the modeled end uses (e.g., intrastate heavy-duty vehicles, heavy-duty drayage vehicles, long-distance motor coaches, forklifts, and cargo handling equipment) reduces NOx emissions from the Reference Scenario by 15% in 2035 and by more than 30% in 2045 (see Figure 29).

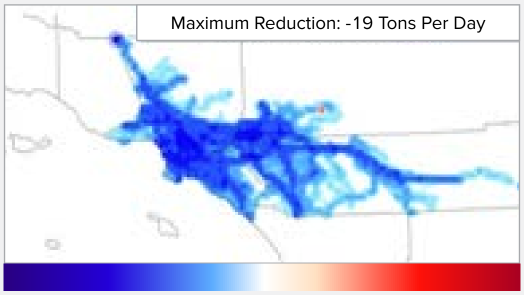
Figure 29 | Improvements in NOx for modeled sources in 2035 and 2045 due to the GH_2 deployment scenario, relative to the Reference Scenario.



Source: University of California, Irvine Advanced Power and Energy Program for HyBuild LA, 2022

Direct NOx emissions reductions are most significant around the major transit pathways (see Figure 30 below), such as the I-710 and the I-10 corridors. However, ozone (which is formed from NOx in the atmosphere), distributes the benefits from reducing emissions across the region.

Figure 30 | Reductions in NOx emissions (tons per day) in 2045 due to the GH_2 deployment scenario.



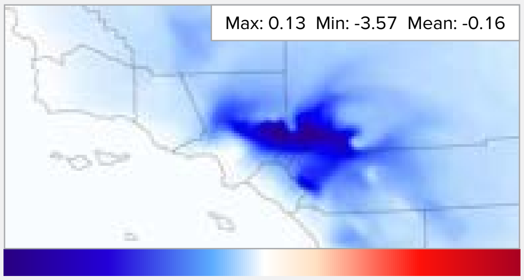
Source: University of California, Irvine Advanced Power and Energy Program for HyBuild LA, 2022

The NOx reductions will result in improvements in ozone greater than 1 ppb, with the largest reductions occurring in eastern San Bernardino and Riverside Counties. In 2045, reductions in ground-level ozone in July (relative to the Reference Scenario) exceed 3.5 ppb.

For context, the regulatory standard for ozone is 70 ppb, and more than half of California's residents live in areas that exceed that health-based standard.[96] Of these nonattainment regions, the South Coast Air Basin and the San Joaquin Valley are the worst, as the only areas in the nation designated as "extreme" by the U.S. Environmental Protection Agency.[97] In the months modeled, peak ozone reductions occur in eastern San Bernardino and Riverside Counties, which are within the South Coast Air Basin and are home to a large population, including numerous DACs, according to CalEnviroScreen.

In a business-as-usual scenario without deployment of GH_2 in the modeled sectors, the Reference Case predicted a peak of 87 PPB in 2045 in the South Coast Air Basin. In the emissions reduction scenario, the improvements of 4 PPB by 2045 shown in Figure 31 can reduce 23% of non-compliance events, or events when the ozone reaches an unsafe level above 70 ppb.

Figure 31 | Improvements in maximum daily 8-hour average ozone (ppb) in July 2045 due to the GH_2 deployment scenario.



Source: University of California, Irvine Advanced Power and Energy Program for HyBuild LA, 2022

96. Melanie Turner, "California adopts comprehensive strategy to meet federal ozone standard over next 15 years," California Air Resources Board, September 22, 2022
97. Environmental Protection Agency, "Current Nonattainment Counties for All Criteria Pollutants," January 31, 2023

In the winter month (January), ozone levels the Reference Scenario are lower than the health-based standard; thus, the modeling does not demonstrate avoided health benefits. However, the reduction in ozone results in significant public health benefits that are reflected during the summer month modeled (July). The avoided health incidence and the subsequent value associated with their avoidance during July 2035 and 2045 is shown in the table below. Overall, as a result of reduced ozone due to the GH_2 deployment scenario during the two modeled months (July 2035 and 2045), communities in the region are estimated to experience health benefits such as:

- 10 fewer premature deaths
- 73 fewer hospitalizations and emergency room visits

Table 12 | The avoided incidence of health issues and associated value caused by reductions of exposure to ozone as a result of the GH_2 deployment scenario in July 2035 and 2045.

		2035		2045	
Endpoint	**Pollutant**	**Incidents Avoided**	**Value of Avoided Health Incidents**	**Incidents Avoided**	**Value of Avoided Health Incidents**
Avoided Mortality, Respiratory	Ozone	2.36	$23,293,800.00	7.59	$79,750,741.20
Incidence, Asthma Onset	Ozone	34.19	$1,304,547.60	97.88	$3,987,905.50
Emergency Room Visits, Respiratory	Ozone	17.43	$32,304.70	49.97	$107,159.90
Asthma Symptoms	Ozone	15,131.73	$4,540,515.60	43,258.88	$13,824,045.70
Hospital Admissions, Respiratory	Ozone	1.32	$80,805.50	4.36	$299,086.70
Total			**$29,251,973.40**		**$97,968,939.00**

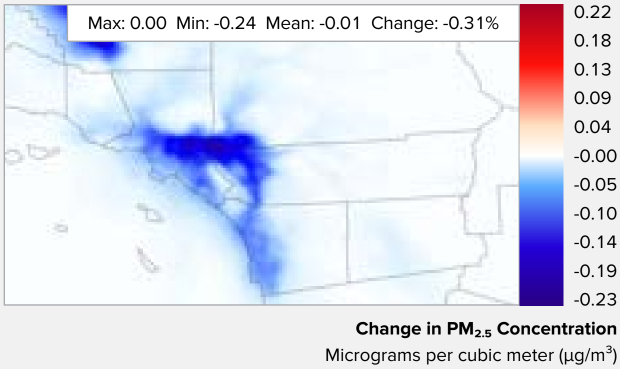
$PM_{2.5}$

Reductions in emissions of $PM_{2.5}$ will result in important public health benefits, given the well-established link between exposure to ambient $PM_{2.5}$ and various harmful health outcomes, including premature mortality, cancer, cardiovascular and neurological disease, enhanced susceptibility to infection including COVID, and many others.[98,99,100]

By 2035, the HyBuild LA winter scenario would result in improvements in $PM_{2.5}$ of greater than 0.24 micrograms per cubic meter ($\mu g/m^3$), with the largest improvements occurring in and around Los Angeles County and extending into western Riverside and San Bernardino Counties.

98. Ioannis Manisalidis, Elisavet Stavropoulou, Agathangelos Stavropoulos, and Eugenia Bezirtzoglou. "Environmental and health impacts of air pollution: a review." Frontiers in public health, 2020.
99. Kampa, Marilena, and Elias Castanas. "Human health effects of air pollution." Environmental pollution 151, no. 2, 2008.
100. Ali, Nurshad, and Farjana Islam. "The effects of air pollution on COVID-19 infection and mortality—A review on recent evidence." Frontiers in public health 8, 2020.

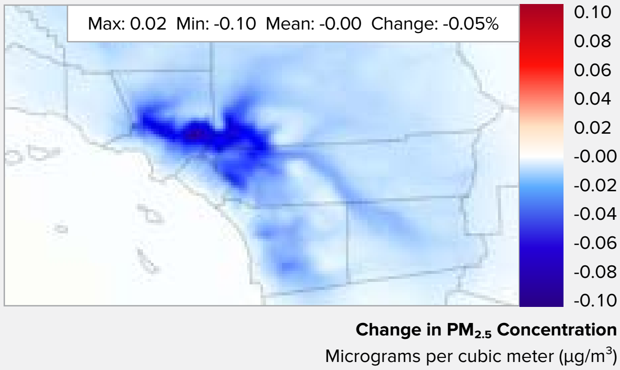
Figure 32 | Improvements in 24-hour average $PM_{2.5}$ ($\mu g/m^3$) in January 2035 due to the GH_2 deployment scenario.



Source: University of California, Irvine Advanced Power and Energy Program for HyBuild LA, 2022

Though it is less pronounced than in the winter month (due primarily to differences in seasonal meteorology), July 2035 still shows a measurable improvement in $PM_{2.5}$ of 0.10 $\mu g/m^3$, with a similar spatial distribution to those observed for the winter scenario.

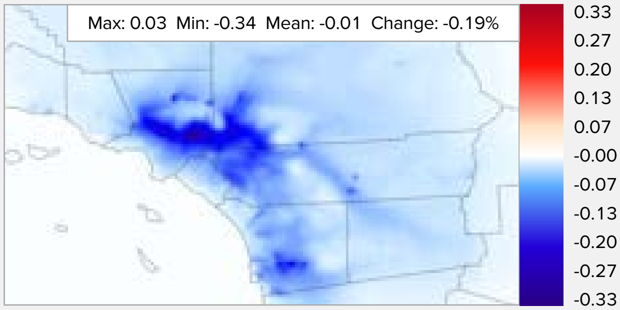
Figure 33 | Improvements in 24-hour average $PM_{2.5}$ ($\mu g/m^3$) in July 2035 due to the GH_2 deployment scenario.



Source: University of California, Irvine Advanced Power and Energy Program for HyBuild LA, 2022

In 2045, anticipated improvements in the winter month (January) exceed 0.72 $\mu g/m^3$. Similar to 2035, the largest improvements occur in Los Angeles County and western Riverside and San Bernardino Counties. In July, improvements in $PM_{2.5}$ reach 0.34 $\mu g/m^3$ with a similar spatial distribution to those observed for the winter scenario.

Figure 34 | Improvements in 24-hour average $PM_{2.5}$ (µg/m^3) in July 2045 due to the GH_2 deployment scenario.



$PM_{2.5}$ Concentration
Micrograms per cubic meter (µg/m^3)

Source: University of California, Irvine Advanced Power and Energy Program for HyBuild LA, 2022

These reductions in $PM_{2.5}$ are expected to result in demonstrable public health benefits across the winter and summer months modeled. Overall, as a result of reduced $PM_{2.5}$ due to the GH_2 deployment scenario during the four modeled months (January and July 2035; January and July 2045), communities in the region are estimated to experience health benefits such as:

- 17 fewer premature deaths
- 890 fewer hospitalizations and emergency room visits
- 7,520 fewer work loss days

Table 13 | The avoided incidence of health issues and associated value caused by reductions of exposure to $PM_{2.5}$ as a result of the GH_2 deployment scenario in January 2035 and 2045.

		2035		2045	
Endpoint	**Pollutant**	**Incidents Avoided**	**Value of Avoided Health Incidents**	**Incidents Avoided**	**Value of Avoided Health Incidents**
Avoided Mortality, All Cause	$PM_{2.5}$	2.49	$24,964,396.40	10.43	$109,732,534.00
Hospital Admissions, Alzheimer's Disease	$PM_{2.5}$	118.22	$29,668,765.20	491.73	$136,681,480.00
Hospital Admissions, Parkinson's Disease	$PM_{2.5}$	9.46	$7,249,092.40	39.40	$33,452,558.60
Incidence, Lung Cancer	$PM_{2.5}$	15.42	$647,172.50	60.89	$2,830,426.80
Incidence, Asthma Onset	$PM_{2.5}$	452.58	$17,594,669.20	1,539.00	$62,688,065.20
Acute Myocardial Infarction, Nonfatal	$PM_{2.5}$	1.35	$758,322.20	5.51	$3,325,135.60
Asthma Symptoms	$PM_{2.5}$	3,850.52	$2,288.20	13,338.63	$8,779.20
Hospital Admissions, Cardiovascular	$PM_{2.5}$	2.09	$59,884.30	8.99	$283,761.80
Emergency Room Visits, Cardiovascular	$PM_{2.5}$	3.54	$7,064.00	14.34	$31,695.00
Hospital Admissions, Respiratory	$PM_{2.5}$	0.32	$5,328.10	1.39	$25,138.00
Emergency Room Visits, Respiratory	$PM_{2.5}$	5.90	$8,864.90	21.32	$35,493.10
Work Loss Days	$PM_{2.5}$	1281.47	$256,656.80	4520.69	$905,417.60
Total			**$81,222,504.30**		**$350,000,484.90**

Table 14 | The avoided incidence of health issues and associated value caused by reductions of exposure to $PM_{2.5}$ as a result of the GH_2 deployment scenario in July 2035 and 2045.

		2035		2045	
Endpoint	**Pollutant**	**Incidents Avoided**	**Value of Avoided Health Incidents**	**Incidents Avoided**	**Value of Avoided Health Incidents**
Avoided Mortality, All Cause	$PM_{2.5}$	0.66	$6,567,303.60	3.10	$32,573,499.80
Hospital Admissions, Alzheimers Disease	$PM_{2.5}$	25.56	$6,309,111.60	123.66	$34,373,219.40
Hospital Admissions, Parkinsons Disease	$PM_{2.5}$	2.17	$1,635,550.80	10.35	$8,789,364.30
Incidence, Lung Cancer	$PM_{2.5}$	3.54	$90,369.40	16.01	$459,779.00
Incidence, Asthma Onset	$PM_{2.5}$	105.15	$4,019,678.40	413.21	$16,834,523.80
Acute Myocardial Infarction, Nonfatal	$PM_{2.5}$	0.38	$209,113.20	1.69	$1,021,512.00
Asthma Symptoms	$PM_{2.5}$	1,032.05	$603.20	4,023.94	$2,648.50
Hospital Admissions, Cardiovascular	$PM_{2.5}$	0.58	$16,193.60	2.71	$85,605.60
Emergency Room Visits, Cardiovascular	$PM_{2.5}$	0.98	$1,917.80	4.35	$9,618.50
Hospital Admissions, Respiratory	$PM_{2.5}$	0.09	$1,444.90	0.42	$7,587.10
Emergency Room Visits, Respiratory	$PM_{2.5}$	0.58	$2,362.40	2.71	$10,765.30
Work Loss Days	$PM_{2.5}$	346.47	$68,253.60	1,370.90	$274,567.50
Total			**$18,921,902.50**		**$94,442,690.80**

Overall Public Health Impacts

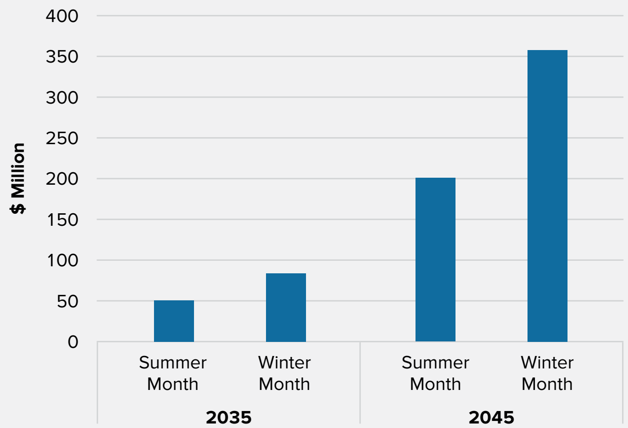
Reducing exposure from both ozone and $PM_{2.5}$ will result in meaningful public health benefits throughout the South Coast Air Basin, including avoided hospitalizations, fewer lost workdays, fewer incidences of disease resulting in reduced mortality, and more. As a result of improved air quality due to the GH_2 deployment scenario during the four modeled months (January and July 2035; January and July 2045), communities in the region are estimated to experience health benefits such as:

- 27 fewer premature deaths
- 964 fewer hospitalizations for respiratory, cardiovascular, and neurological illness
- 7,520 fewer work loss days

These avoided health impacts also have significant statistical value. The total health benefits of the four modeled months result in economic benefits ranges from approximately $50 million for July 2035 to over $350 million for January 2045. The avoided health incidences and health benefits are larger for the January months modeled, reflecting the larger improvements in winter due primarily to seasonal meteorology.

More detail reflecting the value of avoided health incidents by pollutant, relevant health incident, and modeled month are shown in Tables 12, 13, and 14 above.

Figure 35 | Value of total health benefits in the South Coast Air Basin caused by reductions of exposure to $PM_{2.5}$ and Ozone for the four months modeled.



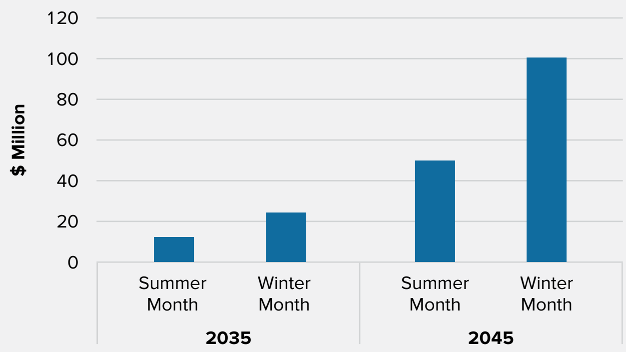
Source: University of California, Irvine Advanced Power and Energy Program for HyBuild LA, 2022

Quantifying annual health benefits for the course of the year would demonstrate significantly greater benefits than those quantified for just two months. However, it should be noted that the results of this assessment represent two distinct conditions (July and January) and cannot be simply multiplied to determine annual impacts. A more comprehensive study, including an evaluation of what can be achieved from reducing annual or cumulative pollutant exposure reduction, should be completed to get an accurate assessment.

Impacts on Disadvantaged Communities

This analysis found that, in total, the benefits of improved air quality from the HyBuild LA scenario are significant within DACs identified by CalEnviroScreen (shown in the figure below). These benefits range from approximately $15 million per month in July 2035 (30% of total South Coast Air Basin health savings) to $100 million per month in January 2045 (28.5% of total South Coast Air Basin health savings). These results should be considered within the context that approximately 25% of the California census tracts are defined as disadvantaged within CalEnviroScreen – in other words, 30% of the benefits occur within 25% of the census tracts – which indicates that the benefits are moderately weighted towards DACs.

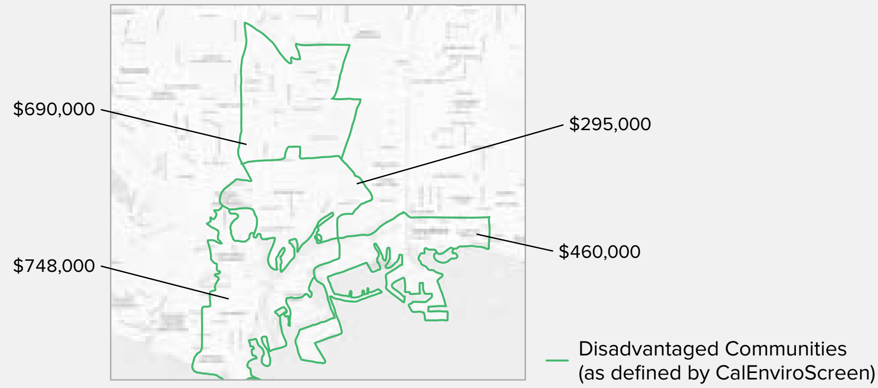
Figure 36 | Value of total health benefits that occur within disadvantaged communities in the South Coast Air Basin caused by reductions of exposure to $PM_{2.5}$ and Ozone for the four months modeled.



Source: University of California, Irvine Advanced Power and Energy Program for HyBuild LA, 2022

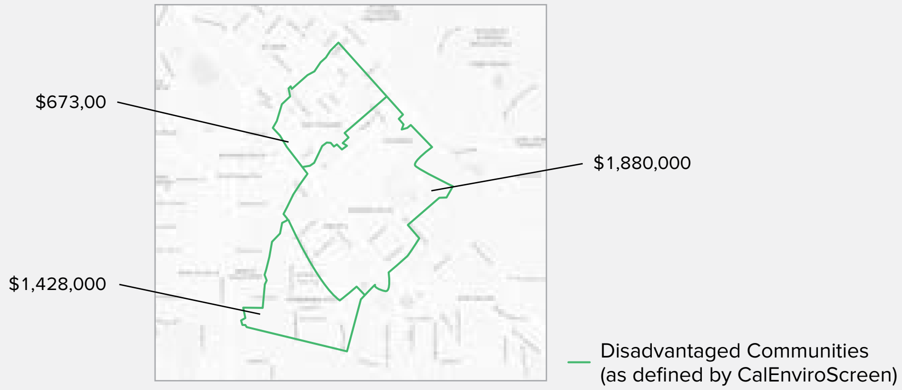
To further demonstrate the health benefits attained within DACs, seven representative communities[101] – which were located in areas particularly impacted by the technologies within the scenario, as defined at the census tract level from CalEnviroScreen – were evaluated to provide an estimate of the benefits that individual communities may experience. Based on stakeholder feedback, the analysis included DACs surrounding the Ports of LA and Long Beach and in the San Fernando Valley. In total for the four modeled months (January and July 2035; January and July 2045), the sampled neighborhoods attain benefits ranging from $295,000 to $1,880,000.

Figure 37 | Value of health benefits that occur within select disadvantaged communities surrounding the Ports of LA and Long Beach caused by reductions of exposure to $PM_{2.5}$ and Ozone for the four months modeled.



Source: University of California, Irvine Advanced Power and Energy Program for HyBuild LA, 2022

Figure 38 | Value of health benefits that occur within select disadvantaged communities in the San Fernando Valley caused by reductions of exposure to $PM_{2.5}$ and Ozone for the four months modeled.



Source: University of California, Irvine Advanced Power and Energy Program for HyBuild LA, 2022

101. Communities were sampled due to interest from stakeholders in Community Impacts Working Groups.

Methodology

This study built upon the findings from the Offtake and Infrastructure workstream, which determined the volumes and geographic location of GH_2 demand as a resource to displace fossil fuels in a variety of end uses. UCI's study considers how replacement of fossil fuel combustion with GH_2 in fuel cells in a variety of end uses may result in a reduction of local pollution.

UCI's Community Multiscale Air Quality (CMAQ) model was used to assess air quality impacts associated with emissions changes from the HyBuild LA system plan. The study considered both primary and secondary $PM_{2.5}$, ozone, and NOx. This model produced changes in air pollutant concentrations, which was compared to the air pollutant concentrations from a reference case.

The reference case was developed using a detailed inventory of total emissions across sector and source, and includes spatial and temporal information regarding source activity developed by the California Air Resources Board. The emissions were then grown and controlled to 2035 and 2045 using output from the E3 PATHWAYS model for technologies, fuels, and energy demand by AB 32 GHG Inventory sector. Additionally, data from various sources was utilized to account for changes in emission rates and control factors for on-road vehicles and other transportation sectors, and the CARB California Emissions Projection Analysis Model (CEPAM) 2019 v1.03 is used for stationary sources.

Because of the computational intensity of the pollution and atmospheric impact modeling, UCI specifically focused their episodic modeling on months that have the highest baseline concentrations of $PM_{2.5}$ and ozone – July and January – as they would provide insight into the maximum potential monthly impacts possible. The Environmental Protection Agency's BENMAP model (v1.5.8) was used to translate pollutant changes from CMAQ into health impacts.

The study utilized the following assumed penetrations of fuel cell electric technologies utilizing GH_2 for intrastate heavy-duty vehicles, drayage heavy-duty vehicles, materials handling equipment, forklifts, and motor coaches.

Table 15 | Fuel cell electric technology deployment assumptions for the HyBuild LA Air Quality Study.

	Deployment Level (% Utilizing Fuel Cell Electric)		
Application	**2035**	**2045**	**Additional Assumption**
Heavy-duty trucks	15%	31%	Deployment levels assumed for several heavy-duty trucks operating intrastate with max travel ranges of 400 miles
Drayage trucks	36%	75%	-
Materials handling equipment	26%	78%	-
Forklifts	44%	48%	Deployment assumed in all major categories in inventory
Motor coaches	None	55%	Reference case assumes high levels of battery electric bus deployment in 2045

Emissions from all other sources are held constant to the Reference Scenario, including some assumed to use GH_2, such as oceangoing vessels, planes, and natural gas power plants in the power sector.

The study conservatively assumes "no change" for power plant NOx emissions for the following reasons:

1. New or repowered turbines must meet local and state air quality standards for power generation facilities to be permitted.
2. GH_2 combustion for electric generation will utilize advanced dry low NOx combustion turbines, which are designed to reduce flame temperature and minimize NOx formation. The U.S. DOE estimates that with these advanced turbines, power plants will be able to achieve or improve upon current NOx emissions standards.[102]
3. Gas turbines in the field will be required to utilize selective catalytic reducers (SCRs), which have been in commercial operation since the 1970s. SCRs are used to reduce "at the stack" NOx emissions and ensure compliance with local air quality regulations.
4. Future power plant utilization will be significantly lower than today, as they will primarily be utilized to support reliability and resiliency, operating at much lower capacity will directly reduce all emissions.[103]

102. U.S. Department of Energy Hydrogen and Fuel Cell Technologies Office, "H2IQ Hour: Addressing NOx Emissions from Gas Turbines Fueled with Hydrogen," September 15, 2022
103. Jaquelin Cochran, et al., eds., "The Los Angeles 100% Renewable Energy Study," National Renewable Energy Laboratory, NREL/TP-6A20-79444, March 2021

For aviation, the primary application for GH_2 up to 2040 is expected to be as a feedstock to make SAF through a variety of processes. This cleaner fuel will technically combust identically to fossil-derived aviation fuels; however, it will be carbon-neutral as it utilizes carbon that is already in cycle (e.g., carbon capture).

Finally, the study assumes "no change" in emissions from the maritime shipping sector as the fuel, propulsion method, and potential fueling location for zero-carbon maritime shipping vessels has not yet been determined. Additionally, given California's requirement for ships to use shore power when at berth in the Ports of Long Beach and Los Angeles,[104] the Reference Scenario assumed that ships will utilize electricity close to shore. Ultimately, it is highly likely that sources such as maritime ships will achieve emissions reductions in the time period modeled. Thus, the scenario modeled is considered highly conservative and scaled GH_2 deployment would likely result in greater net air quality benefits.

6.3 | JOBS STUDY

The Community Impacts Workstream undertook a second analysis to assess the impacts that the GH_2 system envisioned in HyBuild LA would have on net job creation and skill mix.

The study assessed jobs needed throughout the GH_2 value chain (e.g., production, GH_2 transport, and end use) to serve the GH_2 demand of 1.76 MMT per year by 2040. The study also considered jobs associated with the production of GH_2 derivative fuels, such as SAF. While green NH_3 jobs were also measured, stakeholder feedback led to an assumption that green NH_3 would not be produced locally in the LA Basin. The following activities were included in the analysis:

- GH_2 pipeline and storage operations
- GH_2 fueling supply chain operations (i.e., liquefaction, refueling station operations)
- Solar power production operations
- Electrolytic GH_2 production operations
- SAF production operations
- Green NH_3 production operations

In this study, jobs are defined as the number of full-time-equivalent employees required in the industry in 2040. The methodology – which follows the process used in the Princeton Net Zero America study – uses activity factors, such as production quantities or operating capacity, and labor intensity for each activity, to estimate direct jobs required for the activity. The study also evaluated indirect jobs, defined as supporting labor associated with the activity, such as purchasing and accounting. This work is quantified through a multiplier applied to direct jobs.

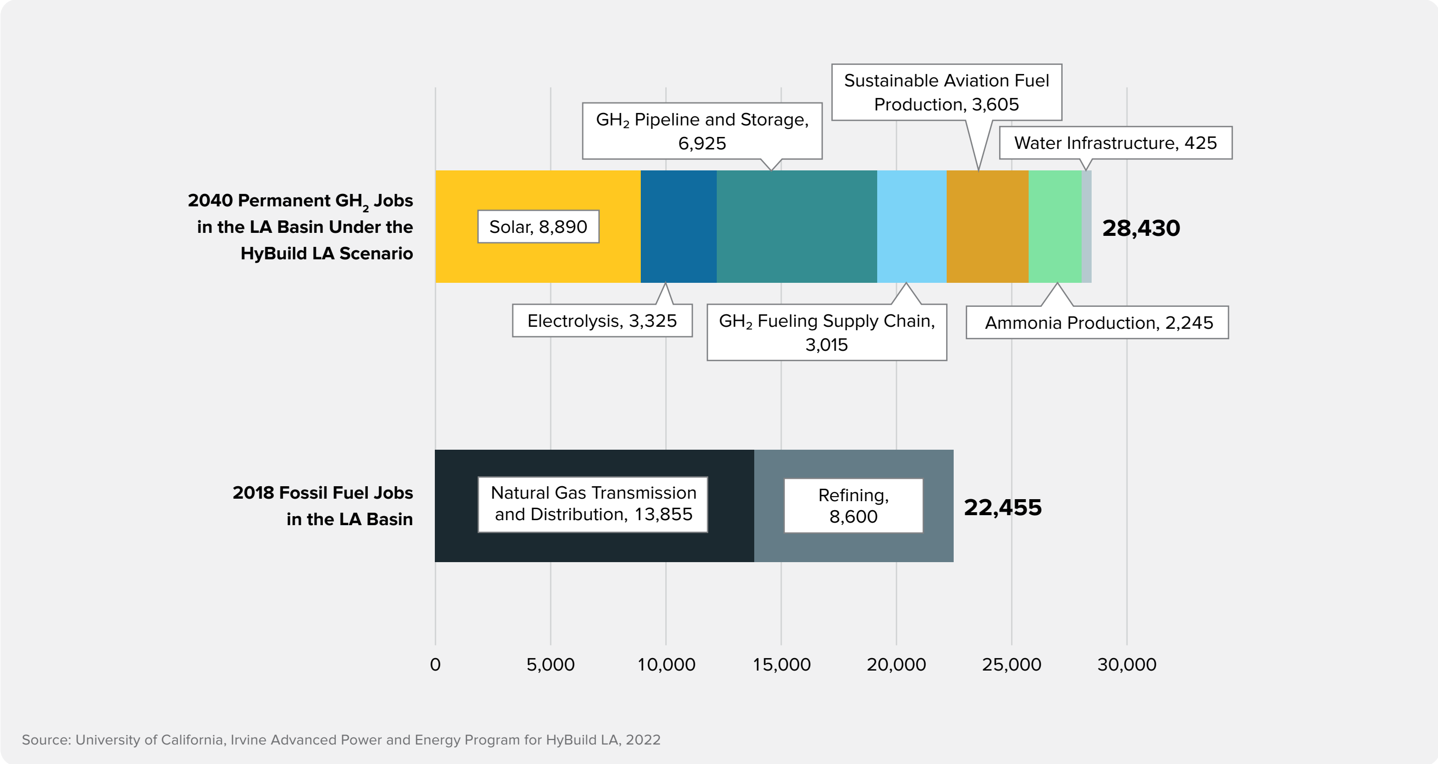
Findings

In total, GH_2 and its derivatives will create tens of thousands of jobs throughout Southern California by 2040. With this level of job creation, the GH_2 industry can offset potential job losses from local oil and gas industries, providing meaningful preservation and creation of high-quality jobs.

Many of the GH_2 jobs are similar to those from the incumbent fossil energy industry, such as jobs related to GH_2 pipelines and storage, fueling infrastructure, SAF production, and green NH_3 production. This creates a strong path for career transition as demand for fossil fuels decreases.

104. California Air Resources Board, "Ocean-Going Vessels At Berth Regulation," January 1, 2023

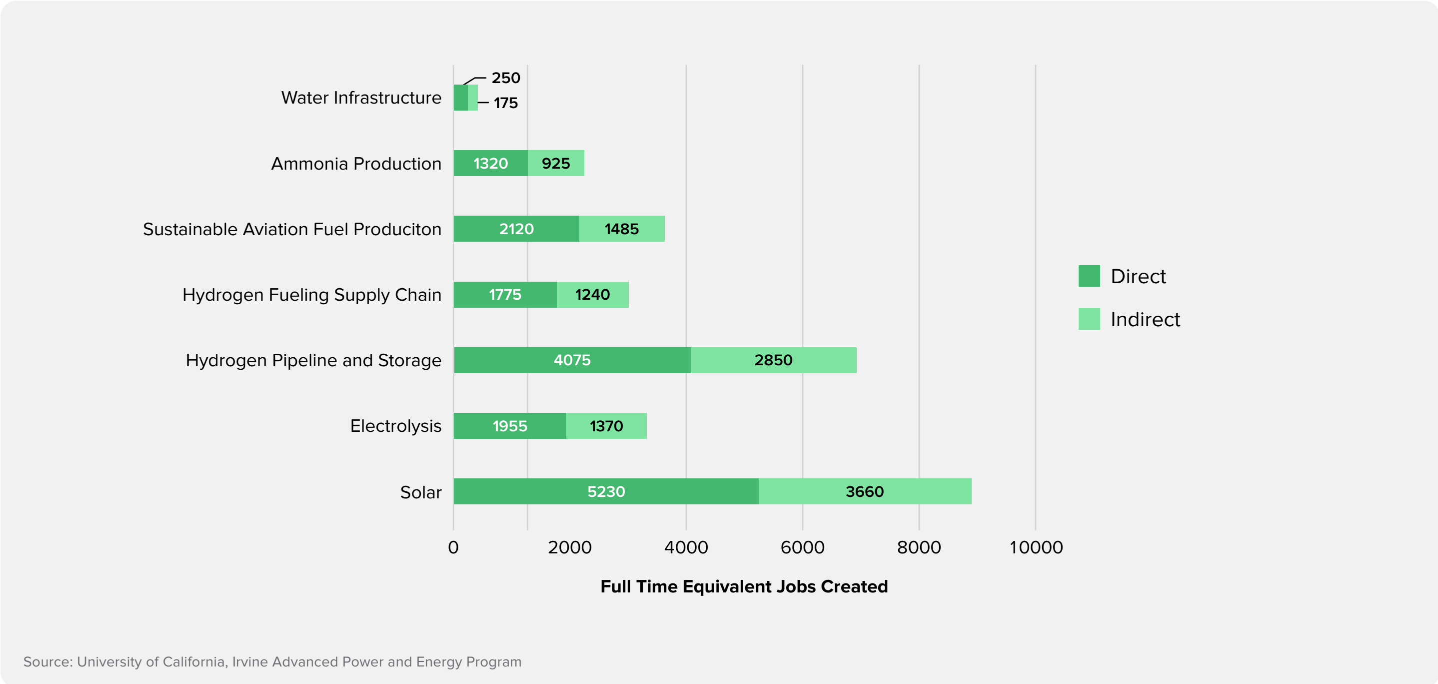
Figure 39 | 2040 GH_2 permanent jobs in SoCal compared to fossil fuel industry jobs.



Source: University of California, Irvine Advanced Power and Energy Program for HyBuild LA, 2022

Jobs created in the envisioned HyBuild LA ecosystem are projected to be made up of 16,725 direct jobs and 11,705 indirect (supporting) jobs. The division of direct and indirect jobs by each activity is detailed in Figure 40.

Figure 40 | 2040 Direct and indirect permanent jobs created as a result of the HyBuild LA scenario.



Source: University of California, Irvine Advanced Power and Energy Program

It should be noted that the job estimates from this assessment are conservative. For example, while HyBuild LA's estimates reflect a business-as-usual scenario, there are likely to be significant additional jobs from construction of GH_2-related facilities. Additionally, while the current analysis is based upon HyBuild LA's qualified GH_2 demand scenario, additional offtakers are likely to emerge as the industry matures, creating even broader industry growth.

Methodology

The study utilized the data sources from the employment analysis in Princeton's Net-Zero America (NZA) study, which assesses five different approaches to decarbonization and its subsequent societal impacts.[105] The NZA data was augmented by additional data gathered by UCI on labor and labor intensity related to GH_2 pathways not represented in the NZA cases. UCI's assessment adapted the scenarios to a regional view, with resource adoption scenarios consistent with the outcomes from the Offtake and Infrastructure Workstream.

The study utilized the following activity factors to estimate direct jobs:

Table 16 | Activity factors used to estimate direct job creation from GH_2 system development.

System Element	Activity	Activity Factor (Direct)	Units	Source
GH_2 Pipelines	Transmission and Storage Operations	13.93	jobs/100,000 kg/d capacity	Assumed equal to natural gas system per unit energy based on[106,107]
GH_2 Pipelines	Distribution Operations	32.50	jobs/100,000 kg/d capacity	Assumed equal to natural gas system per unit energy based on[106,107]
GH_2 Fueling Infrastructure	GH_2 Supply Chain Operations – Liq.	18.00	jobs/100,000 kg/d capacity	U.S. DOE HDSAM model[108]
GH_2 Fueling Infrastructure	GH_2 Refueling Station Operations	218.00	jobs/100,000 kg/d capacity	U.S. DOE HDSAM model[108]
Solar Generation	Power Production Operations	264	jobs/GW utility-scale solar capacity	Net Zero America study[108]
Electrolysis	GH_2 Production Operations	80	jobs/GW capacity	Electrolytic H_2 production bids in CEC GFO-18-304
Sustainable Aviation Fuel	Production Operations	0.26	jobs/million kg/yr capacity	Assumed equal to petroleum refining from NZA[109] and LAEDC[106].
Green NH_3	Production Operations	0.34	jobs/million kg/yr capacity	Based on U.S. ammonia production and jobs from NAICS.com (code 325311).

To assess indirect jobs, the study utilized an indirect labor factor of 2.1 for jobs related to fuel or chemicals supply chains based on a jobs study from the Los Angeles County Economic Development Corporation (LAEDC)[110] and 1.7 for solar generation based on NZA.

Total jobs were then calculated using the following formula:
Jobs = [Activity Factor]*[Labor Intensity]*[Indirect Multiplier]

The analysis does not include manufacturing jobs or construction jobs. Assessment of manufacturing jobs would require further analysis of in-state manufacturing capacity serving the GH_2 market. Construction jobs were not reflected in the projections as these historical labor intensity factors reflect business-as-usual levels of construction activity. Based on the NZA report, that construction of this GH_2 ecosystem has the potential to add an additional 30% to the total job numbers. However, additional specific modeling would be required to assess facility construction scenarios.

105. Princeton University, "Net-Zero America: Potential Pathways, Infrastructure, and Impact," Net-Zero America, Accessed March 2023.
106. S. M. Sedgwick, T. Laferriere, E. Hayes, and Somjita Mitra, "Oil & Gas In California : The Industry, Its Economic Contribution and User Industries at Risk 2017," 2019.
107. D. Sadler and H. Anderson, "H21 North Of England Report," 2018. doi: 10.2307/j.ctt20q1vhk.6.
108. HDSAM model and documentation available at: https://www.hydrogen.energy.gov/h2a_delivery.html
109. E. Larson et al., "Net-Zero America: Potential Pathways, Infrastructure, and Impacts Report," Princet. Univ., pp. 1–345, 2020.
110. Shannon Sedgwick, et al., "Oil & Gas in California: The Industry, Its Economic Contribution and User Industries at Risk 2017," Los Angeles County Economic Development Corporation, July 2019.

7. POLICY AND REGULATORY

The Policy and Regulatory Workstream focused on two tasks: (1) working with regulatory attorneys from Sheppard Mullin to conduct a "readiness assessment" of California's state and local GH_2 regulation and oversight and (2) identifying and prioritizing key policy and regulatory recommendations to support findings from both the Offtake and Infrastructure and Community Impacts Workstreams. The Methodology component of this section further describes these activities.

The Policy and Regulatory Workstream's tasks and objectives include:

Task 1: GH_2 "Readiness Assessment"

Objective: Understand State & Local Regulation

- Conduct a readiness assessment of H_2 regulation and oversight in California
- Identify gaps in policy activities or jurisdictional authority of H_2 regulation
- Develop a plan to address the highest priority regulation that requires modification, clarity, or legislative action

Task 2: Identify Key Policy & Regulatory Recommendations

Objective: Develop Innovative Policy

- Identify and prioritize the top policy opportunities to lower the cost of GH_2 in recognition of its net benefits
- Evaluate a list of competing policies to identify those that may be the most effective in the short-term
- Establish a list of policy recommendations

7.1 | POLICY AND REGULATORY INNOVATION

Findings

Through the two key tasks outlined above, the Policy and Regulatory Workstream established recommendations that address barriers to (1) developing a scaled GH_2 hub, (2) promoting innovation, and (3) driving down the cost of GH_2 in recognition of its net societal benefits.

The following table details HyBuild LA Phase 2's policy and regulatory recommendations, the motivation for taking action, and the key next steps to be taken:

Policy and Regulatory Objective	Motivation	Key Actions
Adopt a Statewide Green or Renewable H_2 Definition	Today, each relevant California agency utilizes a different definition for green and/or renewable H_2. Without a common, established definition, it is challenging to establish GH_2 eligibility for compliance with existing state policy and programs. It is also challenging to make efficient, coordinated progress on the development of needed policies and programs to accelerate progress.	Direct state agencies to adopt a universal definition of "renewable H_2" so that eligibility for existing and future state programs, incentives, mandates, and procurement opportunities is clear. The GHC also recommends adopting an internationally recognized well-to-gate lifecycle carbon intensity (CI) framework for green and renewable H_2, which will enable consistency with federal CI requirements for tax incentive eligibility.[111]

111. Green Hydrogen Coalition, et al., "IIJA 'Clean Hydrogen' Carbon Intensity Framework," March 14, 2022.

Clarify GH_2 Infrastructure Permitting and Siting	The development of GH_2 infrastructure (e.g., production, storage, transport, and dispensing facilities) in California is challenging as a result of complex state and local permitting requirements, differing requirements across local jurisdictions, and insufficient opportunities for community engagement with respect to implementing new infrastructure. Limited understanding of existing standards for GH_2, along with complex permitting and siting requirements, will increase project costs and the timelines required for development.	Direct state agencies to jointly develop a permitting guidebook for the GH_2 supply chain (e.g., production, storage, transport, dispensing, facilities) to help stakeholders – including municipalities – responsibly navigate and safely implement GH_2 projects and infrastructure. As H_2 is already a globally traded commodity, this guidebook may also compile existing safety guidance and best practices from around the world. This guidebook should include optimal locations for permitting and siting GH_2 infrastructure based on: existing local, state, and federal regulation; and the lowest possible burden and risk to local communities.
Conduct a Water Regulation Assessment for GH_2 Production	There is not yet a sufficient understanding of water use regulations by local jurisdiction across the state, particularly for electrolytic GH_2 production. Lack of such knowledge could impact the ability to optimize GH_2 production facility siting.	Assess water use regulations and identify the pros, cons, and implications of using different water resources (e.g., municipal and industrial recycled waste water) for GH_2 production in different regions of the state, based on existing regulations. Publish and clarify findings for all stakeholders.
Certify Technology-Agnostic Renewable H_2 Eligibility in California's Renewable Portfolio Standard (RPS)	Currently, fuel cells are the only RPS-eligible technology that utilize renewable H_2. As a result, California's RPS Eligibility Guidebook does not allow other commercially available and environmentally responsible renewable H_2 technologies – such as combustion turbines and linear generators – to participate in the RPS program.[112] Such technologies can provide clean, firm dispatchable power for grid reliability and resiliency benefits.	Modify the RPS Eligibility Guidebook to ensure all environmentally responsible renewable H_2-capable technologies can participate in the RPS program.[113] Ensure that if the facility uses a combustion process to generate electricity, the combustion process must be appropriately controlled and regulated to meet all required emissions requirements.
Develop A Vision For A 100% GH_2 Pipeline Network in California, WhichWould Eventually Be Interconnected with Other Hubs Emerging Through DOE's Regional Clean H_2 Hubs Program	Coordinated planning is essential to accelerate the development of needed GH_2 infrastructure for California and the broader U.S. Without a plan for a statewide 100% GH_2 pipeline backbone and distribution network, GH_2 transportation will have to occur via truck or rail, which would dramatically increase the final delivered cost of GH_2 and limit scalability. Additionally, the lack of a statewide long-term gas planning strategy prevents important discussions – regarding, for example, the appropriate way to repurpose pipelines – which will impede GH_2 pipeline development.	Require state agencies to jointly develop a statewide vision for establishing a regionally-interconnected California GH_2 backbone. This vision would augment long-term gas system planning to include the evaluation and development of a transition plan to retrofit or replace existing natural gas pipelines with a 100% dedicated GH_2 pipeline backbone and distribution network, analogous to what is being done in Europe via the European H_2 Backbone Initiative.[114]
Clarify Jurisdictional Authority for Interstate Dedicated GH_2 Pipelines	Ambiguity exists regarding the entity that has interstate regulatory authority over 100% dedicated GH_2 pipelines. If left unresolved, uncertainty around jurisdictional authority will impede project development, regional pipeline infrastructure progress, access to out-of-state geologic salt caverns for GH_2 storage, and California's ability to achieve mass-scale GH_2 at low delivered cost.	Collaborate with neighboring states and other regional/national institutions to develop the appropriate regulatory or legislative pathways. This is needed to clarify the appropriate regulatory authority to approve and regulate interstate 100% dedicated GH_2 pipelines.

112. Lin, Janice, "RPS Eligibility of Renewable Hydrogen Gas Turbines," The Green Hydrogen Coalition, October 5, 2021.
113. Ibid.
114. European Hydrogen Backbone, "The EHB initiative," Accessed February 8, 2023.

Establish a Safe GH_2 Blending Standard in the Natural Gas Network	Today, transporting GH_2 via truck and rail makes delivered GH_2 unnecessarily expensive. The most cost-effective way to transport GH_2 is via pipeline. While it is estimated to take several years to develop and deploy dedicated GH_2 pipelines, existing natural gas pipeline infrastructure may be able to catalyze progress by storing and transporting GH_2 at certain blending percentages. However, current policy does not allow for this opportunity, from the recent UC Riverside Study, which demonstrated that GH_2 can be safely blended into the existing natural gas grid at fractions at or below 5%.[115]	Establish an interim GH_2 blending standard at a volume fraction of 5% to begin moving GH_2 molecules through California's natural gas pipeline network to catalyze market development in the near-term. The standard should prioritize blending GH_2 into the natural gas system for hard-to-electrify sectors that require an alternative to electrification. While the GHC supports blending as a near-term solution to catalyze the GH_2 ecosystem, blending alone will not achieve the mass-scale vision established by HyBuild LA. Because of the scale, this vision requires dedicated 100% GH_2 pipeline infrastructure connected to out-of-state underground GH_2 storage in commercially-proven geologic salt caverns.
Expand California's Renewable Gas Mandate to Include GH_2	The CPUC, under the direction of Senate Bill 1440 (2017-2018),[116] approved biomethane procurement targets (72.8 billion cubic feet of biomethane by 2030) for gas utilities to meet the broader goal of reducing methane and other short-lived climate pollutants (SLCP) by 40% by the end of the decade.[117] However, GH_2 is not explicitly included in this mandate. As a result, this limits California's ability to support further methane and SLCP reductions from this scalable alternative fuel.	Through legislative direction, require the CPUC to open a new proceeding, or a new phase of an existing proceeding, to consider establishing procurement goals for GH_2 and require each gas investor-owned utility to annually procure a proportionate share of GH_2 to meet those goals.
Develop A Contracts For Difference (Cfd) Program To Accelerate GH_2 In New End Uses Outside Of The Transportation Sector	GH_2 is currently more expensive than incumbent fossil fuels for end users, particularly since the shared 100% GH_2 pipeline transport and geologic salt cavern storage infrastructure has not yet been built. Even after applying the Production Tax Credit in the federal IRA, some applications – such as process heat applications in the industrial sector – still cannot bridge the cost difference that end users may face between GH_2 and incumbent fossil fuel use, particularly in early GH_2 market development stages.	Direct the creation of a state agency-led CfD program that is aimed at reducing the cost gap between GH_2 and incumbent fossil fuels for specific end use applications where needed (e.g., certain industrial process heat applications). The program should aim to provide GH_2 buyers with price certainty for a set period of time, or until GH_2 delivered $/kg market price is equal to or less than the incumbent fossil fuel market price for the same quantity of energy.
Support GH_2 Refueling Infrastructure for Medium- and Heavy-Duty Vehicles, Ocean-Going Vessels, Harbor Crafts, and Off-Road Equipment	California's H_2 refueling infrastructure system is currently limited to light-duty on-road passenger vehicles. This approach restricts California's ability to fully support decarbonization of other fossil-fueled mobility applications, where low-cost GH_2 can accelerate the transition away from diesel and gasoline. The GHC supports battery electrification where possible; GH_2 will be particularly important for applications with long range or high daily utilization that are difficult to electrify.	Expand the state's H_2 refueling infrastructure credit through the Low Carbon Fuel Standard (LCFS) for medium- and heavy-duty vehicles,[118] ocean-going vessels, harbor crafts, and off-road equipment.
Develop a Vision for GH_2 Long-Duration Energy Storage (LDES) To Meet Reliability Needs	The state's Integrated Resource Planning (IRP) does not properly plan for the inclusion of GH_2 LDES for electric sector balancing and reliability. As a result, the state may unnecessarily rely on the continued use of fossil-fueled generation to achieve system balancing and reliability, while valuable renewable electricity curtailment increases. Electrolytic GH_2 is a commercially viable resource to achieve multi-day, weekly, and ultimately seasonal storage of low-cost renewable energy.	Consistent with Senate Bill 1369 (2017—2018), direct state agencies to plan and coordinate the procurement of electrolytic GH_2 as LDES through the state's IRP process. This planning process should also consider how to repurpose existing infrastructure to accommodate GH_2 to ensure a clean, reliable fossil-free electric system portfolio that is also affordable for all ratepayers.

115. Arun Raju, et al., "Hydrogen Blending Impacts Study," University of California, Riverside, June 18, 2022.
116. See SB1440.
117. CPUC, "Decision Implementing Senate Bill 1440 Biomethane Procurement Program," January 25, 2022.
118. See GHC's Joint Letter on Updates to the Low Carbon Fuel Standard (LCFS) Regarding Heavy-Duty (HD) Hydrogen Refueling Infrastructure (HRI).

Develop Electrolytic GH_2 Tariffs That Recognize the System Benefits of Electrolysis Equipment as a Demand Response Resource	California's grid needs greater flexibility and reliability, as exemplified by recent flex alerts and power outages. It is possible to electrolytically produce and store large amounts of energy for a significant period of time (e.g., days, weeks, or seasons) with GH_2. As a backup energy source for grid resilience, GH_2 energy storage systems can be used in combination with fuel cells, combustion turbines, or linear generators to convert the GH_2 back into electricity. This solution can be used as a demand response resource since it can provide system load when needed, and can also be curtailed during times of grid congestion. Today, no such pricing mechanisms are in place to support this opportunity.	Develop an electrolyzer tariff or demand response program that allows California's load-serving entities to create a "system-beneficial electrolytic GH_2 load." Require these load-serving entities to facilitate the delivery of green electricity to electrolytic GH_2 producers, while also enabling GH_2 producers to access and monetize the system benefits provided by demand-responsive electrolysis production.
Create A Framework to Prioritize Community Impacts in GH_2 Policy Making	Historically, the planning and siting of fossil fuel infrastructure has not sufficiently included the needs and concerns of frontline communities. These communities have been disproportionately harmed by the effects of fossil fuel production and use. The final vision and roadmap for a clean energy transition enabled by GH_2 must equitably include the needs, concerns, and interests of frontline communities through an equitable, transparent, and co-creative process.	As a first step toward a co-creative process, the State, in partnership with communities and environmental justice groups, should develop a community impacts framework that outlines a vision and tangible goals to be incorporated into GH_2 policy development. This framework should include guidance to policymakers and other stakeholders on best practices – such as guiding principles for improving equity, environmental, and energy justice – and a baseline for mitigating, tracking, monitoring, and remedying impacts.

Methodology

The recommendations set forth by the Policy and Regulatory Workstream were developed using the guiding principles and policy priorities identified by HyBuild LA participants. The guiding principles are as follows:

- To create an equitable and sustainable GH_2 ecosystem, the business and community value proposition must be clearly articulated and prioritized.
- Progress must be measured with transparency and accountability.
- Engagement should be based on a transparent, inclusive, and co-creative platform.
- Recognize that we are learning by doing together with the aim of implementing projects at scale while prioritizing an equitable and just transition.

Within this workstream, a four-step process was implemented to advance key objectives:

LISTEN

Attend, understand, & interpret findings from the Community Impacts and Offtake and Infrastructure Workstreams

PLAN

Partner with Workstreams to identify policy and regulatory issues and innovative policy/programs needed to properly value and compensate GH_2 production and use

DEVELOP

Establish a high-level strategy and roadmap to address critical policy and regulatory issues to jump start progress and articulate a business and community value proposition.

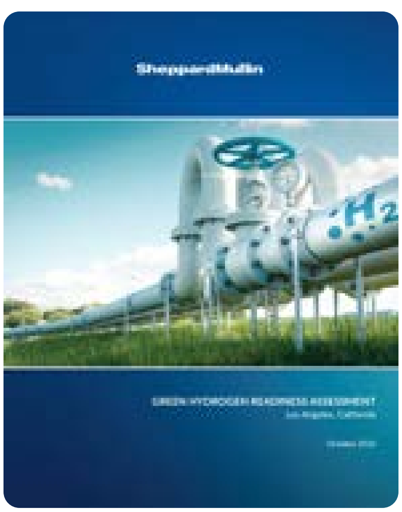
RECOMMEND

Share top policy issues, recommend paths to address these issues, and develop strategies to execute on early gaps to bring down $/kgH_2$ and properly value its benefits

First, the Policy and Regulatory Workstream identified any key policy and regulatory barriers to realize the vision established in the Community Impacts and the Offtake and Infrastructure Workstreams. Once this plan was in place, the Policy and Regulatory Workstream established a high-level strategy and roadmap to address critical policy and regulatory issues to jump start progress, while also brainstorming innovative policies that properly value and compensate for the environmental benefits of GH_2 production and use. Finally, this Workstream developed recommendations based on the highest priority areas identified by initiative stakeholders.

The activities of the Policy and Regulatory Workstream relied upon active stakeholder engagement and continuous collaboration with the other two HyBuild LA Workstreams to co-create strategic recommendations that not only bring down the cost of GH_2 but also properly value its benefits by addressing policy, regulatory, and programmatic gaps and barriers.

7.2 | GREEN HYDROGEN "READINESS ASSESSMENT" OF STATE AND LOCAL GH_2 REGULATION AND OVERSIGHT



HyBuild LA Phase 1 identified a need to better understand jurisdictional authority over GH_2 systems. Developing an informed roadmap for the GH_2 economy requires an understanding of the statutes, regulations, and regulatory bodies that have oversight over GH_2 infrastructure and across the value chain.

Working with Sheppard Mullin,[119] the Policy and Regulatory Working Group identified key hurdles in existing statutes and regulations that stand in the way of large-scale investment in GH_2 infrastructure. The final product was a *Green Hydrogen Readiness Assessment* of state and local (i.e., California and Los Angeles) regulation and oversight applicable to GH_2 systems.

Access the full document on Sheppard Mullin's website:
GH_2 Readiness Assessment of State and Local GH_2 Regulation and Oversight

119. Sheppard Mullin is a nationally renowned leader in renewable and clean energy with over 85 attorneys on its Energy, Infrastructure and Project Finance Team.

GH_2 "Readiness Assessment" Methodology

To complete this assessment, Sheppard Mullin evaluated 20 California agencies, one district agency, six county agencies (Los Angeles), and six city agencies (Los Angeles) by:

1. Reviewing regulations as currently written;
2. Identifying regulators and agencies with relevant jurisdictional authority; and
3. Identifying gaps in policy activities or jurisdictional authority.

The assessment provides a stoplight color-coding system for rating the extent to which a given regulation covers GH_2,[120] as well as an overview of regulation and oversight of GH_2 systems at various levels. This assessment informed the Policy and Regulatory Innovation findings.

120. Any attempt to create simple categories like those detailed in this table necessarily involves interpretations and a measure of subjectivity. Readers should read the underlying regulations and form their own conclusions, using the color-coding system only as a directional guide.

8. POTENTIAL BENEFITS OF A NORTHERN CALIFORNIA HUB CONNECTION

After nearly two years of studying the potential of a mass-scale GH_2 hub in Southern California, the GHC sought to understand the potential for the envisioned ecosystem to support decarbonization throughout California. Momentum for GH_2 continued to build throughout California in 2022; following the release of the U.S. DOE's $8 billion Clean H_2 Hubs Funding Opportunity Announcement, the State established the Alliance for Renewable Clean Hydrogen Energy Systems (ARCHES), a public-private consortium to create a sustainable, statewide clean H_2 hub.

To better understand the potential challenges and benefits of expanding the HyBuild LA vision to help serve mass-scale demand for GH_2 in Northern California, GHC undertook a preliminary assessment to determine: (1) the opportunity for GH_2 in Northern California, with a focus on the area around the Port of Stockton; (2) if the system demand could be satisfied through local infrastructure or if connection to the envisioned HyBuild LA system may be beneficial; and (3) if Northern California may provide additional opportunities to meet the State's growing demand for green NH_3.

Due to resource constraints, this portion of the report should be viewed as a preliminary assessment to identify key themes for further engagement. For example, the study does not include the entire northern part of the state, instead focusing on the area within a 100-mile radius of the Port of Stockton. Additionally, the demand assessment does not comprehensively evaluate all potential offtakers; thus, it likely represents a conservative estimate. Importantly, the GHC has not engaged community stakeholders in this region. Finally, the analysis only considers electrolytic pathways for GH_2 production, whereas Northern California has ample organic waste resources. The ultimate roadmap will require additional analysis and engagement.

8.1 | GREEN HYDROGEN DEMAND IN NORTHERN CALIFORNIA

In this preliminary assessment of major demand sectors in Northern California, HyBuild LA estimated 275 kt GH_2 demand by 2030. This assessment evaluated GH_2 demand in five sectors: maritime shipping, heavy-duty trucking, power generation, refining, and agriculture.

The maritime shipping estimate assumes that Northern California – more specifically, the Port of Stockton – will handle storage and delivery of green NH_3 for all shipping activity in California. The analysis considered the Ports of Oakland, Stockton, and Los Angeles and Long Beach. This assumption was based on the finding that the Port of Stockton is the only port in California that currently handles imports of NH_3, bringing in approximately 120 kt of ammonia imports each year to distribute to agricultural users throughout the state.[121,122] This scenario assumes that NH_3-powered ships coming to any port in California could be refueled at sea by bunkering ships carrying green NH_3 from the Port of Stockton.

Due to the significant potential demand for green NH_3 around the Port of Stockton, the demand assessment focused on other sources of GH_2 demand within a 100-mile radius.

Table 17 | Estimated GH_2 use cases and demand in Northern California for 2030.

End Use	Use Case	2030 Demand
Heavy-Duty Trucking	For use in fuel cell-based vehicles	95
Maritime Shipping – Serving Ports of Oakland and Stockton	To produce green NH_3	3.7
	For direct use in ships	1.3
Maritime Shipping – Serving Ports of LA/Long Beach	To produce green NH_3	55
Power Sector	For use in thermal power plants in place of natural gas	30
Refineries	For direct replacement of grey H_2 in refining processes	75
Agriculture	To produce green NH_3 as a feedstock to replace anhydrous ammonia currently imported.	20

121. Port of Stockton California, "Annual Comprehencive Financial Report," June 30, 2021.
122. CA Imports Source, State of CA Dept of Food and & Ag Report. Reference: categories 2 (anhydrous ammonia), 6 (aqua ammonia), 0 (non-farm use secondary/micronutrients).

8.2 | UNLOCKING SCALE AND LOW-COST RENEWABLES FOR NORTHERN CALIFORNIA'S GREEN HYDROGEN ECONOMY

Key Findings

This preliminary assessment found that the demand profile for GH_2 in Northern California is relatively inflexible. In this study, an "inflexible" demand profile for GH_2 implies that offtakers have limited ability to adjust the timing and quantity of their offtake, which creates additional system design challenges to ensure that offtakers can be consistently supplied with GH_2 (given the intermittent profile of renewable energy resources, which impacts the production profile of electrolytic GH_2). This creates additional system design challenges to ensure seasonal system balancing.

Table 18 | Demand profile for GH_2 in Northern California.

GH_2 End Use	Flexibility Potential
Green NH_3 Production	Low Flexibility: Decreasing the capacity factor of the Haber-Bosch process due to varying GH_2 supply degrades economics
Thermal Power Plants	No Flexibility: Co-firing must have consistent flow of GH_2 to meet demand
Refineries	Medium Flexibility: Refineries can utilize existing SMR infrastructure (grey H_2 / blue H_2 production) and blend it with GH_2
Mobility	Medium Flexibility: Some daily fluctuation from heavy-duty mobility (trucks), but must have reliable supply on a seasonal basis

Because offtakers in Northern California are not flexible enough to follow seasonal solar and GH_2 production profiles, the assessment concluded that offtakers must have pipeline access to mass-scale GH_2 storage in geologic salt caverns. However, directly connecting to the closest geologic salt caverns in Delta, Utah would require a challenging route that crosses protected National Forest areas and the Sierra Nevada Mountains. Instead, this assessment found that storage capacity can be most cost-effectively accessed by connecting a mass-scale Northern California GH_2 hub system to the LA Basin system via GH_2 pipeline connection. The envisioned 300-mile pipeline between Northern and Southern California would follow existing rights-of-way and would enable Northern California to access geologic salt cavern storage in Utah by way of LA's GH_2 backbone pipeline.

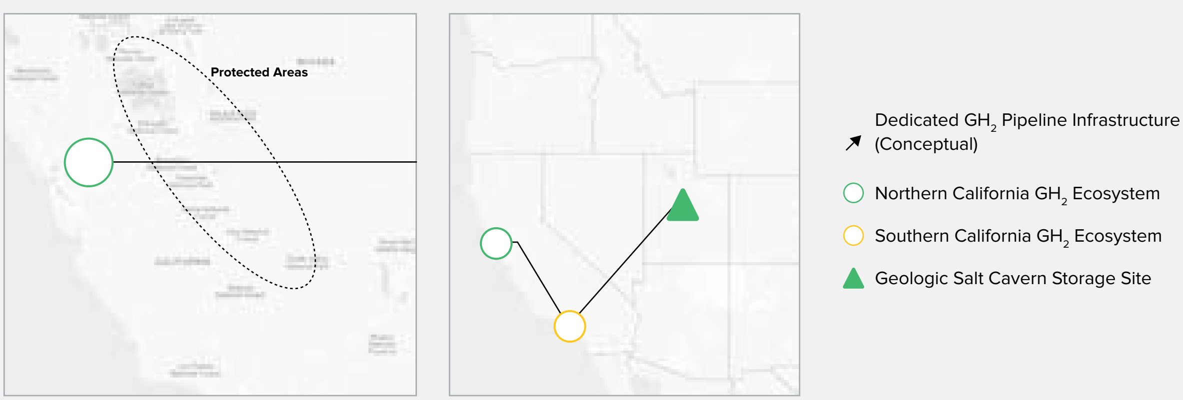
Figure 41 | Scenarios for Northern California connection to geologic salt cavern storage.

Scenario 1
Direct connection from Northern California GH_2 ecosystem to geologic salt cavern storage

Not feasible: This pathway would lead through protected areas (National Forest and Sierra Nevada Mountains)

Scenario 2
Connection to geologic salt cavern storage via Southern California GH_2 ecosystem

Feasible: A dedicated pipeline connecting Northern and Southern California, following existing natural gas infrastructure routes, would enable shared access to geologic salt cavern storage



Because the solar yield in the Southern California desert is higher than solar yields in Northern California, this connection would also enable GH_2 to be produced utilizing the lower cost solar resource in Southern California and then transported north. This GH_2 is anticipated to cost approximately 15% less at the point of production in Southern California relative to GH_2 from Northern California.

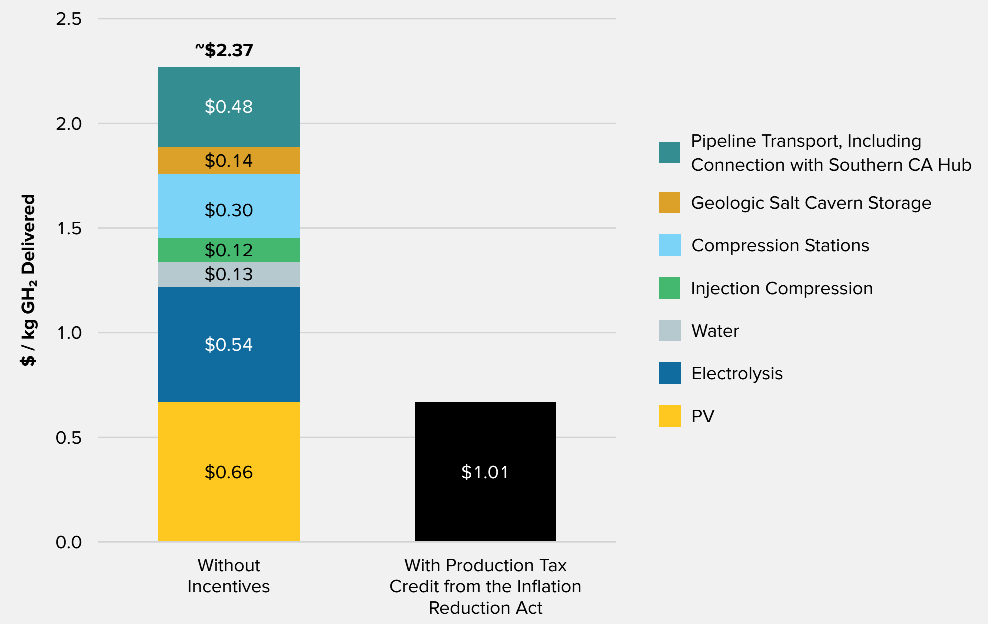
While this analysis only considered electrolytic pathways to produce GH_2, it should be noted that the Central Valley of California has abundant organic waste resources that may be utilized to produce GH_2 with a consistent production profile. These resources may be explored as a near-term solution to optimize GH_2 production and to help alleviate other environmental and societal problems caused by excess organic waste.

Northern California LCOH and CapEx

Based on this design, the delivered cost of GH_2 in Northern California would be around $2.37/kg in 2030, which would be reduced to $1.01/kg if utilizing the IRA Production Tax Credit.

It's estimated that a dedicated GH_2 pipeline connecting the HyBuild LA system with Northern California would require close to $750M in capital investment. This capital expenditure would result in an additional $0.32/kg in transport costs for offtakers in Northern California.

Figure 42 | Estimated levelized cost of GH_2 in Northern California in 2030.



Source: Corporate Value Associates for HyBuild LA, 2022

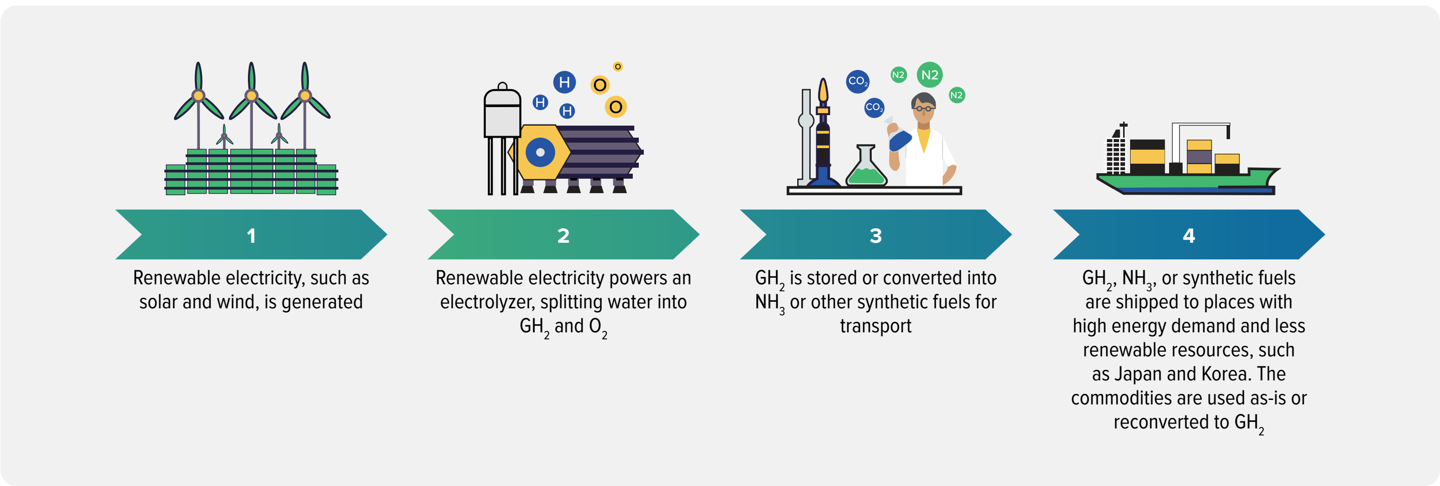
8.3 | ENABLING CALIFORNIA'S GREEN AMMONIA OPPORTUNITY

Since the 1970s, California has utilized imported ammonia (NH_3) to serve the local agricultural industry, taking advantage of low-cost fossil fuel resources in states like Texas as well as from abroad.[123,124] NH_3 is produced via the Haber-Bosch process by combining nitrogen with H_2, and today, this imported NH_3 and its fertilizer derivatives are all produced from fossil fuels.[125] With the war in Ukraine impacting global natural gas prices, in addition to California ceasing to import NH_3 directly from Russia, fertilizer prices skyrocketed to unprecedented levels.[126] In July 2022, the cost of anhydrous ammonia tripled from 2021 prices, negatively impacting California's farmers and consumers across the country.

Demand for green NH_3 in California is anticipated to increase, with shipping driving demand for approximately 316 kt of green NH_3. Rather than supply the agriculture and maritime shipping sectors with imports, California has the potential to bring NH_3 production in-state to increase jobs, create economic and export opportunities for the state, and hedge against fossil price volatility.

Stockton's long-standing experience with handling ammonia imports makes it the most viable prospective location to locate green NH_3 fuel for ships serving the state. It also has the potential to be a location for export of green NH_3, which could be a method of moving California-produced GH_2 around the world (see Figure 43).

Figure 43 | GH_2 export pathway.



Given this opportunity, HyBuild LA worked with CVA to evaluate (1) the total demand for green NH_3 in the state and (2) if California can produce its own cost competitive green NH_3.

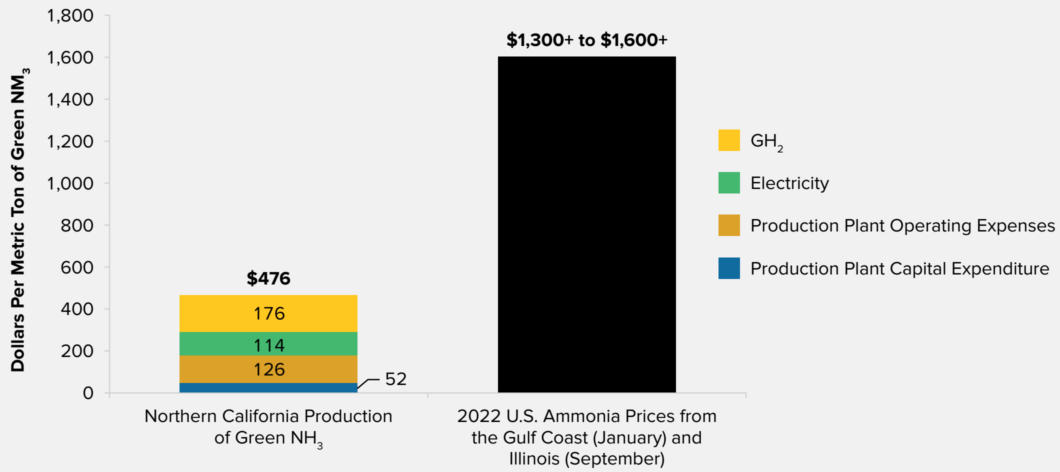
Key Findings

The analysis found that California's total combined annual demand for green NH_3 in the agricultural and maritime shipping industries would be around 444 kt of green NH_3 in 2030. This includes the demand from the Ports of Oakland, Los Angeles, and Long Beach, the primary ports driving demand for bunkering fuel across the state. This scenario assumes that NH_3-powered ships coming to any port in California could be refueled at sea by special bunkering ships carrying green NH_3 from the Port of Stockton.

The analysis estimated that Northern California can produce green NH_3 for $468/ton, a cost which is in line with price expectations for imported green ammonia in 2030.[127]

123. Brittany Johnson, "Fertilizer prices are skyrocketing for California Central Valley farmers. Here's why it matters," KCRA3, July 13, 2022.
124. U.S. EIA, "Natural Gas Weekly Update," April 1, 2021.
125. Ibid.
126. Brittany Johnson, "Fertilizer prices are skyrocketing for California Central Valley farmers. Here's why it matters," KCRA3, July 13, 2022.
127. Mahdi Fasihi, et al. "Global potential of green ammonia based on hybrid PV-wind power plants," Applied Energy, July 2021.

Figure 44 | Estimated cost of green NH_3 produced in Northern California from low-cost GH_2 feedstock compared to grey NH_3 pricing in 2022.



Source: BloombergNEF and Farm Doc Daily

Assumptions and Methodology

The scenario modelled has the capacity to produce 450 kt of green NH_3/year at a 90% capacity factor. This high capacity factor was critical to enabling a low levelized cost of green NH_3, allowing the plant's capital costs to be spread over a larger volume of production. As a result, the plant would require access to a consistent supply of low-cost GH_2 year-round. In this scenario, it is assumed this GH_2 is supplied via pipeline connection to the integrated Northern – Southern California system at $1.01/kg GH_2 (see above for more details on this LCOH).

The analysis assumes that a mixture of grid power and dedicated solar or power purchase agreements are utilized to meet the power needs of the Haber-Bosch process at a cost of $155/MWh. Other operating expenses reflected in the green NH_3 costs include water, labor, catalyst, and land (see Appendix for more details).

9. CONCLUSION

GH_2 is a key resource for deep decarbonization in Los Angeles. When deployed at scale in the LA Basin, GH_2 can dramatically reduce harmful local pollutants from mobility sectors, create diversely skilled job opportunities, and enable an affordable and reliable clean energy transition.

Rapid adoption of GH_2 technologies in hard-to-abate sectors can be unlocked by lowering the cost of delivered GH_2. HyBuild LA uncovered a pathway to achieve a levelized cost of delivered GH_2 of $2.05/kg by 2030 without incentives. However, this low delivered cost depends upon the use of large-scale, shared infrastructure, including a 100% GH_2 transmission pipeline that connects LA to mass-scale production regions and underground geologic salt cavern storage. If utilized, the IRA's Production Tax Credit can provide additional cost benefits for GH_2, lowering the levelized cost of delivered GH_2 in the HyBuild LA system plan to $0.69/kg. It is critical to get started on the near-term roadmap to tap into these 10-year tax credit opportunities and meet the urgency of the climate crisis.

The envisioned HyBuild LA hub – which includes electrolytic production of GH_2 from dedicated solar resources, water supply and treatment infrastructure, GH_2 compression, transportation via dedicated GH_2 pipeline backbone, interconnection with out-of-state salt cavern storage, local liquefaction, and truck delivery of GH_2 to fueling distributed fueling stations – is estimated to cost nearly $34 billion, delivering 1.4 MMT of GH_2 to the LA Basin.

While federal funding from the Infrastructure Investment and Jobs Act and the IRA will help to drive momentum, this hub will be primarily supported by private sector investment. Thus, it is critical to reduce regulatory uncertainty to secure investments into GH_2 infrastructure at scale. Some urgent actions for market enablement include: establishing a state definition for GH_2, streamlining permitting and siting of infrastructure, providing financial incentives, and developing a purpose-built and dedicated GH_2 pipeline network.

In addition to policy and regulatory innovation, catalyzing LA's GH_2 ecosystem will require a near-term, large-scale, committed offtaker to catalyze infrastructure investment. The power sector is a committed first-mover, motivated by the City of LA and LADWP's commitment to reach 100% renewable energy by 2035 and the need for significant quantities of firm, dispatchable, GHG-free power. It is important to note that all repowered power plants must either meet or outperform current regulatory emissions standards when converted to utilize GH_2. Demand at this scale will justify shared infrastructure and drive down end-user GH_2 costs, enabling adoption in highly polluting sectors, such as heavy-duty trucking, shipping, port operations, and aviation. While the power sector plays an important role in the establishment of a GH_2 market, it is unlikely to be a large consumer of GH_2 in the long-term, as in-basin power plants are likely to be utilized primarily for high-demand or emergency needs.[128]

The roadmap for the region must ensure a strong community value proposition and include local stakeholders in the planning processes from inception. A few areas for future collaboration identified in HyBuild LA's stakeholder engagement include: ensuring the safety of GH_2 infrastructure, providing input on infrastructure decisions, ensuring climate integrity of the system, maximizing public health benefits, creating jobs and career transition opportunities, and conducting analysis around appropriate uses for GH_2. Co-creating the region's GH_2 ecosystem will be a big undertaking for a diverse range of stakeholders. Community members should be supported as needed to create capacity and reduce barriers to engage in these processes.

"Never doubt that a small group of thoughtful, committed citizens can change the world; indeed, it's the only thing that ever has."

From our preliminary evaluation, the opportunity for local communities in the LA Basin to benefit from the GH_2 economy are immense; even conservative adoption estimates show significant air quality improvements, leading to public health benefits. By 2035, the public health benefits of the envisioned GH_2 economy can be valued at nearly $80 million for residents in January 2035 alone. The HyBuild LA adoption scenario is also estimated to create nearly 29,000 direct and indirect jobs, which have diverse skill demands that enable a just, clean energy transition. The GHC will continue to collaborate with key stakeholders to understand the interests and valid areas of stakeholder concerns.

Ultimately, HyBuild LA envisions the transition of the energy system we have relied upon for the last century to create a vibrant, inclusive, and clean energy economy. Creating a GH_2 hub at this scale has never been accomplished before. However, the work from HyBuild LA demonstrates that the vision for mass-scale, low-cost GH_2 to decarbonize multi-sectoral offtakers is commercially viable and technically achievable. Bringing the vision to life will require transformational leadership and collaboration across sectors, but in the words of the American anthropologist Margaret Mead: *"Never doubt that a small group of thoughtful, committed citizens can change the world; indeed, it's the only thing that ever has."*

128. Cochran, Jaquelin, and Paul Denholm, eds., "The Los Angeles 100% Renewable Energy Study," National Renewable Energy Laboratory, NREL/TP-6A20-79444, March 2021.

APPENDIX A

Offtake Assessment – Inputs, Assumptions, and Methodology

Authors: Corporate Value Associates (Mobility Infrastructure, Land-Based Mobility Use Cases, E-Kerosene for Aviation, Ammonia Production); American Bureau of Shipping (Maritime Shipping).

A.1 | MOBILITY INFRASTRUCTURE

A.1.1 | Fuel Delivery Infrastructure

HyBuild LA Phase 2 built upon the findings from the Phase 1 (2021) analysis, which found that a dedicated transmission pipeline carrying compressed GH_2 gas was the most cost-effective way to transport large volumes of GH_2 from production zones into the LA Basin. This infrastructure was referred to as the "pipeline backbone."

For locations with large quantities of aggregated GH_2 demand, distribution pipelines are likely to be the lowest cost option. Where demand is dispersed or distribution pipelines are not feasible, truck transport of liquid hydrogen was selected as the lowest-cost option for delivery of GH_2 to refueling or local storage infrastructure within 50 – 200 miles from the GH_2 pipeline backbone. In the HyBuild LA scenario, liquefaction plants are placed at the most cost-effective locations along the GH_2 pipeline backbone to optimize for the costs and availability of land.

Truck delivery of liquid GH_2 may be feasible for dispersed refueling infrastructure that is located beyond 200 miles from the GH_2 pipeline backbone, particularly if located along major transit corridors. However, if sufficient demand can be aggregated to justify implementation of a distribution pipeline, distribution pipeline delivery will be more cost-effective than truck delivery of liquid GH_2.

A.1.2 | Other Fuel Scenarios Considered

In addition to transportation of liquid GH_2 via truck and transportation of compressed GH_2 via pipeline, HyBuild LA considered additional transport mediums: trucked transport of compressed gas, liquid organic hydrogen carriers (LOHC), and ammonia cracking (i.e., transporting as ammonia and then converting back into GH_2 at the destination). These storage and delivery methods were assessed based on infrastructure cost, technology maturity, and transport potential (including carrying capacity and the distances at which they could economically transport GH_2). This analysis of GH_2 transportation pathways concluded that truck delivery of compressed gas would not be feasible for GH_2 fueling stations for the applications considered in HyBuild LA, given the expected daily GH_2 demand at these facilities. LOCH and ammonia cracking were also excluded as they are not yet technologically mature and require higher-cost infrastructure.[129]

A.1.3 | Liquefaction Infrastructure Scenarios

Two different design options were analyzed for liquefication configurations: fewer, larger liquefaction stations that require greater GH_2 transportation distances via truck, and a greater number of smaller liquefaction stations, enabling shorter GH_2 transportation distances via truck. The first configuration includes two large liquefaction plants next to the GH_2 pipeline backbone, minimizing land use and maximizing economies of scale. Using this design option, the estimated cost of liquefaction and GH_2 transportation via truck in 2030 was determined to be \$2.40/kg GH_2, with \$2.10/kg attributed to the liquefaction process and the remaining \$0.30/kg attributed to truck transport costs. The liquefaction costs can be further broken out into CAPEX (17%), liquefaction electricity (48%), and operations and maintenance and other OPEX (35%). This lower-cost option is reflected in the HyBuild LA scenario.

The second design configuration includes multiple smaller liquefaction plants next to the pipeline backbone, thus minimizing the average distance of GH_2 transport via truck. The estimated cost associated with the second design option is \$3.10/kg GH_2, with \$3.00/kg resulting from liquefaction costs, and the remaining \$0.10/kg from truck transport. The liquefaction costs were divided between CAPEX (19%), liquefaction electricity (42%), and operations and maintenance and other OPEX (39%).

Table 1 identifies the inputs used in the liquefaction design calculation and Table 2 includes the associated sources.

129. Mario Conte, et al. "Hydrogen as Future Energy Carrier: The ENEA Point of View on Technology and Application Prospects," Energies, vol. 2, no. 1, pp. 150-179, 2009.

Table 1 | Liquefaction design calculation inputs.

Input	Design 1	Design 2	Unit
Technical Data			
Average transport distance	200	60	miles
# of plants	2	15	# plants
GH_2 loss from liquefaction process	0.7	1.4	%
Plant capacity	200,000	27,000	kg/day
CAPEX Data			
Infrastructure lifespan	30	30	years
Project start year	2025	2030	year
# of years for station construction	1	1	years
CAPEX	4,000	5,600	$/kg of liquefaction capacity
OPEX Data			
OPEX and O&M	6	6	% of CAPEX
Plant size	10,000	2,500	m^2
Land rent cost	4	1	$\$/m^2$
Electricity consumption	4	5	kWh/kg of GH_2 liquefied

Table 2 | Liquefaction design calculation sources.

Input	Source
Maximum supply capacity of one station	Connelly et al. 2019[130]
GH_2 loss	Derking et al. 2019[131]
Infrastructure lifespan	Connelly et al. 2019
CAPEX	Connelly et al. 2019
Land rent cost	USDA 2021[132]

130. Elizabeth Connelly et al., "Current Status of Hydrogen Liquefaction Costs," DOE, Hydrogen and Fuel Cells Program Record, #19001, August 6, 2019.
131. Henrie Derking, et al., "Liquid Hydrogen Storage: Status and Future Perspectives," Cryogenic Heat and Mass Transfer, Enschede, The Netherlands. Cryoworld Advanced Cryogenics, November 4, 2019.
132. USDA National Agricultural Statistics Service. "Pacific Region – State Cash Rent & Land Values," August 6, 2021.

A.2 | LAND-BASED MOBILITY USE CASES

Before developing an estimate for GH_2 demand in the mobility sector, CVA first filtered potential use cases based on whether GH_2 would provide a cost-competitive decarbonization solution compared to electrification. For this assessment, CVA developed sample use profiles for different mobility applications. These use profiles were utilized to compare the cost of fueling a particular mobility end use with GH_2, diesel, or electricity. The use cases are not based on specific facilities or vehicle routes; rather, they were developed with inputs from stakeholder interviews and other industry knowledge and are meant to be representative of general use patterns in Southern California.

The following sections identify use cases where GH_2 was determined to be a cost-effective option, provide details on the sample use profiles, and share any other relevant inputs that were utilized to study each use case. Mobility infrastructure use cases where GH_2 was not considered a cost-effective option, or where demand was too limited to warrant further analysis, are identified in Table 3.

Table 3 | Summary of use cases not included in offtake and infrastructure analysis.

Use Cases Not Included in Analysis		
Vehicle Types	**Use Case**	**Reason Why Not Included**
Trucks for last-mile delivery	Last-mile delivery in LA, using fleet of light trucks operating from single vehicle depot at logistic hub	Not competitive vs. electrification (can be charged overnight at stationary base sufficiently)
City buses	Los Angeles County Metropolitan Transit Authority (LACMTA) use of local/rapid/express buses	Not competitive vs. electrification (LACMTA already invested in charging infrastructure which can sustain use cases)
Diesel trains	Locomotives powering interstate cargo trains	Complete fueling need is out of scope for the HyBuild LA system (earliest refueling stop 800 miles from LA)
	Switcher locomotives powering intrastate cargo trains	Limited demand
	Amtrak Metrolink Commuter Trains	Not competitive vs. electrification
Heavy-duty construction equipment	A variety of equipment types operated by LA-based construction companies on construction sites around LA	Low maturity of technology, with very heterogenous and dispersed equipment fleet. Some construction site may utilize GH_2-powered mobile generators, but this application has limited scale of demand.

A.2.1 | Heavy-Duty Trucks

Based on Federal Highway Administration statistics on truck registrations in California[133] and population distributions across the state, it was estimated that around 450,000 heavy- and medium-duty trucks operate in the LA Basin. Assuming that 50% of this quantity are heavy-duty trucks (HDTs) and 22,000 are drayage trucks (which are assessed separately),[134] the addressable vehicle base was assumed to be around 205,000, growing to 240,000 in 2030 based on traffic flow predictions. The use case developed for the HyBuild LA analysis (described below) applies to 70% of this addressable vehicle base.

The HyBuild LA study assumed that public GH_2 stations would be available within 400 miles of LA, or that refueling would be available at route destinations for trips up to 400 miles outside of LA. In this scenario, 85% of GH_2 fuel would be provided by small depot-based, private refueling solutions with a capacity of 400 kg GH_2/day, and the remaining 15% would be provided at public heavy-duty GH_2 stations with 6 t GH_2/day. This extrapolation assumes there are 10 small depot base stations, each with a capacity of 0.4 t/day, at base and destination locations.

Assuming a 12-year vehicle replacement time, HyBuild LA anticipates that fleet penetration would reach nearly 30% of HDTs registered in the LA Basin by 2040, translating to a fleet of roughly 90,000 FCEV trucks by 2040. Estimated GH_2 demand from heavy-duty trucks and related fueling infrastructure projections are shown in Table 4. The projected annual demand at the pump is 135kt in 2030, increasing to 705kt in 2040.

133. Federal Highway Administration. "Truck and Truck-Tractor Registrations – 2019," U.S. Department of Transportation. November 2020.
134. Port of Long Beach. "Clean Trucks: Program Details." Accessed January 30, 2022.

Table 4 | Heavy-duty trucks and fueling infrastructure estimates in the HyBuild LA system plan.

Value	Unit	2030	2040
# of FCEV heavy-duty trucks in LA Basin	thousands of FCEVs	17	88
GH_2 demand/year (at the pump)	kt	135	705
# of small depot-based station at 400 kg/day capacity	#	1,051	5,505
# of public heavy-duty stations at 6,000 kg/day capacity	#	23	121

LA is both a destination and an origin for interstate trucking – 81% of the mileage traveled by trucks leaving, entering, or moving within CA is due to interstate transport.[135] While interstate travel dominates heavy-duty truck traffic in LA, many key destinations are within a 400-mile radius of LA. Traffic flow predictions include an increase in delivery volumes of 35% by 2040, with the same key destinations and routes as current delivery patterns.[136]

Table 5 | Key regions and destinations for heavy-duty trucking.

Key regions and roads for interstate heavy-duty truck traffic from/to LA
Bakersfield Region – Interstate 5 / CA99
Indio Region – Interstate 10
Barstow – Interstate 15 and 40
San Diego – Interstate 8
Interstate 8 / 10 Intersection
Flagstaff Region
Interstate 40 / U.S. 93
Key destinations for LA-origin heavy-duty truck traffic flows
San Francisco
Las Vegas
Phoenix
Sacramento
Saint George

Total Cost of Ownership Analysis

A total cost of ownership (TCO) analysis was undertaken to assess the point at which GH_2 fuel cell heavy-duty trucks may become cost-competitive with current internal combustion engine technology. This analysis was based on a sample trucking use case for heavy goods transport from a fleet operator that is based in the LA Basin, but operates interstate. The specific scenario evaluated in this use case assessment includes a dedicated fleet of 200 HDTs arriving and leaving from a warehouse in the LA Basin. It was assumed that 290 trips were started per day, some of which were interstate trips. Overall driving behavior for the HDT use case can be aggregated into three types of routes, depending on endpoint, mileage, and necessary refueling/recharging infrastructure.

135. Bureau of Transportation Statistics (BTS), "Freight Analysis Framework Version 5.3," December 22, 2022.
136. Ibid.

Table 6 | Generalized usage profiles for heavy-duty trucks.

Generalized HDT Routes (Assuming dedicated fleet of 200 HDTs)			
	Route type 1	**Route type 2**	**Route type 3**
Description of trip profile	Return trips and multi-pickup/ delivery within LA Basin	Direct to destination within daily driving distance	Multi-stop tours
Destination examples	• Ports of Long Beach/Los Angeles • SCALA Logistic Airport • LA last mile to customer	• San Diego • Las Vegas • Phoenix/Tucson • San Jose	Any other U.S. or Mexico location
Start – end (stops)	Depot – Depot (multiple stops)	Depot – 3rd party warehouse	Depot – 3rd party warehouse in another state
Idle time and locations of vehicles if no refueling	None (shift operation)	Can (at depot, overnight)	Must (driver rests at night)
Mileage/trip	50 (3 per day)	300-400 (1 per day)	1400 (5-day return)
Mileage/day	150	200-300	~300
Interstate trip	No	Some (NV, AZ)	Always
# of vehicles per trip type (% of total vehicles)	60 (30%)	100 (50%)	40 (20%)
Departures/day from depot (% of total departures)	180 (56%)	100 (31%)	10 (3%)
Total fleet mileage/day (% of total mileage)	9,000 (20%)	25,000 (54%)	12,000 (26%)
Refueling at own base depot (% of fuel required for trip)	Yes (100%)	Yes (40%)	Yes (20%)
Refueling at 3rd party depot (% of fuel required for trip)	No (0%)	Yes (40%)	No (0%)
Public refueling (% of fuel required for trip)	No (0%)	Yes (20%)	Yes (80%)

As demonstrated in Table 6, all HDT trips within the LA Basin (route type 1) can be refueled at small depot-based stations which can be supplied with liquefied GH_2 from the pipeline backbone. The longer, direct to destination routes (route type 2) would need to be fueled at small depot-based stations and at large public heavy-duty refilling stations. Finally, demand for GH_2 and related fueling infrastructure for route type 3 was considered out of scope for this analysis, as the HyBuild LA study found that it was uneconomic for an LA-focused hydrogen hub to supply liquid GH_2 via truck to fueling stations more than 400 miles from the LA Basin. However, given efforts to develop GH_2 hubs around the nation, it is highly likely that longer interstate routes with GH_2 fueling would eventually be enabled by hydrogen production in other regions.

An alternative charging scenario for battery electric vehicles (BEVs) was modeled for a TCO comparison. This scenario evaluates the same use case (i.e., the same trip types done as in Table 5), but instead includes all necessary charging infrastructure for electric trucks. The analysis assumed that BEV charging infrastructure for all trips within the LA Basin would be powered by Level 4 (350kW DC) charging points at a warehouse or depot. Outside of the LA Basin, the analysis assumed that 80% of the direct to destination routes would be powered by Level 4 warehouse or depot charging points, and the remaining 20% would be recharged at public fast-charging truck stations (Level 4 350kW DC). For long-haul trips, the analysis assumed that 20% of recharging would occur at the warehouse or depot and the remaining 80% would occur at public stations.

In 2030, FCEVs were determined to have the lowest TCO: $71 per 100 miles. BEVs were slightly higher at $72 per 100 miles, and diesel trucks significantly higher at $80 per 100 miles. The primary costs assessed were vehicle depreciation (based on starting capital costs), fuel costs, and operations and maintenance (O&M). Fuel costs at the pump account for the majority of costs for all technologies, contributing $58 per 100 miles for diesel vehicles, $47 per 100 miles for FCEVs, and $40 per 100 miles for BEVs. Vehicle depreciation is the second largest contributor to cost, at $25 per 100 miles for BEVs, $14 per 100 miles for FCEVs, and $12 per 100 miles for diesel. The smallest cost contribution is O&M, which accounts for $10 per 100 miles for diesel and FCEVs and $7 per 100 miles for BEVs.

The key drivers identified for GH_2 cost competitiveness in heavy-duty trucking applications are identified in Table 7. Due to decreases in capital costs for FCEVs, it is projected that FCEVs will become cost competitive by 2029. If the maximum Production Tax Credit from the Inflation Reduction Act is applied to GH_2 production to lower fuel costs, FCEVs could be cost competitive with diesel trucks as early as 2026.

Table 7 | Drivers and key dynamics for FCEV heavy-duty truck cost-competitiveness.[137]

Value	FCEV	BEV	Diesel	Key dynamic
Vehicle price (USD/unit) 2022/2030	$322k / $180k	$620k / $281k	$170k / $159k	FCEV strongly decreasing and BEV slightly decreasing, diesel stable
GH_2 costs ($/kg) 2022/2030	$12 / $2	N/A	N/A	Assuming $2/kg at the pipeline backbone after 2030
Diesel/electricity price increase (%/year)	N/A	1%	2%	Starting price of $1.40/L for diesel and $0.20/kWh for electricity
# of trucks required to meet transportation needs	160	167	160	Due to tonnage capacity and charging time difference

A.2.2 | Drayage Trucks

The analysis of drayage trucks considered the use case of picking up and delivering containers between the Port of Long Beach and a warehouse within the LA Basin. A sample trip profile was used to summarize drayage truck operation. The routes considered were primarily short distance, returning to the depot and crossing the port terminals multiple times a day. Expected destinations included a local warehouse within 20 miles of the port area, or a maximum transportation distance to the West Barstow railyard. Typical mileage per trip would range from 5 to 200 miles, with an average mileage per day for a vehicle of around 120 miles, assuming an average of 3 trips and an average of 60 miles per trip. This analysis also assumed drayage trucks would have an idle time of 8-10 hours overnight.

For drayage trucks, the analysis assumes that about 80% of trip mileage is refueled at small, depot-based stations, supplied with liquid GH_2 via truck from the pipeline backbone with a capacity of 400 kg GH_2/day. The remaining 20% of fueling needs are assumed to be provided by medium public stations that have a capacity of 1.4 t GH_2/day, also supplied by the pipeline backbone.[138]

An alternate scenario utilizing BEVs was assessed as a comparison. This scenario assumed that charging infrastructure for all trips within the LA Basin would be powered by Level 4 (350kW DC) charging points; 80% of the direct to destination routes would be powered by Level 4 warehouse or depot charging points, and the remaining 20% would be recharged at public heavy-duty fast charging stations (Level 4 350kW DC).

BEVs were determined to have the highest TCO at $114 per 100 miles. Diesel and FCEVs had slightly lower TCOs, at $112 and $109 per 100 miles, respectively. Fuel costs at the pump accounted for most of the cost for all technologies, contributing $80 per 100 miles for diesel vehicles, $73 per 100 miles for FCEVs, and $59 per 100 miles for BEVs. Vehicle depreciation contributed $48 per 100 miles for BEVs, $26 per 100 miles for FCEVs, and $22 per 100 miles for diesel. The smallest contribution came from operations and maintenance, with $10 and $11 per 100 miles for diesel and FCEVs, respectively, and $7 per 100 miles for BEVs.

FCEV drayage trucks were determined to be cost competitive by 2026 when compared with BEVs. This was primarily driven by decreasing FCEV CAPEX costs. Inputs for this analysis are illustrated in Table 8.

137. Inputs extrapolated from interviews and relevant literature. See: Chad Hunter, et al., "Spatial and Temporal Analysis of the Total Cost of Ownership for Class 8 Tractors and Class 4 Parcel Delivery Trucks," NREL/ TP-5400-71796, September 2021.
138. Sample trip profile developed with reference to: Andrew Papson, et al., "Key Performance Parameters for Drayage Trucks Operating at the Ports of Los Angeles and Long Beach," CALSTART, November 11, 2013.

Table 8 | Drivers and key dynamics for FCEV drayage truck cost-competitiveness.[139]

Value	FCEV	BEV	Diesel	Key dynamic
Vehicle price (USD/unit) 2022/2030	$322k / $180k	$620k / $281k	$170k / $159k	FCEV strongly decreasing and BEV slightly decreasing, diesel stable
GH_2 costs ($/kg) 2022/2030	$12 / $2	N/A	N/A	Assuming ~$2/kg at the pipeline backbone after 2030
Diesel/electricity price increase (%/year)	N/A	1%	2%	Starting price of $1.40/L for diesel and $0.20/kWh for electricity
# of trucks required to meet transportation needs	50	55	50	Due to tonnage capacity and charging time difference

The estimated addressable vehicle base for drayage trucks is 13,000 of the 22,000 registered in the Ports of Los Angeles and Long Beach.[140] Most drayage trucks do not travel interstate and can be fully sustained by fueling within the HyBuild LA system. Expected annual sales of new drayage trucks are projected to reach 1,256 in 2040. Assuming a 10-year vehicle replacement time, fleet penetration would reach approximately 70% of drayage trucks operating in LA ports by 2040, or nearly 10,000 FCEVs.

Table 9 | Drayage truck and fueling infrastructure estimates in the HyBuild LA system plan.

Value	Unit	2030	2040
Number of FCEV drayage trucks	Trucks	1,401	10,270
GH_2 mobility demand/year	kt	11	77
Number of small depot-based station at 400 kg/day capacity	Depot Stations	28	205
Number of public medium stations at 1,400 kg/day capacity	Public Stations	36	267

A.2.3 | Forklifts

The analysis of forklifts is based on a sample use case that assumes a single depot operates a fleet of 100 forklifts running 1 to 2 shifts per day. A typical forklift route would stay within the depot area and travel to diverse storage sites within the warehouse or outdoors. On average, each forklift has 8 hours per day of usage time, and forklifts are estimated to operate 300 days per year. All forklift refueling is assumed to occur at the depot.[141]

A GH_2 refueling setup for the forklift use case would consist of a small refueling station with a daily capacity of 400 kg GH_2 and multiple dispensers (between 8 and 12) to serve the fleet of 100 forklifts. Liquid GH_2 fuel would be delivered by truck from the pipeline backbone.

An alternative scenario was analyzed, which included BEV forklifts charged overnight at a forklift charging station with 50 charging spots. The nominal power for this station is assumed to be 1,000 kW, and the output per charger would have 20kW of AC charging power. Based on these assumptions, the TCO comparison showed that FCEV forklifts would be more cost competitive than BEVs by 2028.

139. Inputs extrapolated from interviews and relevant literature. See: Chad Hunter, et al., "Spatial and Temporal Analysis of the Total Cost of Ownership for Class 8 Tractors and Class 4 Parcel Delivery Trucks," NREL/ TP-5400-71796, September 2021.
140. Port of Long Beach. "Clean Trucks: Program Details," Accessed February 7, 2023.
141. Sample profile developed with reference to: John Sullivan, "How Long Will an Average Forklift Last?" Toyota Material Handling Northern California, December 13, 2016.

Table 10 | Drivers and key dynamics for FCEV forklift competitiveness.[142]

Value	FCEV	BEV	Propane	Key dynamic
Vehicle price (USD/unit) 2022/2030	$35k / $30k	$30k / $25k	$25k / $23k	FCEVs and BEVs strongly decreasing, diesel stable
GH_2 costs ($/kg) 2022/2030	$12 / $2	N/A	N/A	Assuming $2/kg at the pipeline backbone after 2030
Propane/electricity price increase (%/year)	N/A	1%	1%	Starting price of $0.7/L for propane and $0.20/kWh for electricity
# of forklifts required to meet operational needs	100	110	100	BEV additional quantity due to charging time difference
O&M cost ($/year)	224	500	1500	Strongly decreased O&M for FCEVs and BEVs

By 2030, TCO per day is projected to be $36 for diesel forklifts, and as low as $27 for BEV and $26 for FCEVs. The majority of costs for diesel forklifts are fuel costs, which are $18, compared to the fuel costs for BEVs and FCEVs, which are $8 and $7 respectively. For BEVs and FCEVs, the largest portion of cost is allocated to vehicle depreciation, at $19 for FCEVs and $17 for BEVs, and slightly lower at $14 for diesel. The remaining cost is due to operations and maintenance, which was calculated to be $4 for diesel and $1 for both BEVs and FCEVs.

The total addressable forklift vehicle base in the LA Basin was estimated to be approximately 40,000 forklifts.[143,144] Of the total addressable vehicle base, 55% was assumed to be electrified, as BEVs already have significant market penetration and some depots have already invested in charging infrastructure.[145] It was assumed that that FCEV forklifts will replace all remaining fossil fueled forklifts from 2025 onward and will be fully competitive with BEVs by 2028. Expected annual sales for FCEV forklifts are projected to be over 5,000 by 2040, making up nearly half of total forklift sales for that year. Fleet forklifts tend to have short operational life of approximately 4 years, so approximately 45% of forklifts could be FCEVs by 2030.[146]

Table 11 | Forklift and fueling infrastructure estimates in the HyBuild LA system plan.

Value	Unit	2030	2040
# of FCEV forklifts	k #	19	21
GH_2 mobility demand/year	kt	8	9
# of small depot-based station at 400 kg/day capacity	#	194	214

A.2.4 | Coaches

Coaches operating from a base in the LA Basin and traveling interstate for individual business and leisure charters were analyzed in the HyBuild LA study. There is a complete base of approximately 2,000 coaches registered in and operating out of the LA Basin, including a variety of operators and trip profiles.[147] Generally, coach depots are smaller than those used by heavy-duty trucks.

Four potential usage profiles were evaluated within the coach use case, which were developed consistent with data provided by HyBuild LA interview participants:

- Route 1 includes fast routes around LA (e.g., LAX shuttle). Coaches on these routes spend at least 4 hours per day at the depot for cleaning and refueling. The typical mileage per vehicle per day is 150, with around 300 vehicles dedicated to this type of route. The refueling profile is similar to that of city buses and is likely not favorable for GH_2 compared to BEVs.

142. Inputs extrapolated from interviews and relevant literature. See: Simon Walker, "Compare LPG Forklift to Hydrogen Forklift," Lean INC Material Handling, July 24, 2021.
143. Reese Wagner, "Forklift Accident Statistics in the United States," December 15, 2020.
144. Zippia, "Forklift Operator Demographics and Statistics in the US." September 9, 2022.
145. Industrial Truck Association, "North American Forklifts Have Record 2015 Sales; Nearly 2/3 Were Electric," Industrial Distribution, February 24, 2016.
146. John Sullivan, "How Long Will an Average Forklift Last?" Toyota Material Handling Northern California, December 13, 2016.
147. United Motorcoach Association. "Motorcoach industry by the numbers," November 2021.

- Route 2 includes charter coach travel within California. Destinations may include San Diego, Palomar, and Yosemite. These vehicles would have at least 10 hours per day of idle time, which could be taken anywhere in Southern California. Coaches on Route 2 may make 1 to 2 trips per day with mileage per trip varying between 120 and 400 miles. Approximately 1,500 vehicles have been allocated to this usage profile, and all of the refueling for these trips would be done at public refueling stations.
- Route 3 includes intrastate commute to and from LA via transit providers. Destinations in these cases may be locations such as Fresno and San Jose. These vehicles would spend a maximum of four hours per day in a coach yard and would only take one trip per day. These routes would cover approximately 600 miles and would generally be round-trip, so coaches would start and end their trip at the same depots based in the LA Basin. There are approximately 100 coaches allocated to this usage profile which would divide their refueling between the LA Basin depot (around 20% of mileage) and public refueling stations (80%).
- Route 4 includes interstate commutes to and from LA via transit providers. Destinations for this route profile include Las Vegas, NV, and Tulsa, OK. As these routes require refueling outside of California, they were not considered by the HyBuild LA system.

Table 12 | Generalized usage profiles for coaches.

Generalized Coach Routes				
	Route type 1	**Route type 2**	**Route type 3**	**Route type 4**
Description of trip profile	Fast routes around LA (e.g., LAX Shuttle)	Charter coach travel in California	Intrastate commute from/to LA via transit providers	Interstate commute from/to LA via transit providers
Destination examples	• Santa Barbara Airbus Stop	• San Diego • Palomar • Yosemite	• Fresno, CA • San Jose, CA	• Las Vegas, NV • Tulsa, OK
Start – end (stops)	LAX to Santa Barbara Airbus Yard	From LA Basin to Santa Barbara and back	San Bernadino Greyhound Terminal to Fresno Terminal	San Bernadino Greyhound Terminal to Tulsa Terminal
Idle time and locations of vehicles	Min. 4h per day at depot (cleaning and refueling)	Min. 10h per day anywhere in Southern CA	Max. 4h per day in coach yard	Max. 4h per day in coach yard
Mileage/trip	100 (3 per day)	120 to 400 (1-2 per day)	600 (full day)	1,800 (3 days)
Mileage/day	160	200	600	600
Interstate trip	No	No	No	Yes
# of vehicles per trip type	300	1500	100	100
Departures/day from depot (% of total departures considered)	Similar profile as city buses, likely not competitive vs. BEV	2250 (96%)	100 (4%)	Requires refueling out of California, cannot be sustained by HyBuild.
Total fleet mileage/day (% of total mileage)		450k (88%)	60k (12%)	
Refueling at LA Basin depot (% of fuel required for trip)		No (0%)	Yes (20%)	
Refueling at 3rd party depot (% of trip mileage)		No (0%)	No (0%)	
Public refueling (% trip mileage)		Yes (100%)	Yes (80%)	

The types of refueling infrastructure that could be used for coach applications include medium public refueling stations with 1.4t GH_2/day capacity and large public refueling stations with 6t GH_2/day capacity. Intrastate commuter coaches could also use overnight refueling if the operator has their own depot.

The alternative charging setup for BEVs would include public fast charging stations (Level 4 350kW DC chargers) with some depot charging (Level 4 350kW DC charging point) in the case of intrastate commuting coaches. For a company-owned fuel/charging station to be economic, a fleet size of more than 20 would be required, and less than 10% of all coach companies meet this condition.[148]

148. United Motorcoach Association, "MOTORCOACH Industry by the Numbers," 2021.

Based on this analysis, FCEV coaches were determined to be more competitive than BEVs for route types 2 and 3 by 2033. Full leverage of IRA Production Tax Credits could accelerate FCEV coach cost competitiveness by up to four years.

Table 13 | Drivers and key dynamics for FCEV coach competitiveness.[149]

Value	FCEV	BEV	Diesel	Key dynamic
Vehicle price (USD/unit) 2022/2030	$1,270k / $635k	$1,000k / $600k	$500k / $461k	FCEV and BEV strongly decreasing, diesel stable
GH_2 costs ($/kg) 2022/2030	$12 / $2	N/A	N/A	Assuming $2/kg at the pipe after 2030
Diesel/electricity price increase (%/year)	N/A	1%	2%	Starting price of $1.4/L for diesel and $0.20/kWh for electricity
# of coaches needed to meet transportation needs	1,600	1,680	1,600	Due to charging time difference

By 2030, the TCO per 100 miles would be $117 for FCEVs, compared to $108 for diesel and $128 for BEVs. For diesel and BEVs, the largest cost component is fuel costs, which are $59 and $70 respectively, compared to $46 for FCEVs. The other major cost driver is vehicle depreciation, which accounts for $38 in the case of diesel, $50 for BEVs, and $57 for FCEVs. Finally, all technologies have relatively small contributions from operations and maintenance, with $14 for FCEVs, $11 for diesel, and $8 for BEVs.

Based on the above analysis, FCEVs were determined to be the most cost-competitive option for decarbonized coach travel for approximately 80% of the 2,000 total coaches registered in the LA Basin (i.e., those traveling Routes 2 and 3). Because few operators would be able to sustain their own refueling solutions, only about 2% of fuel would be supplied via small depot-based refueling stations. The remaining fuel would be split evenly between public large GH_2 stations (6t GH_2 per day) and medium GH_2 stations (1.4t GH_2 per day).

Driven by regional decarbonization targets, annual sales for FCEV coaches are projected to reach 154 in 2035 and 194 in 2040. With an expected vehicle replacement time of 12 years, FCEV fleet penetration is assumed to reach around 60% of coaches registered in and operating from the LA Basin by 2040, with approximately 1,800 FCEV coaches deployed based on expected market growth.

Table 14 | Coach vehicle and fueling infrastructure estimates in the HyBuild LA system plan.

Value	Unit	2030	2040
# of FCEV coaches	k #	500	1800
GH_2 mobility demand/year	kt	2700	10300
# of small depot-based station at 400 kg GH_2/day capacity	#	1	2
# of public medium stations at 1,400 kg GH_2/day capacity	#	7	25
# of public large stations of 6,000 kg GH_2/day capacity	#	2	6

A.2.5 | Port Material Handling Equipment

Port material handling equipment evaluated in this portion of the analysis include rubber-tired gantry cranes (RTG), yard tractors, and top handlers in the Port of LA and Long Beach. The ports have set a goal to transition to zero-emission handling equipment by 2035 and have determined that electrification would not be feasible for significant portions of the fleet operating equipment due to the demands of their duty cycles, which require long periods of continuous operation.[150] Thus, it was assumed that at least 80% of the zero-emission port handling equipment in 2035 would be fuel cell based.

Assuming a 4-year operational use life for material handling equipment, and factoring in the 2035 zero-emission equipment goal, CVA estimated that the projected fleet of fuel cell handling equipment in 2035 would include 1,900 yard tractors, 370 top handlers, and 150 RTG cranes.[151] As port handling equipment does not leave the terminal, all refueling would need to occur on site through a combination of stationary and mobile refueling options.

149. Inputs extrapolated from interviews and industry sources.
150. Long Beach City College Workforce Development, "Zero-emission Port Equipment: Workforce Assessment," Port of Long Beach. Accessed February 7, 2023.
151. Estimates of existing port equipment based on interviews with Toyota Tsusho and Fenix Marine Services.

A.3 | AVIATION USE CASE

In addition to land-based mobility end uses, the HyBuild LA analysis also looked at potential use for GH_2 in aviation and maritime shipping, considering both direct use of GH_2 and use of GH_2 as a feedstock for the production of derivative fuels. CVA conducted the assessment for GH_2 use in aviation, while the American Bureau of Shipping (ABS) conducted the assessment for the maritime sector.

E-Kerosene for Aviation

Analysis of sustainable aviation fuel (SAF) production assumed a 2% annual increase in consumption of kerosene (also known as Jet-A, or JET).[152] Other key assumptions included a $2B investment by World Energy to expand production capacity at their Paramount facility to 340 million gallons of SAF production annually by 2025;[153] a 2030 goal of 3 billion gallons of SAF production in the U.S. (25% of which would be produced in the LA area); and further momentum to increase production beyond 2030.[154] This analysis also assumed a shift in production pathways of SAF would occur, from the use of hydrotreated esters and fatty acids (HEFA) feedstocks to more advanced and GH_2 intensive routes (as these methods mature and the necessary feedstocks are available). For example, the projected production method of SAF in 2025 was limited to high and low O2 feedstock HEFA, but by 2040, production was projected to be evenly distributed between Alkaline-to-Jet, Fischer-Tropsch using organic feedstocks, and Power-to-Liquid using GH_2 and CO2 as a feedstock.

Assuming that the H_2 used in SAF production would be gradually replaced with GH_2 from the HyBuild system, demand for GH_2 was estimated to be 62 kt in 2030 and 439 kt in 2040.

Table 15 | Projected uptake of SAF in 2030 and 2040.

Metric	Unit	2030	2040
SAF available in LA Basin	M gallon	750	1125
Share of total U.S. JET consumption	%	2.5%	3.4%
Share of LAX JET consumption	%	54%	73%
Average GH_2 intensity of SAF production process (kg GH_2 per gallon SAF)	kg/gallon	0.21	0.78
GH_2 demand from the HyBuild LA system	kt	62	439

A.4 | MARITIME SHIPPING SCENARIO

Conservative Zero Carbon Fuel Adoption Scenario

The HyBuild LA system plan utilized a Regional Best-Case Forecast scenario to estimate demand for GH_2 in the maritime shipping sector in 2030 and 2040. This scenario, which is detailed in the main body of the report, assumed that LA clean energy initiatives like the Ship It Zero resolution[155] would spur the accelerated decarbonization of shipping routes between LA and Shanghai. In addition to this scenario, ABS also developed a Conservative Forecast for maritime shipping fuel use that assumed the Ports of LA and Long Beach's zero-carbon fuel use would progress at the same rate as global trends, without accounting for any regional acceleration to meet local carbon reduction goals. While usage rates for each type of bunkering fuel would be the same in 2040 and 2050 in both scenarios, use of zero-carbon fuels would advance more slowly in the conservative case, leading to lower projected adoption levels in 2030. These estimates are based on the "Zero Carbon Outlook" report published by the ABS with no adjustments for LA's more stringent emission reduction targets.[156]

152. Kristi Moriarty. "U.S. Airport Infrastructure and Sustainable Aviation Fuel." National Renewable Energy Laboratory, NREL/TP-5400-78368. February 2021.
153. Air Products, "Air Products Teaming Up with World Energy to Build $2 Billion Conversion of Sustainable Aviation Fuel (SAF) Production Facility in Southern California," April 22, 2022.
154. The White House, "FACT SHEET: Biden Administration Advances the Future of Sustainable Fuels in American Aviation," The White House, September 9, 2021.
155. Kim Biggar, "Long Beach City Council passes Ship It Zero resolution," Splash 247.com.
156. American Bureau of Shipping (ABS), "Setting the Course to Low Carbon Shipping: Zero Carbon Outlook," 2022.

Table 16 | Conservative estimates of shipping fuel usage levels by fuel type.

Fuel Type (Million Metric Tons)	2019	2030	2040	2050
Heavy Fuel Oil (HFO)	2.84 (86%)	3.03 (70%)	2.66 (48%)	1.85 (26%)
Liquid Natural Gas (LNG)/Bio-LNG	0.38 (14%)	0.88 (27%)	1.13 (25%)	0.87 (15%)
E-Methanol	0 (0%)	0.08 (1%)	0.86 (8%)	2.20 (16%)
Green NH_3	0 (0%)	0.09 (1%)	0.80 (7%)	2.65 (18%)
GH_2	0 (0%)	0.01 (1%)	0.21 (12%)	0.58 (25%)

The cost estimate of \$5.30 – \$5.80/kg for GH_2 delivered to ships in the Ports of LA and Long Beach in 2030 includes liquefaction, storage, and dispensing costs. This analysis assumed that liquefaction would occur at a plant system operating at a capacity of 400 tons of GH_2 per day and a 90% utilization rate, located within close proximity to the ports. The cost of storage and dispensing was assumed to resemble cost profiles of a large refueling station (e.g., around \$1.20 – 1.50/kg GH_2). These additional costs are added to a "base" GH_2 cost of \$2.05/kg, delivered to the LA Basin via dedicated pipeline.

The point at which GH_2 and bunker fuel reach cost parity was calculated based on their relative energy contents and the relative efficiencies by which maritime propulsion equipment could translate that energy into mechanical force. The analysis assumed that ships in the Ports of LA and Long Beach primarily used very low sulfur fuel oil (VLSFO) with a lower heating value of 39.0 megajoules (MJ)/kg, and that ship combustion engines operated at efficiencies of 45%.[157] GH_2 was assumed to have a lower heating value of 120.2 MJ/kg, with ship fuel cells operating at efficiencies of 54%.[158] A reference price of \$1,033/ton was used for bunker fuel in the Ports of LA and Long Beach,[159] and the study assumed that ship operators would be willing to pay a 20% premium for fuels that would meet Southern California's stringent carbon emission restrictions.[160,161]

A.4.1 | Ammonia Production

HyBuild LA also undertook a preliminary assessment on the potential to produce cost competitive green NH_3 in Northern California that could serve the estimated demand from the martime shipping sector and agricultural sector throughout the state.

This analysis considered the economics of two scenarios to produce green NH_3 near the Port of Stockton in 2030: (1) this scenario assumed all GH_2 that would be needed as a feedstock to produce green NH_3 is produced in Northern California, utilizing local solar resources for electrolysis; and (2) this scenario assumed that green NH_3 production in Northern California would be connected to a consistent supply of GH_2 from the LA-area hub via a dedicated pipeline. Both scenarios assumed that grid electricity would be used to power the Haber-Bosch process to produce green NH_3. In the LA hub-connected scenario, roughly 25% of electricity for NH_3 production was assumed to be sourced from lower-cost solar power via PPAs, with the rest being supplied by connection to the electrical grid.

In Scenario 1, the system does not have access to mass-scale storage of GH_2. As a result, production of both GH_2 and green NH_3 follow solar availability. This would require significant oversizing of both the GH_2 and green NH_3 production to accommodate disparities in solar production across the year. The added capital costs to oversize production equipment made green NH_3 in this scenario uncompetitive with global prices.

The primary inputs for the green NH_3 production model are provided in Table 17. This analysis is built upon other analyses from the offtake and infrastructure workstream (e.g., GH_2 demand, LCOH). The related sources and methodology for these inputs are described in the earlier sections of this appendix.

157. Assumptions provided by ABS based on industry expertise.
158. Elise Georgeff, et al., "Liquid hydrogen refueling infrastructure to support a zero-emission U.S.-China container shipping corridor," International Council on Clean Transportation, Working Paper 2020-24, October 2020.
159. Based on VLSFO prices in May 2022. See: "LA / Long Beach Bunker Prices," Ship & Bunker.
160. Assumptions provided by ABS based on industry expertise.
161. Kim Biggar, "Long Beach City Council passes Ship It Zero resolution," Splash 247.com.

Table 17 | Inputs for green NH_3 production model.

Inputs	Units	Data	Source
GH_2 demand in Northern California (100 mi radius from Port of Stockton)	kt/y	275.0	CVA Northern California demand assessment
Levelized cost of delivered GH_2 (utilizing the production tax credit from the IRA)	$/kg	0.69	CVA LCOH analysis
Grid electricity price (June 2022)	$/MWh	178.0	U.S. estimate from EIA[162]
PV PPA electricity price (July 2022)	$/MWh	41.9	LevelTen Energy[163]
PV Factor Load	% year	26%	CVA Northern California Connection Analysis
WACC	%	6.00%	Industry estimate[164]
Usage of GH_2 to produce NH_3	t GH_2/t NH_3	0.177	FuelCell Works[165]
Energy requirements for Haber-Bosch	MWh/ton NH_3	0.738	Fasihi et al.[166]
% of Electricity from Grid vs. Solar PPA (North-South Scenario)	% of total use	75%	CVA Northern California Connection Analysis

The ammonia production model utilized over 20 points of reference data from existing ammonia production plants, which range in capacity from 3 to over 1,200 kt green NH_3 per year, to develop a regression formula that calculated CAPEX cost as a function of production capacity. Using this methodology, CVA estimated that an ammonia plant with 450 kt of annual ammonia production capacity would require roughly $262M in upfront CAPEX. This CAPEX was annualized over the lifetime of the plant, which is estimated at 20 years, and then divided by production volumes to determine the contribution to the levelized cost of green NH_3.

In addition, the model included OPEX per ton of green NH_3 based on projected electricity and GH_2 usage, chemical and catalyst costs,[167] labor and maintenance costs,[168] and process and cooling water needs.[169] The estimated CAPEX and OPEX values were then combined to provide a final levelized cost of NH_3.

162. U.S. Energy Information Agency, "Table 5.6.A. Average Price of Electricity to Ultimate Customers by EndUse Sector, by State, November 2022 and 2021 (cents per kilowatt-hour)," Accessed February 2023.
163. LevelTen News, "North American Renewable PPA Prices Rose 5.3% in Q2 and Nearly 30% Year-Over-Year, Spurred by Specter of Solar Tariffs and Inflation, According to LevelTen Energy," LevelTen Energy, July 13, 2022.
164. Based on discussions with stakeholders (e.g., offtakers, developers, financiers) in other green hydrogen hub projects, as well as in reference to developer bids for such projects in Europe and elsewhere.
165. FuelCellWorks, "Green Ammonia Now Cheaper than Fossil Fuels," April 25, 2022.
166. Mahdi Fasihi, et al., "Global potential of green ammonia based on hybrid PV-wind power plants," Applied Energy 294, 2021.
167. Gulf Petrochemicals and Chemicals Association, "The Roadmap to Carbon-Efficient Agriculture: How can the Agri-Nutrients Industry Support It?" GPCA Webinar Series, April 7, 2021.
168. Ibid.
169. Based on HyBuild LA water resource analysis conducted by PNNL.

APPENDIX B

Water Demand and Sources Analysis – Inputs, Assumptions, and Methodology

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B.1 | WATER DEMAND AND SOURCES

B.1.1 | Water Demands of Green Hydrogen Production via Electrolysis

In the GH_2 electrolysis process, renewable electricity breaks the bonds between hydrogen and oxygen in purified water to produce constituent gases. Manufacturer specifications for process water can range from between 10.0 to 22.4 kg of H_2O[170] required per 1 kg of GH_2 produced, depending on the type of electrolysis equipment used (Simoes, Catarino et al. 2021). In addition to the process water requirements, estimated losses from evaporation and leaks add roughly 10% to water demand, and cleaning needs add approximately 25% additional water demand per unit GH_2 produced. The HyBuild LA analysis estimates the total process input water demand for electrolysis is approximately 15 kg H_2O / kg GH_2, based on the water needs for alkaline electrolysis equipment (Brophy 2022).

Additional water demands for electrolysis result from process cooling requirements using evaporative cooling systems (i.e., cooling towers) and water losses occurring in the water treatment process. Because the HyBuild LA plan consists of large scale centralized hydrogen production facilities, cooling water demands account for approximately 4.6 kg of H_2O per 1 kg of GH_2 produced (Lampert, Cai et al. 2015). Water that is not evaporated in the cooling tower, can be recycled and reused in the cooling process to recover approximately 10% of the input or makeup cooling water (Boyd, Harris et al. 2022, Boyd 2022). Therefore, after recovery, roughly 4.2 kg of cooling water is required per kg of GH_2 produced, for a subtotal of 19.2 kg H_2O / kg GH_2 for input process and cooling water demands.

Electrolysis systems require high-quality water as a feedstock, and in recognition of water scarcity concerns in Southern California, the HyBuild LA scenario modeled the use of alternative water sources to avoid dependence on the region's limited freshwater resources.[171] At a minimum, two-phase reverse osmosis (RO) and deionization (DI) treatment is required for these resources to reach needed purity. Within these processes, water treatment losses can range from as low as 8% of the raw water when higher quality source water is used, and up to 50% when highly contaminated water is used (e.g., raw wastewater or "produced" water from crude oil extraction). As such, if using recycled wastewater, another 19.2 kg of raw water is required, bringing the total estimated water demand for GH_2 electrolysis to 38.4 kg H_2O / kg GH_2 produced.

B.1.2 | Water Demands of Green Ammonia Production via Haber-Bosch

Similar to GH_2 production, green NH_3 production from the Haber-Bosch process has process, cooling, and treatment water demands. The Haber-Bosch process uses high temperatures and pressures to convert atmospheric nitrogen (N_2) and hydrogen gas (H_2) to ammonia (NH_3) using a metal catalyst in an exothermic reaction. Due to the large amounts of waste heat produced in the Haber-Bosch process, cooling systems – typically evaporative systems – are required. As the Haber-Bosch process is a separate process from electrolysis, the water needs for this process are incremental to the 38.4 kg of water required to produce 1 kg of GH_2.

170. t: metric ton; m^3 H_2O / t NH_3 = liter H_2O / kg NH_3 = kg H_2O / kg NH_3.
171. See Table 2 for a list of considered resources.

B.1.3 | Total Water Demand Findings

The component and total water demands for GH_2 and green NH_3 are compiled and illustrated below in Table 1 and Figure 1.

Table 1 | GH_2 and green NH_3 production process water demands with mid, high, and low estimates.

	Water Demand				
Production Phase	Mid	High	Low	Unit[(a)]	Source
GH_2 Alkaline Electrolysis Process Input Water	11.1	11.7	10.6	m^3 H_2O / t GH_2	(Simoes, Catarino et al. 2021)
Process Water Losses[(b)]	10%	10%	10%	Percent of Input	(Simoes, Catarino et al. 2021)
Process Cleaning Water[(b)]	25%	25%	25%	Percent of Input	(Simoes, Catarino et al. 2021)
GH_2 Electrolysis Total Input Water	15.0	15.7	14.2	m^3 H_2O / t GH_2	(Simoes, Catarino et al. 2021)
GH_2 Processing Cooling Water[(c)]	4.2	4.4	3.9	m^3 H_2O / t GH_2	(Lampert, Cai et al. 2015)
GH_2 Water Treatment Loss	19.2	20.1	18.2	m^3 H_2O / t GH_2	(Shields 2022)
GH_2 Production Total Water Demand	38.3	40.2	36.4	m^3 H_2O / t GH_2	Calculation
NH_3 Haber-Bosch Process Input Water	2.1	2.6	1.5	m^3 H_2O / t NH_3	(Will and Lukas 2018)
NH_3 Haber-Bosch Total Input Water	2.8	3.5	2.0	m^3 H_2O / t NH_3	Calculation
NH_3 Processing Cooling Water[(c)]	5.4	5.7	5.1	m^3 H_2O / t NH_3	(Will and Lukas 2018)
NH_3 Water Treatment Loss	8.2	9.2	7.2	m^3 H_2O / t NH_3	(Shields 2022)
NH_3 Production Total Water Demand	16.5	18.4	14.3	m^3 H_2O / t NH_3	Calculation

(a) t: metric ton; m^3 H_2O / t NH_3 = liter H_2O / kg NH_3 = kg H_2O / kg NH_3
(b) Percentages for water losses and cleaning water used for both GH_2 and NH_3 production
(c) Assuming a 10% reduction of total cooling water demand from recovery

B.1.4 | Evaluated Water Sources

The water sources, definitions, estimates of availability, development timeframes, and data sources utilized for this analysis are included in Table 2. Due to concerns around stressed freshwater resources in Southern California, this analysis only considered recycled wastewater, water that could be diverted from local oil and gas operations, or desalinated seawater as sources for electrolytic hydrogen production demand.

Table 2 | Potential water sources and details for the HyBuild LA estimated demands.

		Existing Availability (Mm^3 / year)		Estimated Development Timeframe	
Potential Water Source	Definition	Raw	Treated[(a)]	Years	Source
South Coast California Wastewater	Wastewater sent to water treatment plants in the CA South Coast region (e.g. raw sewage)	1,153	577	10–20	(Rodman, Cervania et al. 2018)
Southern California Fracking Offset	Water used in oil and gas fracking operations that can be diverted to other uses, assuming fossil fuel production operations are reduced	42	39	5–10	(Pfister, Vionnet et al. 2016)
Southern California Fracking Produced Wastewater	Wastewater "produced" through fracking operations (i.e. flowback from fracking wells)	301	150	5–10	(Bohan 2021)
Southern California Oil Refinery Offset	Water currently used in oil and gas refining that can be diverted to other uses, assuming refinery operations are reduced	262	241	10–20	(Pfister, Vionnet et al. 2016)
Southern California Oil Refinery Wastewater	Wastewater from the crude oil refinery processes	207	104	5–10	(Pfister, Vionnet et al. 2016)
Desalinated Seawater	Seawater or brackish water that has been treated for commercial use	(b)	(b)	10–20	-

(a) Treated to quality required for hydrogen electrolysis via two-pass RO and DI
(b) Limited by infrastructure devoted to desalination, not seawater availability

B.2 | WATER INFRASTRUCTURE REQUIREMENTS

The infrastructure required to meet the water demands for GH_2 production includes water transportation from the recycled or repurposed source to the GH_2 production site, including water pipelines and pumping stations; water treatment plants to achieve the required quality for electrolysis and Haber-Bosch;[172] and water storage at the production site.

B.2.1 | Water Treatment

High quality water is required for GH_2 and green ammonia production to prevent interruptions in operations from impurities contaminating the processes. As such, all potential water sources, regardless of the raw water quality, would need to be treated through a two-phase RO process with a final DI treatment. The HyBuild LA scenario assumed that a dedicated RO/DI water treatment plant would be located at each production site

The amount of water loss (i.e., discharged as waste sludge and brine) in the treatment process depends on the source water quality. Table 3 identifies all stages of treatment and their associated water losses. For example, with raw sewage wastewater, approximately 38% of the influent water is removed in the primary and secondary treatment process, roughly 8% of the secondary wastewater effluent is rejected in the tertiary/recycled water treatment process (to Title 22 water quality standards), and about 14% of the recycled water is rejected when treated with RO/DI to the quality required for GH_2 production. The total water lost in the process of upgrading raw wastewater to electrolysis-quality water is 51%.

172. Due to safety concerns, it's possible green NH_3 production via the Haber-Bosch process will take place at specialized facilities and not located at GH_2 production sites in Southern California.

Table 3 | Water treatment process details.

Wastewater Treatment Process	Effluent Water Quality	Percent Effluent from Influent by Volume[a]	Source
Primary & Secondary	EPA Effluent Guidelines[b]	62%	(Shields 2022)
Tertiary/Wastewater Recycling	Title 22 Guidelines	92%	(Shields 2022)
Reverse Osmosis	5-60 Total Dissolved Solids [TDS]	86%	(Shields 2022)
Raw Wastewater to Electrolysis Quality	<5 microsiemens/cm	49%	(Will and Lukas 2018, Shields 2022)

(a) Effluent (treated water output) volume divided by influent (raw water input) volume
(b) epa.gov/eg

B.2.2 | Water Transportation

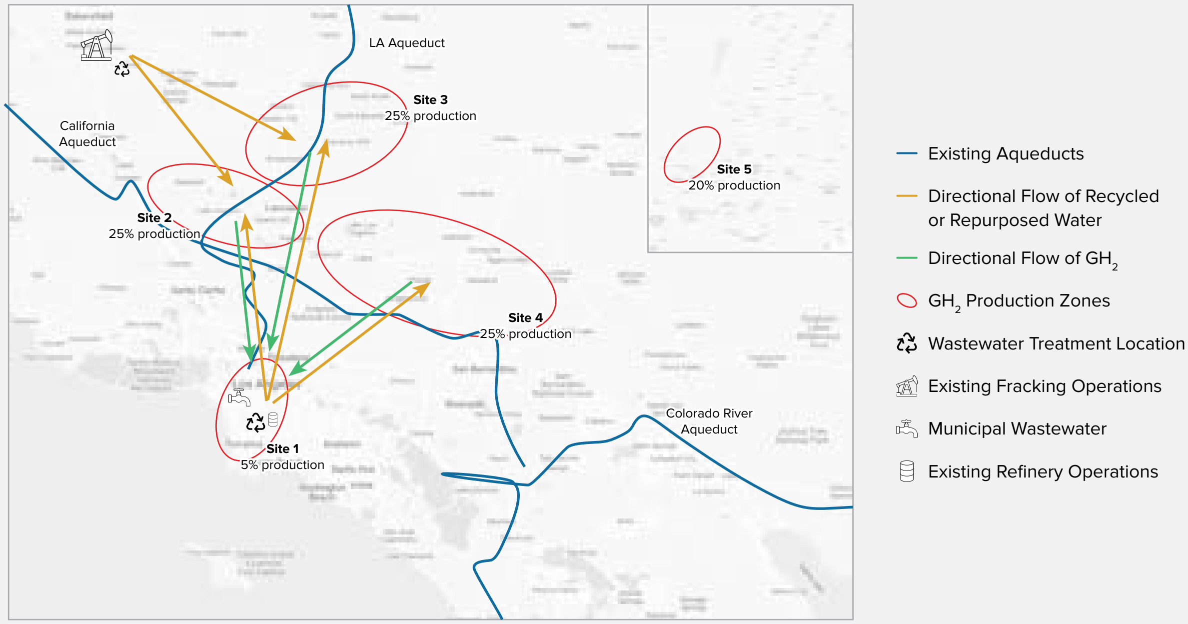
Water transportation has two primary considerations: infrastructure such as pipelines and pump stations, and electricity requirements for pumping the water from the alternative water sources to the production sites.

1. Water Pipeline Infrastructure

Water pipeline distances, sizing, and configuration depend on a variety of factors, including the number and locations of sources and production sites, the magnitude of demand at each site, and the location of water treatment facilities. Each proposed site detailed in Figure 2 is assumed to have source water delivered from several alternative water sources to meet the production demands. It's also assumed that the RO and DI treatments required to purify water past Title 22 guidelines will occur at the H2 production site. However, the configuration and locations of water treatment and transportation systems are only representative and would need to be optimized based on further analysis at each production site.

The HyBuild LA scenario assumes recycled or repurposed water is transported from LA to each GH_2 production site outside of the city, where final water stages of treatment (i.e. RO and DI) are completed. The details of this scenario are defined in Table 4. In the case of Site 5 in Utah, it was assumed wastewater would be sourced from local sources (not from LA). Additionally, pipeline infrastructure distances were assumed to be built along existing roadways and transportation right of ways.

Figure 1 | Map of Southern California showing high-level details of proposed production sites, water sources, and product flow directions.



Note: HyBuild LA system plan assumes dedicated GH_2 pipeline connection with Central Utah.
Note: This map is illustrative and is not representative of planned infrastructure.
Source: Pacific Northwest National Laboratory for HyBuild LA, 2022

Table 4 | Wastewater transportation needs from LA to potential HyBuild LA GH_2 production sites.

Production Site	Percent of Total HyBuild LA System GH_2 Production	Annual Recycled Water Demand 2030; 2040 (Mm^3/year)	Distance from LA Source[(a)] (km)	Elevation Change from LA Source[(b)] (m)
Site 1	5%	3.5; 5.8	32	-124
Site 2	25%	17.7; 29.1	129	675
Site 3	25%	17.7; 29.1	185	587
Site 4	25%	17.7; 29.1	129	873
Site 5	20%	14.1; 23.3	(c)	(c)

(a) Distances were determined using Google Maps along established roadways, and may be longer or shorter based on final planning and configuration (Mehta, Kanani et al. 2019).
(b) Elevation changes determined using Google Earth from the center of the proposed production site area. These quantities show net elevation changes, but do not include peaks or dips in elevation between the sites.
(c) Site 5, located in Utah near St. George, was assumed to obtain all recycled water from nearby sources with a transportation distance assumed to be 100 km and elevation change to be 200 m.

The diameter of the water transportation pipeline depends on the volumetric flow rate of the water being transported through the pipeline as detailed in Table 5 (USBR 2002). The greater the volume flow rate, the larger the required water pipeline diameter. Capital costs for pipeline construction also increase with pipeline diameter.

Table 5 | Details for determining required water pipeline diameters and associated base costs factors.[a]

Diameter (m)	Volumetric Flow Rate (m^3/s)	Volumetric Flow Rate (Mm^3/year)	Base Capital Cost[b] ($USD22/m of water pipeline)
0.15	0-0.02	0-0.6	$308.56
0.30	0.02-0.11	0.6-3.5	$487.20
0.46	0.11-0.25	3.5-7.9	$719.98
0.61	0.25-0.45	7.9-14.1	$952.76
0.76	0.45-0.69	14.1-21.8	$1,212.60
0.91	0.69-1.1	21.8-34.5	$1,494.09
1.22	1.1-2.15	34.5-67.8	$2,251.97
1.52	2.15-3.91	67.8-123	$3,166.83
1.83	3.91-6.4	123-202	$4,265.75
2.13	6.4-8.72	202-275	$5,478.35
2.44	8.72-11.38	275-359	$6,777.56
2.74	11.38-14.4	359-454	$8,190.45
3.05	14.4-17.8	454-561	$9,684.55
3.35	17.8-21.52	561-679	$11,238.19
3.66	21.52-25.62	679-808	$12,856.79

(a) Table values converted from table A-2 in the Southern California Comprehensive Water Reclamation and Reuse Study Phase II Final Report by the United States Bureau of Reclamation (USBR 2002)
(b) An inflation rate of $1.65 was used to adjust $USD02 to $USD22 (USBLS 2022)

Cost scaling factors were used to adjust final capital costs for pipeline construction to reflect potential increased costs due to barriers (e.g., crossing water bodies or mountainous areas). An estimate of the base cost for water pipelines on each land-use type was determined using Google Maps analysis and expert determinations to approximate an overall cost scaling factor for all pipeline construction modeled in this study (Table 6). This was used to calculate an average cost scaling factor weighted according to the percentage of pipeline length constructed across each land-use type. This weighted average was determined to be 1.68, so the total of base capital costs determined by pipeline length and diameter was multiplied by 1.68 to determine to total estimated pipeline construction costs (Table 7).

Table 6 | Estimated percent of water transport pipeline on different land-use types and associated scaling factors based on additional cost to build on specific terrain and land-use types.[a]

Land-Use Type	Cost Scaling Factor	Estimated Percent of Pipeline on Land-Use Type
Urban-Residential	1.2	2%
Urban-Commercial	1.53	2%
Urban-Industrial	1.53	2%
Urban-Transportation	1.53	2%
Urban-Airports	10	0%
Urban-Mixed	1.35	5%
Urban-Agricultural	1	10%
Urban-Forest & Range	1	10%
Water-Wetlands	7.5	1%
Water-Streams/Canals	5.33	0.5%
Water-Bays/Estuaries	7.5	0.5%
Water-Lakes/Reservoirs	10	1%
Water-Open Space	1	30%
Water-Unknown	1	1%
Barren-Salt Flats	1	0%
Barren-Beaches	5.33	0%
Barren-Dunes	0.75	0%
Barren-Rock	7	5%
Barren-Mines	1.2	0%
Barren-Transitional	1.2	5%
Barren-Mixed	1.2	5%
Freeways-Cross	5.33	1%
Freeways-Follow	0.8	5%
Freeways-Cross Interchange	10	0%
Highways-Cross	5.33	0.5%
Highways-Follow	0.8	5%
Railroads-Cross	5.33	0.5%
Rivers-Cross	5.33	0.5%
Rivers-Follow	0.8	5%
Canals-Cross	5.33	0.5%

(a) Land-use types and cost scaling factors are sourced from table A-3 in the Southern California Comprehensive Water Reclamation and Reuse Study Phase II Final Report by the United States Bureau of Reclamation (USBR 2002)

Table 7 | Water pipeline infrastructure capital cost details.

Pipeline	Pipe Diameter (m)	Pipeline Distance (km)	Pipeline Cost (USD$22)
LA to Site 1	0.46	32	$38.7M
LA to Site 2	0.76	129	$262.8M
LA to Site 3	0.46	185	$223.8M
LA to Site 4	0.76	129	$262.8M
Bakersfield to Site 1	0.3	185	$151.4M
Bakersfield to Site 2	0.91	113	$276.9M
Bakersfield to Site 3	1.22	129	$488.1M
Bakersfield to Site 4	0.61	209	$334.6
Site 5	0.91	100	$251.0M
Total	-	**1,211**	**$2,290.1M**

2. Pumping Station Power Requirements

Electricity requirements in the HyBuild LA water scenario include: (1) the pumping power needed to transport water from the source to the GH_2 production sites; and (2) the power required to pump the water through the RO treatment process.

The total estimated electricity requirements for water transportation and treatment are provide in Table 8. For 2030 and 2040, the pumps' collective average energy demand would be equivalent to 15.6 and 29.1 MW, and the pumps' annual energy use would be equivalent to 490.1 and 917.6 TJ/year, respectively.

Table 8 | Details from power and energy calculations to transport recycled wastewater to each production site in 2030 and 2040.[a]

Source to Production Site	Recycled Wastewater Demand 2030; 2040 (Mm^3/year)	Volumetric Flow Rate 2030; 2040 (m^3/s)	Pipe Diameter 2040[b] (m)	Pump Power 2030; 2040 (MW)	Annual Pump Energy 2030; 2040 (TJ)
LA to Site 1	3.5; 5.8	0.11; 0.18	0.46	0.02; 0.8	0.6; 2.7
LA to Site 2	17.7; 29.1	0.56; 0.92	0.91	3.27; 47.5	103.1; 170.9
LA to Site 3	17.7; 29.1	0.56; 0.92	0.91	3.22; 47.0	101.7; 169.1
LA to Site 4	17.7; 29.1	0.56; 0.92	0.91	4.03; 58.5	127.1; 210.4
Local to Site 5	14.1; 23.3	0.45; 0.74	0.91	4.5; 7.5	142.5; 234.9
Total	**70.7; 116.3**	-	-	-	**475.1; 788.1**

(a) Pre-treatment water volume requirements are oversized to account for RO/DI treatment losses at the production site (~14% loss from recycled wastewater).
(b) It is assumed the pipe diameter required for the flow in 2040 is installed for 2030 demands to accommodate increase in production and demand.

Table 9 | Pumping station infrastructure capital and energy operating cost details for 2030 and 2040.

Pipeline	Water Input Volume (Pre-Treatment) (Mm^3/year)	Capital Costs of Pumps 2030; 2040 ($USD22)	Annual Energy Requirements 2030; 2040 (TJ)	Annual Cost of Energy that is Required for Pumping 2030; 2040 ($USD22/year)
LA to Site 1	2.7; 4.4	$0.2M; $0.3M	0; 0	$0; $0
LA to Site 2	8.8; 14.5	$0.6M; $1.0M	43.9; 79.6	$2.4M; $4.4M
LA to Site 3	4.4; 7.3	$0.3M; $0.5M	24.6; 58.1	$1.4M; $3.2M
LA to Site 4	13.3; 21.8	$0.9M; $1.5M	88.8; 170.3	$4.9M; $9.5M
Bakersfield to Site 1	1.5; 2.5	$0.1M; $0.2M	2.6; 10.8	$0.1M; $0.6M
Bakersfield to Site 2	15.5; 25.4	$1.1M; $1.8M	86.5; 156.7	$4.8M; $8.7M
Bakersfield to Site 3	23.2; 38.1	$1.6M; $2.7M	113.2; 196.5	$6.3M; $10.9M
Bakersfield to Site 4	7.7; 12.7	$0.5M; $0.9M	62.2; 122.8	$3.4M; $6.8M
Site 5	14.1; 23.3	$1.0M; $1.6M	69.1; 122.8	$3.8M; $6.8M
Total	**91.2; 150.0**	**$6.4M; $10.5M**	**490.9; 917.5**	**$27.3M; $50.9M**

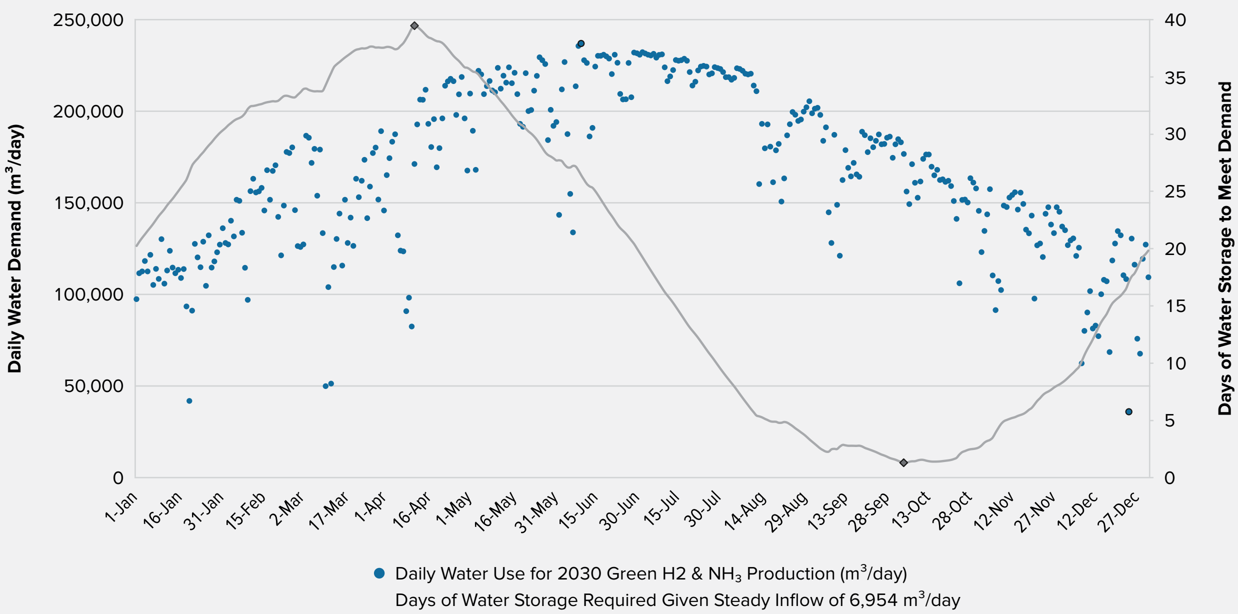
B.2.3 | Water Storage

Post-Water Treatment Storage

If GH_2 and green NH_3 were produced steadily over the course of the year at a single production site, the hourly water demands would be 6,954 m^3/hour for 2030 and 11,435 m^3/hour for 2040. This was calculated by dividing the total annual water demands by 8,760 hours per year. However, GH_2 production will fluctuate seasonally based on solar resource peaks, meaning that water demands will also fluctuate throughout the year. By contrast, recycled or repurposed water will likely be supplied steadily over the course of the year.

To balance the seasonal water demands from GH_2 and green NH_3 production, the analysis determined that a total of 39.7 days of water storage would be required in mid-April to meet increased summer production rates. Water would be pulled from these storage tanks throughout the summer and early fall, with water storage tanks being close to empty in early October. Water storage would then fill up during the decreased winter production rates to meet the following summer's demands.

Figure 2 | Total daily water demand and days of water storage required for 2030 HyBuild LA GH_2 and green NH_3 production estimates. This model assumes a steady inflow of treated source water and a variable solar profile driving the daily production rates and water demands in Southern California. Maximum and minimum values for both demand and storage are highlighted with grey diamonds.



Pre-Water Treatment Storage

Pre-treatment water storage requirements will depend on the quality of water being stored prior to water treatment. The lower the quality of water being treated at the production site, the larger the volume of pre-treatment storage required. The analysis assumed a scenario of constant onsite water treatment rate and two-days of onsite pre-treatment water storage to accommodate minor variations of raw water supply. Estimates for concrete water storage tank capital and maintenance costs were determined using a 2019 study for the City of Madera (Carollo 2019). A power function regression was made utilizing three data points (2.5, 3.25, and 5 million gallon tanks) from the City of Madera study, and Excel trendline features were utilized to determine capital costs, adjusting for economies of scale for the large tank sizes required at the production sites.[173] Total onsite construction costs, scaled by the power function derived from the City of Madera study, were used for the capital cost estimates. Finally, a fixed total 20-year recurring cost of \$1,800/m^3 divided by 20 was used for the annual cost estimates. Results of this analysis are provided in Table 10 and Table 11.

173. Capital costs per m^3 of water storage was given by \$CAPEX/m^3 = \$2.27x105 * (m^3 storage required)-0.593

Table 10 | Post-treatment concrete water storage requirements and estimated costs at each production site for 2030 and 2040.

Production Site	Annual Treated Water Demand 2030; 2040 (Mm^3/year)	Water Storage Requirement 2030; 2040 (Mm^3)	Water Storage Capital Cost ($USD22)	Water Storage Annual Cost ($USD22)
Site 1	3.1; 5.0	0.33; 0.54	$46.5M; $56.9M	$0.07M; $0.12M
Site 2	15.2; 25.0	1.66; 2.72	$89.4M; $109.5M	$0.37M; $0.60M
Site 3	15.2; 25.0	1.66; 2.72	$89.4M; $109.5M	$0.37M; $1.8M
Site 4	15.2; 25.0	1.66; 2.72	$89.4M; $109.5M	$0.37M; $1.8M
Site 5	12.2; 20.0	1.33; 2.18	$81.7M; $100.0M	$0.29M; $0.48M
Total	**60.9; 100.2**	**6.6; 10.9**	**$396.4M; $485.4M**	**$1.46M; $2.40M**

Table 11 | Pre-treatment concrete water storage requirements and estimated costs at each production site for 2030 and 2040.

Production Site	Annual Recycled Wastewater Demand 2030; 2040 (Mm^3/year)	Pre-treatment Storage Requirement 2030; 2040 (km^3)	Pre-treatment Water Storage Capital Cost ($USD22)	Pre-treatment Water Storage Annual Cost ($USD22)
Site 1	3.5; 5.8	17, 27	$13.8M; $16.9M	$3.6K; $6.1K
Site 2	17.7; 29.1	83; 137	$26.5M; $32.5M	$18.4K; $30.3K
Site 3	17.7; 29.1	83; 137	$26.5M; $32.5M	$18.4K; $30.3K
Site 4	17.7; 29.1	83; 137	$26.5M; $32.5M	$18.4K; $30.3K
Site 5	14.1; 23.3	67; 109	$24.2M; $29.6M	$14.7K; $24.2K
Total	**70.7; 116.3**	**334; 549**	**$117.5M; $143.9M**	**$73.6K; $121.0K**

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APPENDIX C

Air Quality and Public Health Analysis

C.1 | APPROACH

An integrated modeling approach was utilized to characterize and quantify the air quality and associated public health impacts of the HyBuild LA GH_2 adoption scenario relative to a business-as-usual Reference Scenario to provide insight into the co-benefits that are achieved in 2035 and 2045.

Using outputs from E3's PATHWAYS model, spatially and temporally resolved characterizations of pollutant emissions were developed for all sectors and sources in California – including stationary, area, and mobile source emissions – to develop an analytical baseline. The HyBuild LA Phase 2 demand assessment developed by CVA was used to provide a scenario for fuel cell deployment in place of fossil fuel combustion technology in the following applications:

Modeling assumed emissions reductions from fuel cell deployment in place of internal combustion engines in the following applications:

- Heavy-Duty Trucks (Intrastate)
- Drayage Trucks
- Materials Handling Equipment
- Fuel Cell Forklifts
- Fuel Cell Buses (Motor Coach)

Modeling assumed no change in emissions from the following applications:

- Maritime Shipping
- Planes
- Industry/ Power Plants

Emissions were forecast to 2035 and 2045 utilizing a detailed base year California Air Resources Board (CARB) pollutant emissions inventory (2020 CARB v0018), and were spatially and temporally resolved using the Sparse Matrix Operator Kernels Emissions (SMOKE v4.7) model.

Emission changes were translated into impacts on atmospheric pollution levels, including ground-level ozone and fine particulate matter ($PM_{2.5}$), via an advanced photochemical air quality model called the Community Multiscale Air Quality (CMAQ v5.3.2). This model accounts for atmospheric chemistry and transport. Given the intensive computational requirements to run CMAQ, an episodic air quality modeling approach was used; January and July were selected for analysis relative to the Reference Scenario to demonstrate seasonal variation in air pollution.

Air quality changes were then used to conduct a health impact assessment using the Environmental Benefits Mapping and Analysis Program – Community Edition (BenMAP v1.5.8) which provides a quantitative estimate of the incidence and value of avoided harmful health outcomes associated with air pollution in each scenario. Finally, the health impact results were analyzed through an environmental justice screening tool called CalEnviroScreen 4.0, which enabled UCI to quantify the benefits that occur specifically within socially and economically disadvantaged communities (as identified in CalEnviroScreen 4.0).

C.2 | SCENARIO ASSUMPTIONS

The HyBuild LA air quality analysis utilized the assumed adoption levels of FCEVs from each mobility end use in the Offtake and Infrastructure Workstream. The study developed an emissions reduction scenario for the South Coast Air Basin which was then compared to a business-as-usual Reference Scenario to determine emissions, air quality, and health benefits. The assumed penetration of fuel cell electric technologies relative to the total addressable fleet in the LA Basin are shown in Table 1. Considered end uses include intrastate heavy-duty trucks (HDT), drayage trucks, materials handling equipment, forklifts, and motor coaches. Emissions from all other sources were held constant to the Reference Scenario due to a lack of data.

Table 1 | HyBuild Scenario Assumptions.

	Deployment Level	Additional Assumptions
Fuel cell heavy-duty trucks (intrastate)	**2035:** 15% FCEV **2045:** 31% FCEV	Deployment assumed for several HDV categories operating intra-state that are applicable
Fuel cell drayage trucks	**2035:** 36% FCEV **2045:** 75% FCEV	
Fuel cell materials handling equipment	**2035:** 26% FCEV **2045:** 78% FCEV	
Fuel cell forklifts	**2035:** 44% FCEV **2045:** 48% FCEV	Deployment assumed in all major categories in the invetory
Fuel cell buses (motor coach)	**2035:** No FCEV **2045:** 55% FCEV	Reference case already assumes high levels of zero emission buses in 2045 (minor impact)

C.3 | POLLUTANT EMISSIONS

Baseline pollutant emissions represent a highly detailed inventory developed by CARB (CARB 2020 v0018), which includes total emissions by sector and source as well as spatial and temporal information regarding source activity. The emissions are then forecasted out to 2035 and 2045 using output from the PATHWAYS[1] model for technologies, fuels, and energy demand in each sector identified in California's Global Warming Solutions Act (AB 32). Additionally, data from EMFAC 2021 v1.0.1[2] for on-road vehicles, OFFROAD2021[3] for other transportation sectors, and the CARB California Emissions Projection Analysis Model (CEPAM) 2019 v1.03 for stationary sources was used to account for changes in emission rates and control factors.[4]

The pollutant emissions inventory was then processed into air quality model-ready format using the Sparse Matrix Operator Kernel Emissions model (SMOKEv4.7) to resolve the location and timing of the emissions to correspond with the responsible sources (e.g., the location of refineries, the locations of residential and commercial buildings, the locations of major roadways and the traffic patterns for vehicles).[5] On-road vehicle emissions were spatially resolved to the locations of vehicle activity using the Emissions Spatial and Temporal Allocator (ESTA) model developed by CARB.[6]

C.4 | AIR QUALITY

Atmospheric chemistry and transport were simulated using the Community Multiscale Air Quality model (CMAQ, v5.3.2) to provide a comprehensive understanding of impacts on pollutant concentrations, accounting for both primary (emitted) and secondary (formed) species, including ground-level ozone and $PM_{2.5}$.[7] CMAQ was developed by U.S. EPA and is widely used for air quality assessments of emission inventories,[8] energy sectors integrating alternative technologies in energy systems,[9] regulatory compliance[10] and research associated with tropospheric ozone, PM, acid deposition, and visibility.[11,12] The use of CMAQ is particularly important to assess air quality because a significant portion of the pollution impacting California populations is secondary and forms in the atmosphere. Depending on season and region, secondary $PM_{2.5}$ can comprise 40-60% of the total atmospheric $PM_{2.5}$ burden in California.[13]

For this work, the SAPRC-07 chemical mechanism[14] was utilized to model gas-phase chemistry, and AERO6 module[15] was used to calculate aerosol dynamics. The simulation domain is the same as Reference[16] with a 4 km x 4 km horizontal resolution that covers California. The Advanced Weather Research and Forecasting Model (WRF-ARW, 3.9.1)[17] was used to downscale meteorological conditions from the NCEP North American Regional Reanalysis dataset.[18] Boundary conditions were generated using the Community Atmosphere Model with Chemistry v2.1 (CESM2.1/CAM-chem).[19] Biogenic emissions, including those from vegetation and soil, were generated using the Model of Emissions of Gases and Aerosols from Nature (MEGANv2.1).[20] Although simulations are conducted for the year 2045, the boundary and meteorological conditions were held constant with the 2020 base emission inventory year to ensure that resulting impacts were attributable only to changes in anthropogenic emissions associated with the changes in the HyBuild LA scenario.

The two pollutants considered to assess air quality and health were $PM_{2.5}$ and tropospheric ozone, as many regions of California experience ambient levels in excess of State and Federal health-based standards[21] and both are well known to be associated with health consequences in exposed populations and commonly included in similar health impact assessments.[22,23,24] For consistency with ambient air quality standards, ground-level concentrations have been reported as maximum daily 8-h average ozone (MD8H) and 24-h average $PM_{2.5}$.

Table 2 | Overview of the air quality modeling tools utilized and sources of data inputs.

	Model
Base Year Inventory	2020 CARB v0018
Emissions Processing	SMOKE v4.7 and ESTA
Air Quality Model	CMAQ v5.3.2
Chemical Mechanism	SAPRC-07 and AERO6
Biogenic Emissions	MEGAN v2.1
Meteorological Files	WRF-ARW v3.9.1
Boundary Conditions	CESM v2.1/CAM-chem

Two simulation periods were conducted to capture the effect of seasonal variation in meteorology and emissions concentrations including a summer month (July) and winter month (January). July was selected as it includes conditions conducive to high ozone and $PM_{2.5}$ concentrations, including high surface temperatures, an abundance of sunlight, lack of natural scavengers, and the presence of inversion layers.[25] Similarly, the month of January was included as it is associated with high levels of $PM_{2.5}$ in some regions of California, including the South Coast Air Basin (SoCAB) and the Central Valley. For both seasons, the first five days of the simulation period were considered model spin-up and excluded from the analysis. The CMAQ output has been validated for the 2020 base year using observational data from the U.S. EPA's Air Quality System[26] and found to be within the statistical parameters established by the scientific community for acceptable model performance.[27]

C.5 | HEALTH IMPACTS

Epidemiological studies have shown that reducing air pollution exposure results in reductions in the incidence of harmful health endpoints. Public health benefits from the HyBuild LA system were quantified and valued using The Benefits Mapping and Analysis Program — Community Edition version 1.5.8 (BenMAP) from the U.S. EPA.[28] BenMAP allows for the quantification of the avoided incidence and economic value of health endpoints that result from differences in air pollution concentrations.

The endpoints selected for the health analysis, as well as the corresponding reference for the concentration-response function used to quantify reductions in the incidence of certain health issues from reduced exposure to $PM_{2.5}$ and ozone, are shown in Table 3 and Table 4. The selection of inputs, including concentration-response functions, baseline incidence rates, and valuation functions, generally follow those recommended by the U.S. EPA in the BenMAPv1.5.8 user's manual.[29] Additionally, the quantification of avoided incidence of premature mortality due to reduced short-term exposure to $PM_{2.5}$ was estimated using Atkinson et al. 2014[30] following methods used by the South Coast Air Quality Management District.[31] A value of statistical life of $8.7 million was used to quantify mortality risk reduction benefits as recommended by the U.S. EPA. The health benefits were quantified in 2015 dollars, and then converted and reported in 2022 dollars. Health impacts were quantified for the entire month of July and January, except for the first five days of each month which were discarded as model spin-up.

Impacts were estimated for avoided short-term exposure to ozone and $PM_{2.5}$ in July. In January, only the impacts of avoided exposure to $PM_{2.5}$ was estimated given that ozone concentrations are generally below health-based standards in winter and share an inverse relationship with precursor emissions, which prevented useful conclusions from the results. Finally, the estimated health savings were quantified specifically within census tracts that have been identified as DAC using the CalEnviroScreen 4.0 tool.[32] Population projections to 2045 at the census tract level were obtained from GeoLytics.[29]

Table 3 | Health endpoints and their concentration-response function reference included in the BenMAP analysis for reduced exposure to ozone.

Ozone Health Endpoints	Reference
Avoided Mortality	Huang et al. 2005
Emergency Room Visits, Respiratory	Barry et al. 2018
Hospital Admissions, Respiratory	Katsouyanni et al. 2009
Asthma Symptoms	Lewis et al. 2013
Incidence, Asthma Onset	Tetreault et al. 2016

Table 4 | Health endpoints and their concentration-response function reference included in the BenMAP analysis for reduced exposure to $PM_{2.5}$.

$PM_{2.5}$ Health Endpoints	Reference
Avoided Premature Mortality	Atkinson et al. 2014
Hospital Admissions, Alzheimer's Disease	Kioumourtzoglou et al. 2016
Hospital Admissions, Parkinson's Disease	Kioumourtzoglou et al. 2016
Incidence, Lung Cancer	Gharibvand et al. 2016
Incidence, Asthma Onset	Tetreault et al. 2016
Acute Myocardial Infarction, Nonfatal	Zanobetti et al. 2009
Asthma Symptoms	Rabinovitch et al. 2006
Hospital Admissions, Cardiovascular	Bell et al. 2015
Emergency Room Visits, Cardiovascular	Ostro et al. 2016
Hospital Admissions, Respiratory	Bell et al. 2015
Emergency Room Visits, Respiratory	Krall et al. 2016

C.6 | AIR QUALITY AND HEALTH IMPACT ASSESSMENT CAVEATS

Assumptions and caveats should be considered when interpreting the results of this analysis.

Of note, episodic modeling provides insight into the maximum impacts of the GH_2 adoption scenario on air quality but does not provide a comprehensive understanding of the air quality impacts. Due to the selection of modeling periods coinciding with high pollutant formation periods, the pollutant differences and the corresponding health impacts are also maximized during those periods and may not be as significant in other months. The results of both the air quality and health benefit assessments represent two distinct months and cannot be used to estimate other periods.

Additionally, health benefits have been quantified and reported for reduced short-term exposure to $PM_{2.5}$ and ozone for two months in 2035 and 2045, so therefore, the results do not provide a comprehensive accounting of the health benefits that could be achieved annually or cumulatively. Further, although BenMAP can be used to estimate long-term health impacts such as those occurring from annual average $PM_{2.5}$ changes, impacts have been reported for short-term exposure to ozone and $PM_{2.5}$ as appropriate for the modeled episodes. It should be noted that the value of health benefits related to avoided short-term exposure is significantly lower than those estimated for long-term exposure, which are generally 8–12x higher.

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GREEN HYDROGEN COALITION

The Green Hydrogen Coalition, a 501(c)(3) educational nonprofit organization, is dedicated to facilitating practices and policies to advance the production and use of green hydrogen in all sectors where it will accelerate a carbon-free energy future.

HyBuild™ North America is the GHC's platform to architect low-cost, mass-scale green hydrogen hubs throughout the continent. The first regional focus of the platform, HyBuild Los Angeles, was launched in 2020 and has identified a pathway to achieve $2.05/kg delivered green hydrogen costs in the Los Angeles Basin to serve multi-sectoral offtakers, reduce air pollution, and create diversely skilled local jobs.

The GHC's second platform, the Western Green Hydrogen Initiative, is a public-private partnership to assist interested states and partners in advancing and accelerating deployment of green hydrogen infrastructure in the Western region for the benefit of the region's economy and environment.

For more information on the GHC, visit ghcoalition.org.

June 4, 2024

Informal Comments of the Public Advocates Office on
Southern California Gas Company's Angeles Link Pipeline Sizing Preliminary Findings Report

The Public Advocates Office at the California Public Utilities Commission (Cal Advocates) provides these comments on Southern California Gas Company's (SoCalGas) *Angeles Link Pipeline Sizing and Design Criteria Preliminary Data and Findings* (Design Findings), which was issued on May 21, 2024.

As a general matter, the Design Findings document is only 12 slides from a presentation which reveals little additional information on pipeline design that had not been discussed in prior PAG meetings. In addition, the Design Findings document raises new questions about possible shortfalls in the LA Basin and whether utilizing underground storage in California will be a viable option. Cal Advocates offers these comments and questions to inform and improve the draft Pipeline Sizing and Design Criteria study to be released later this year and to address the current shortfalls based on what SoCalGas has provided to date.

The Pipeline Sizing and Design Criteria Study Must Satisfy Commission Orders

The Design Findings document notes that although the Pipeline Sizing and Design Criteria study will "identif[y] specific materials for pipeline, fittings, and differences in operational equipment",[1] it does not identify the pipeline materials used for the proposed Angeles Link. This information is needed in order to evaluate the safety of the pipeline design. Commission Decision (D.) 22-12-055, Ordering Paragraph [OP] 6(f), requires that SoCalGas provide, as part of its Phase 1 Feasibility Studies, "Evaluations of safety concerns involved in pipeline transmission, storage, and transportation."[2] Therefore, this deficiency must be addressed in the draft study.

[1] Design Findings, at 2.
[2] D.22-12-055, Ordering Paragraph [OP] 6(f) – "Evaluations of safety concerns involved in pipeline transmission, storage, and transportation".

<u>Angeles Link Pipeline is Being Sized and Designed to Below the Conservative Demand Scenario</u>

The Design Findings document provides a high-level approach on how to design a pipeline solution to match in-basin demand from production sites[3] outside of the LA Basin. One of the principal study assumptions is that the pipeline is being designed for multiple scenarios to meet an annual throughput range of between 0.5 – 1.5 million metric tons per year (TPY).[4] This throughput range is compared to the estimated hydrogen demand for end users in-basin from Angeles Link's Demand Study draft report, summarized in Table 1:

Table 1 - Renewable Hydrogen Demand Scenarios for 2045 in SoCalGas' Service Territory in Millions of Tons per Year [5]

Conservative	Moderate	Ambitious
1.9M TPY	3.2M TPY	5.9M TPY

In both the Design Findings[6] and the *Production Planning & Assessment Preliminary Data and Findings* (Production Findings), [7] SoCalGas is planning for the delivery of 1.5M TPY. This is below even the most conservative demand scenario for 2045 from the Demand Study draft report. This leaves several questions which SoCalGas should address in its draft report:

- Is the Angeles Link pipeline solution, from the three production locations examined, expected to fall short of delivering to even the most conservative demand scenario estimate by 2045?
- Is the estimated production quantity constrained by the amount of green hydrogen which can be produced by the three production locations, the diameter and number of pipelines with which to transport hydrogen from production to end users in-basin, or other unnamed constraints?
- How does SoCalGas expect the remaining volume of gas not delivered by Angeles Link to be produced and delivered to meet forecasted 2045 demand in its draft Demand Study draft report?

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[3] "Third-party clean renewable hydrogen production potentially located in San Joaquin Valley, Lancaster, and Blythe based on input from the Production Planning and Assessment study[.]" Design Findings, at 7.
[4] Design Findings, at 7.
[5] Angeles Link Demand Study draft report, at 5.
[6] Design Findings, at 7.
[7] In Production Findings, at 4, SoCalGas notes "Angeles Link is envisioned to potentially serve throughput scenarios of 0.5 - 1.5 million metric tonnes per year (MMTPY), which is a portion of the estimated 1.9 - 5.9 MMTPY* of hydrogen demand in SoCalGas service territory[.]"

- If the Ambitious demand scenario occurs, does SoCalGas expect that there may need to be additional pipelines constructed beyond this initial Angeles Link dual run[8] pipeline design?

SoCalGas Should Clarify if its Analysis Shows Deliverability Constraints In-Basin

The Design Findings document notes that while the preliminary pipeline system will likely have a Maximum Allowable Operating Pressure (MAOP) of 1,200 pounds per square inch gauge (psig), the lowest delivery pressure found in the system would be to the Ports of Lost Angeles and Long Beach where pressure would be lowered to 200 psig. The document does not elaborate on how or where the pressure will be regulated from 1,200 to 200 psig, nor whether this lower pressure is a result of adequately meeting end-user demand or whether it is a result of pipeline design constraints[9] limiting hydrogen deliverability within the LA Basin. SoCalGas should elaborate on the reasons that drive the reduction in operational pressure, especially if these lower pressures begin to affect deliverability to end users in the LA Basin.

The Feasibility and Value of Hydrogen Storage Resources near Production Sites Must be Quantified to Assess Primary Production Siting

The Design Findings document provides new, useful geospatial analysis on the available underground storage options across California, Utah, Arizona, and New Mexico.[10] Since the Angeles Link pipeline is being proposed as "an intrastrate hydrogen system that would transport clean renewable hydrogen between regional third-party production, storage, and end use areas within Central and Southern California",[11] several of the larger, out-of-state salt caverns would not be considered for use as hydrogen gas storage. What remains are the few, smaller in-state depleted oil and gas fields that offer a mixture of storage capabilities in the southern San Joaquin Valley and Los Angeles mountains. With SoCalGas looking to avoid use of its existing natural gas storage facilities[12] in and around Los Angeles, the San Joaquin Valley remains the main region capable of supporting underground hydrogen storage in California.

In the separate *High-Level Economic Analysis and Cost Effectiveness* (Cost Findings) document, SoCalGas notes in a levelized cost of hydrogen analysis that it had "…assumed underground storage for

[8] "Select pipelines modeled as two-parallel lines (dual run) for functional flexibility[.]" Design Findings, at 7.
[9] E.g. 49 CFR 192.5 Class Location constraints to the system MAOP, 49 CFR 192.903(c) Pipeline Impact Radius constraints to system MAOP and pipe diameter, etc.
[10] Design Findings, at 10.
[11] Design Findings, at 10.
[12] "While SoCalGas facilities were evaluated for geologic adequacy because they are located within the study area, they are not currently being considered as storage options for Angeles Link." Design Findings, at 11.

Angeles Link and trucking options, and above ground storage for the rest of the alternatives."[13] This cost assumption dramatically reduces the levelized cost of hydrogen for the Angeles Link pipeline solution, which saves between $1.38 - $2.03 per kg of H_2 compared to those scenarios that use aboveground storage.[14] For SoCalGas' cost assumption to make sense, the primary production location of a proposed Angeles Link pipeline must be located near underground storage options. The Lancaster or Blythe production locations fail to meet this requirement as there are no available storage options between these locations and demand in the LA basin. Instead, both Lancaster and Blythe production would have to rely on aboveground storage, a more costly solution.[15] Although the Blythe location has potential to connect to out-of-state salt storage, it is not evident from the preliminary filing whether this is expected. Of the options studied, only the San Joaquin Valley (SJV) site has the potential to use underground storage local to the production region. This also implies that any production scenario that does not include the SJV site[16] would similarly make the Angeles Link pipeline solution far less cost-effective compared to its hydrogen delivery alternatives.[17]

The existence and location of reliable hydrogen storage appears to be an impediment to the siting of primary production locations analyzed in the Design Findings document. Quantifying the suitability and storage capacity of depleted oil and gas fields for underground storage will be critically important to determine whether the proposed Angeles Link is as cost effective as stated.[18] In its draft report, SoCalGas must provide additional estimates of the storage capacities of California's depleted oil and gas fields for potential use as underground storage, so that stakeholders can properly assess the cost-effectiveness of the Angeles Link compared to other hydrogen delivery alternatives.

SoCalGas Must Cite Research of Safely Storing Hydrogen at Depleted Oil and Gas Fields

Separate from the issue of siting primary production near underground storage, there remains several unanswered safety questions raised specifically by utilizing depleted oil and gas fields for hydrogen storage. The California Public Utilities Commission, as part of its process to design safety thresholds for injecting hydrogen

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[13] *Angeles Link High-Level Economic Analysis and Cost Effectiveness Preliminary Findings* (Cost Findings), at 8.
[14] Cost Findings, at 8, shows an estimated storage cost of **$0.28/kg of H_2** for underground storage vs. **$1.65/kg of H_2** for Liquid Hydrogen Shipping, the nearest cost competitor. Storage savings are even stronger for other alternatives analyzed as their assumed levelized cost was **$2.31/kg of H_2**.
[15] Cost Findings, at 8, shows an estimated storage cost of **$0.28/kg of H_2** for underground storage vs. **$2.31/kg of H_2** for the storage cost of non-Angeles Link alternatives. Stakeholders are left to assume that aboveground storage costs for the Angeles Link pipeline solution would be comparable to these alternatives and that the difference in levelized storage cost is due to this aboveground/underground cost assumption.
[16] At page 9 of Findings document, Scenarios 2, 3, and 5 are all examples of production without SJV site, and therefore without access to local underground storage.
[17] Cost Findings, at 5.
[18] Cost Findings, at 8.

into the natural gas pipeline system in the Biomethane Rulemaking (R.13-02-008), commissioned the University of California Riverside (UCR) to perform a literature review of the issues associated with hydrogen blends. Although focused on blends specifically, the resulting research paper – the UCR Study – also assessed safety issues with the injection of hydrogen into depleted oil and gas reservoirs for long-term storage.[19] Among the concerns raised were twenty major issues involved with storing hydrogen inside of depleted oil and gas fields.[20] The UCR study later concluded that additional effort should be undertaken to "Conduct experimental and modeling work and analysis to develop strategies to mitigate or avoid known hydrogen impacts including underground storage facilities other than salt caverns…".[21] The Design Findings document does not address these risks, nor does it present new information which may have clarified these safety concerns. Cal Advocates recommends that SoCalGas include in its draft report all the information on the mitigation strategies for these known safety issues that SoCalGas intends to implement so that hydrogen storage at these depleted oil and gas field locations will be safe.

Conclusion

In summary, underground storage will be essential to influence the locations that can be developed for hydrogen production. Understanding and analysis of the viability of underground storage will determine whether a pipeline solution is safe and the most cost-effective solution for delivering hydrogen to demand in-basin. As such, the draft Pipeline Sizing and Design Criteria study should clearly answer the following questions:

- What are the specific materials for pipeline, fittings, and differences in operational equipment SoCalGas identifies for its pipeline?
- How is SoCalGas finding its deliverability to end users constrained by either production outside of the basin or design considerations in-basin?
- How is the use of depleted oil and gas fields as underground storage for hydrogen feasible from a safety mitigation and storage capacity perspective?

[19] UCR Study, at 15-16.
[20] "Hydrogen is known to have serious detrimental effects on underground porous reservoirs. Twenty different hydrogen related phenomena have been observed that have negative effects on porous reservoirs' performance as storage facilities for methane-hydrogen gas blends. The most serious of these is bacterial growth and activity, resulting in loss of gas volume, potential for H_2S production and damage to reservoir itself [44]." UCR Study, at 15.
[21] UCR Study, at 114.

COMMUNITIES FOR A BETTER ENVIRONMENT
established 1978

June 4, 2024

Southern California Gas Company
555 West Fifth Street,
Los Angeles, CA 90013

Submitted via email to ALP1_Study_PAG_Feedback@insigniaenv.com.

Feedback for Southern California Gas Company on Preliminary Findings Presentations Provided on May 21, 2024

Communities for a Better Environment (CBE) submits this letter of feedback to Southern California Gas Company (SoCalGas) on the following materials:

I. Proposed Timelines
II. Project Options and Alternatives: Preliminary Data and Findings
III. Pipeline Sizing and Design Criteria: Preliminary Data and Findings
IV. High-Level Economic Analysis and Cost Effectiveness: Preliminary Data and Findings

These comments specifically pertain only to the preliminary findings presented in the abbreviated presentations provided on May 21, 2024. Per SoCalGas's representations at the April 23, 2024 joint PAG and CBOSG meeting, CBE expects that a separate, complete draft of the data, analysis, and findings will be released at an unknown later date. These preliminary presentations lack basic data, let alone the analysis parties need to provide feedback, and these comments cannot and do not comprise the entire scope of feedback from CBE on any of the topics presented. Failing to provide data does not comply with part seven of the CPUC Decision D.22-12-055 (hereinafter "CPUC Decision"), which requires SoCalGas to "make the data, findings, and results of Phase One feasibility studies…available to the public and not redacted unless SoCalGas is granted confidentiality of data."[1]

As previously raised in CBE's May 3, 2024 feedback letter, it is deeply concerning that these presentations are labeled "data and findings." The presentations contain no data or related analysis to support any findings they may be summarizing. Overall, the presentations are more like public relations materials, which the PUC prohibited SoCalGas from promulgating in this

[1] CPUC Decision, Order No. 7 pg. 77.

process, than feasibility studies.[2] The CPUC Decision emphasized the importance of stakeholder engagement to identify potential impacts of the project on disadvantaged and environmental justice communities.[3] Meaningful engagement is impossible without the facts on which findings or conclusions are based.

I. Concerns Regarding Proposed Timelines

CBE is troubled by the shortened timeline for feedback for this set of materials specifically and all materials in general. These materials were provided after 5:00 pm on May 21, 2024, with a feedback submission deadline of June 4, 2024, at 5:00 pm. Accounting for the federally observed holiday of Memorial Day, that is nine business days. This timeline was further strained when SoCalGas released a 60-page Hydrogen Leakage Assessment Draft Report for feedback on May 29, 2024. Under the California Environmental Quality Act (CEQA), the required public comment period for Environmental Impact Reports is at a minimum 30 days and more than 60 days in exceptional circumstances.[4] Even a negative declaration is open for public review for 20 days at the very least, and local authorities provide for public review of notices of exemption, which can be challenged within 35 days.[5] CEQA is California's iconic public engagement statute, and its timeline provides a useful comparison for the pace at which SoCalGas demands feedback.

Of even greater concern, the timelines provided in the Project Options and Alternatives, and High-Level Economics Analysis and Cost Effectiveness presentations suggest that the complete studies, which presumably will include all the data and information that is lacking from the presentations, will be released in June 2024 and comments will be "incorporated" in June/July 2024. This timeline is incredibly concerning because these draft studies require considerable time to review in order to provide meaningful feedback. Community groups and other stakeholders have repeatedly requested longer feedback periods for these technical reports. CBE echoes these requests, in asking that SoCalGas adjust these timelines to provide appropriate periods for feedback.

II. Project Options and Alternatives: Preliminary Data and Findings

The Project Options and Alternatives: Preliminary Data and Findings Presentation ("Alternatives Presentation") is rooted in a set of criteria established by SoCalGas for the purpose of evaluating options and alternatives to the Angeles Link project. The Alternatives Presentation does not provide any substantive basis for establishing these criteria as a valid means of comparing and "carrying through" project options or alternatives. The Angeles Link project as it has been proposed is a significant investment of public funds, for new hydrogen

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[2] CPUC Decision D.22-12-055 (hereinafter CPUC Decision), pg. 38.
[3] CPUC Decision, pg. 80. See also pg. 58 "Stakeholder engagement, including those from CBOs, ESJ groups, and disadvantaged communities (DAC) groups, are important to the planning process."
[4] Cal. Pub. Resources Code §21091; Cal. Code Regs. Tit. 14 §15105.
[5] Cal. Pub. Resources Code §21091; Cal. Code Regs. Tit. 14 §15062.

infrastructure that covers vast swaths of Southern California with substantial impact and risks to communities along the pipeline. Accurately and transparently weighing alternatives such as electrification at this early juncture in decision making is important to obtaining meaningful community consent and feedback. The Alternatives Presentation fails to do so.

In the Alternatives Presentation it is unclear what the complete set of criteria even are. Nine distinct criteria are named throughout the presentation, but only five of these criteria are defined. On slide three SoCalGas states that "alternatives that meet the criteria established in the study will be carried forward to the environmental and environmental social justice analysis." However, confusingly, slide 11 indicates that environmental impacts are a criterion of comparison based on the category's inclusion in a comparative heat map. Failing to provide a complete set of criteria and definitions precludes community members from providing feedback on the comparative process which is essential to establishing the viability of alternatives. Further, the Alternatives Presentation provides conflicting information about how undefined criteria are established within this study and in relation to others. For example, while CBE strongly supports screening alternatives based on "Alignment with California's Environmental Law and Public Policies", SoCalGas identifies only three applicable laws and policies - the 2022 Scoping Plan, the Advanced Clean Fleets regulation and the Executive Order (N-79-202) on zero-emissions vehicles.[6] Is this the invitation from SoCalGas for feedback on the laws and policies it should include in the screening criteria? If so, CBE requests confirmation and an opportunity to provide additional briefing, as we have extensive experience explaining to decisionmakers such as the PUC and local decisionmakers what environmental laws and policies apply to projects like Angeles Link, but it is not at all clear from the slide deck whether the listed laws/policies are illustrative or comprehensive. This lack of clarity calls into question the reliability of the findings presented in the Alternatives Presentation. CBE requests that SoCalGas clearly define each criterion and establish a separate criterion of evaluation for environmental justice concerns.

It is unclear how the criteria are applied and what exactly the four-part color-coded scale used in comparative heat maps represents. In the study approach slide[7], step two states that SoCalGas will "evaluate potential alternatives against identified criteria" but does not elaborate, and no further clarity is provided in the presentation. When examining the multiple heat map charts using the same four-part color scale which ranks criteria from highest to lowest score, Angeles Link is rated differently throughout. Because no background is provided on how or what kind of evaluation criteria are used, it is impossible to discern what a high or low score indicates. For example, on slide six, Angeles Link does not satisfy the technological maturity criteria, however later in the presentation on slide 13, in the same category as applied to distinct subsectors Angeles Link was rated in the middle of the high to low scale. Further, slide 13 asserts that "molecules are easier to store than electrons, supporting system reliability", but provides no evidence for this statement that is heavily contested. These and other inconsistencies and questionable assertions throughout the Alternatives Presentation raise significant questions as to the legitimacy of SoCalGas' findings. These inconsistencies seem to indicate a troubling bias

[6] Project Options and Alternatives, Slide 7.
[7] Project Options and Alternatives, Slide 4.

towards development of the Angeles Link project over alternatives. This lack of transparency regarding alternative comparison and the overall criteria application process precludes meaningful community feedback on the important matter of alternatives comparison.

Further, an array of non-hydrogen alternatives are dismissed without providing information on the application of the stated criteria. For the sake of transparency and equitable analysis, CBE requests that SoCalGas provide the analysis related to the following dismissed alternatives: Energy Efficiency, Hydro, Geothermal, and Plug-in Hybrid.

Although the presentation slide deck does not show how SoCalGas arrived at its methodology, CEQA requires alternatives consideration, and the CEQA guidelines may be instructive. These require consideration of a "no project" alternative and alternatives that are feasible and meet some of the project's high-level goals, which cannot be framed in terms so narrow that only the project could meet them.[8]

SoCalGas concludes the slide deck by summarizing stakeholder feedback. While it identifies parties, including CBE, who have submitted feedback, it is impossible to discern from the summary slide what feedback is attributable to any particular group. This gives the classic "hearsay" problem, by making sweeping statements that are unreliable and untraceable. To the extent SoCalGas intends to summarize participant comments, it should identify who said what, so CBE can understand SoCalGas's responses to its comments.

III. High-Level Economic Analysis and Cost Effectiveness: Preliminary Data and Findings

The High-Level Economic Analysis and Cost Effectiveness: Preliminary Data and Findings presentation ("Economic Presentation") provides no data or explanation of the methods of analysis, and troublingly only compares the estimated cost of Angeles Link to selected alternatives. At this early stage, the projected costs for the Angeles Link project already amount to billions of dollars. SoCalGas clearly intends to rate-base this costly infrastructure, which will particularly harm ratepayers in low income communities of color who already carry a disproportionate burden of utility debt and are more susceptible to shut off.[9] Particularly with respect to the use of hydrogen in electricity production, low-income ratepayers could be bearing higher costs both for the infrastructure (Angeles Link) and in their electric bills, whether through LADWP or Southern California Edison. The Economic Presentation is entirely silent about ratepayer impacts.

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[8] Cal. Code Regs. Tit. 14 §15126.6; *see also* Cal. Pub. Resources Code Section 21083; 21002, 21002.1, 21003, and 21100; *Citizens of Goleta Valley v. Board of Supervisors*, (1990) 52 Cal.3d 553; *Laurel Heights Improvement Association v. Regents of the University of California*, (1988) 47 Cal.3d 376; *Gentry v. City of Murrieta* (1995) 36 Cal.App.4th 1359; and *Laurel Heights Improvement Association v. Regents of the University of California* (1993) 6 Cal.4th 1112.

[9] Paul M. Ong et al., *Keeping the Stove On: COVID-19 and Utility Debt, UCLA Luskin Center for Innovation*, (2021). "Gas bill debt disproportionately impacts low-income neighborhoods.

The Economic Presentation only examines production, storage, transmission, regasification, liquification, and distribution once the Angeles Link pipeline is in place. The Economic Presentation fails to account for the significant economic cost of building out pipeline infrastructure. In fact, the presentation does not provide any estimates regarding the cost of the project or potential funding in support of the project. Information regarding the complete estimated cost of the project must be made available before any further action on the Project can be taken.

Slide nine of the Economic Presentation borrows the comparative heat map, four color scale diagram provided in the Alternatives Presentation to provide a comparative evaluation of the cost effectiveness of electrification and hydrogen. In the Economic Presentation, the environmental category has been redacted. Whereas in the Alternatives Presentation, this column is noted as "pending environmental study impact results." This seems to indicate that the criteria analysis in the Alternative Presentation draws from the body of the other studies. It is troubling then that SoCalGas has elected to not provide any further details for the economic analysis for electrification than what has already been filtered into Alternatives Presentation. This again raises questions regarding the validity and transparency with which SoCalGas is performing these preliminary studies. CBE requests that the full and complete economic analysis for electrification be released.

IV. Pipeline Sizing and Design Criteria: Preliminary Data and Findings

The Pipeline Sizing and Design Criteria: Preliminary Data and Findings Presentation ("Design Presentation"), like other presentations provided by SoCalGas provides no data, references or analysis for the findings presented within. Which is particularly concerning because the "pipeline system" shown on slide nine provides an array of not previously identified pipeline routing scenarios that could connect the San Joaquin Valley, Blythe, and Lancaster with 578 miles of pipeline. Further concerning, slide eleven identifies significant storage areas in Utah, Nevada, New Mexico, and Arizona, and despite slide ten stating that "Angeles Link is proposed to be an intrastate system… within Central and Southern California" it goes on to state that these areas were evaluated for "potential future market conditions." CBE strongly believes that in order to avoid perpetuating the impacts of gas infrastructure on environmental justice communities and limit the impacts of infrastructure development, operations and decommissioning, any form of the Angeles Link Project must be limited in size and scope.[10] The Design Presentations conflicting statements regarding the scope of the Angeles Link project raises significant concern regarding the intended scale of the project, and the transparency with which SoCalGas is discussing their intent to expand the project beyond what has been examined in the CPUC Decision.

Further concerning, Footnote 2 on slide 9 states that "Blythe scenarios were not carried through for detailed modeling." Despite Blythe having been named in the Preliminary

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[10] *See* CBE et al., Environmental Justice Position on Green Hydrogen in California, *Equity Principles for Hydrogen*, at 28 (2023).

Routing/Configuration Analysis, Including Right-of-way and Franchise: Preliminary Data and Findings Presentation released on April 14, 2024. CBE requests that SoCalGas clarify why the Lancaster and San Joaquin Valley routes were carried through and the Blythe scenarios were not.

The Design Presentation states that depleted oil and gas fields are promising candidates for local underground hydrogen storage. The use of existing gas infrastructure is deeply concerning to CBE because it poses particular risk to fence line environmental justice communities. CBE firmly believes that hydrogen should not be transported, stored, or blended into existing gas pipelines or storage containers. The Design Presentation makes no indication that the concerns of environmental justice communities near these depleted oil and gas fields have been consulted or considered in the Design study underlying the presentation or elsewhere. It is essential that SoCalGas avoid perpetuating the impacts of gas infrastructure on environmental justice communities. SoCalGas cannot begin to do so until they begin to address how they are considering historic harms of gas infrastructure in project communities and obtain meaningful consent with fence line, impacted communities.

Further, the Design Presentation states that SoCalGas facilities are not currently being considered as storage options for Angeles Link because "they are located within the study area." It is unclear what this means, CBE requests that SoCalGas state clearly what the study indicated concerning SoCalGas facilities based on the confidence in geologic elements adequacy scale used throughout the Design Presentation. Further, CBE requests that more localized maps of the Los Angeles basin be provided. The sole map provided in the Design Presentation shows a geographic area that includes almost the entire length of California, and well into Utah, and Arizona making it difficult to examine the proposed storage options in Southern California where SoCalGas has highlighted potential pipeline routes.

Concerningly, the Design Presentation indicates that "'safety considerations, pressures, and maintenance operations associated with design' are addressed in the Plan for Applicable Safety Requirements." However, the Preliminary Data and Findings: Plan for Applicable Safety Requirements Presentation provided on April 14, 2024 did not indicate any kind of risk analysis, or mention the major safety considerations of leakage, exposure, flammability, explosion, and end-use related health risks.[11] In fact, the Plan for Applicable Safety Requirements Presentation did not mention storage, pipeline sizing, or pipeline siting at all.

As reiterated throughout this letter, and in CBOSG meetings, these presentations and SoCalGas's stakeholder engagement methodologies have raised serious concerns regarding transparency. The vague language regarding stakeholder engagement and actions taken on slide three of the Design Presentation does not address the serious concerns regarding data transparency, and community engagement that have been repeatedly raised by CBE and other community groups.

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[11] *See* CBE Letter Re*: Feedback for Southern California Gas Company on Preliminary Findings Presentations* dated May 3, 2024.

Conclusion

CBE appreciates the opportunity to provide feedback on these matters. However, neither the format nor minimal substantive information allows CBE, or other interested stakeholders, to understand the many necessary studies SoCalGas must undertake if it intends to move forward the Angeles Link project.

Respectfully Submitted.

Lauren Gallagher
Communities for a Better Environment

CC:
Emily Grant, SoCalGas
Chester Britt, Arellano Associates
Alma Marquez, Lee Andrews Group
Angeles Link PAG Service List

From: Andrea Vega
Sent: Tuesday, June 4, 2024 3:18 PM
To: ALP1 Study CBO Feedback
Cc: Emily Grant; Alma Marquez
Subject: Feedback on Angeles Link Project Preliminary Data and Findings - Food & Water Watch

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Hello,

The following is feedback on the preliminary data and findings on project options and alternatives, pipeline sizing and design criteria, and high-level economic analysis and cost effectiveness:

As members of the Community Based Stakeholders Group, we need full, detailed preliminary data and findings reports rather than slidedecks. We look forward to providing feedback on project options and alternatives, pipeline sizing and design criteria, and high-level economic analysis and cost effectiveness once those full reports are available in the Angeles Link Project's Living Library.

Thank you,
Andrea Vega

Andrea Vega
Southern California Senior Organizer
Food & Water Watch and Food & Water Action

Fight like you live here.

June 4, 2024
California Public Utilities Commission (CPUC)
505 Van Ness
Avenue San Francisco, CA 94102

RE: Protect Playa Now Feedback for Angeles Link and CBO Stakeholder Group

To the California Public Utilities Commission (CPUC),

Feedback on Preliminary Findings Presentations

I am providing concise feedback on SoCalGas's preliminary presentations for the Angeles Link project. The presentations lack the detailed data and analysis necessary for stakeholders to give meaningful input. It is quite frankly unprofessional in addition to being irresponsible. This brevity prevents a full understanding of project impacts, especially on disadvantaged communities.

Timeline Concerns: The feedback period is too short, especially with overlapping reports. Please extend deadlines and align with CEQA standards for public comment.

Alternatives: The criteria for evaluating alternatives are not fully disclosed, undermining the legitimacy of the findings. It's crucial to clearly define all criteria to aspire to include environmental justice in the evaluations.

Economic Analysis: The economic impacts, especially on low-income communities, are not addressed. A more thorough analysis comparing all alternatives, including non-hydrogen options, is necessary.

Pipeline Design and Sizing: There's a lack of transparency in the selection and evaluation of pipeline routes and storage. Ensure local community concerns are considered in planning and design to avoid perpetuating past harms.

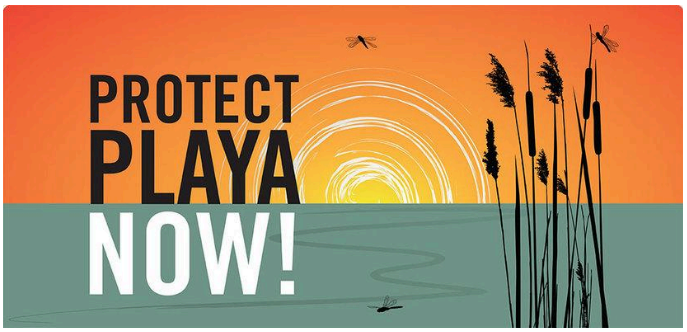
General needs for overall process:

- This process is still failing to include robust engagement with local tribal leaders which directly conflict with the CPUC's emphasis on inclusive stakeholder engagement and the need for consent from tribal communities for projects of this nature.
- Require detailed, independent studies on all aspects of the project.
- Schedule meetings at least 3 months in advance (6 months would be more appropriate) Avoid repetitive opening remarks and public service announcements on unrelated topics to maximize discussion time.
- Survey stakeholders for suitable meeting times to enhance participation.

These steps are crucial for ensuring a transparent, inclusive process that addresses the needs and concerns of all stakeholders.

Sincerely,

Faith Myhra (she/they)
Member
Protect Playa Now
protectplayanow@gmail.com
Writing from the traditional, ancestral, and unceded territory of the Tongva, Kizh, and Chumash People.



COMMUNITIES FOR A BETTER ENVIRONMENT
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June 25, 2024

Southern California Gas Company
555 West Fifth Street,
Los Angeles, CA 90013

Submitted via email to ALP1_Study_PAG_Feedback@insigniaenv.com.

Feedback for Southern California Gas Company on Environmental & Environmental Social Justice Analysis Provided on June 11, 2024

Communities for a Better Environment (CBE) submits this letter of feedback to Southern California Gas Company (SoCalGas) on the Environmental & Environmental Social Justice Analysis: Preliminary Data and Findings presentation (Environmental Presentation).

These comments specifically pertain only to the preliminary findings presented in the abbreviated presentation provided on June 11, 2024. Per SoCalGas's representations at the April 23, 2024 joint PAG and CBOSG meeting, CBE expects that a separate, complete draft of the data, analysis, and findings will be released. This preliminary presentation lacks basic data, let alone the analysis parties need to provide feedback, and these comments cannot and do not comprise the entire scope of feedback from CBE on any of the topics presented. Failing to provide data does not comply with part seven of the CPUC Decision 22-12-055, which requires SoCalGas to "make the data, findings, and results of Phase One feasibility studies…available to the public and not redacted unless SoCalGas is granted confidentiality of data."[1] The CPUC Decision emphasized the importance of stakeholder engagement to identify potential impacts of the project on disadvantaged and environmental justice communities.[2] Meaningful engagement is impossible without the facts on which findings or conclusions are based. To foster meaningful community feedback at the upcoming environmental justice focused July workshops, CBE requests that the Environmental Draft Report, the Environmental Social Justice Plan, and related materials are released at least a week in advance of the July workshop meetings in order to provide sufficient time for review.

As previously raised in CBE's May 3, 2024, and May 21, 2024 feedback letters, in one-on-one meetings with SoCalGas staff, and in stakeholder meetings it is deeply concerning that these preliminary presentations are labeled "data and findings." All the presentations provided thus far contain no data or related analysis to support any findings they may be summarizing. Overall, the presentations are more like public relations materials, which the PUC prohibited SoCalGas from promulgating in this process, than feasibility studies.[3]

[1] CPUC Decision, Order No. 7 pg. 77.
[2] CPUC Decision, pg. 80. See also pg. 58 "Stakeholder engagement, including those from CBOs, ESJ groups, and disadvantaged communities (DAC) groups, are important to the planning process."
[3] CPUC Decision D.22-12-055 (hereinafter CPUC Decision), pg. 38.

CBE also reiterates concerns regarding the timeline for feedback demanded by SoCalGas. During the 9-day feedback period for the Environmental Presentation (accounting for Juneteenth, a federal holiday) there were two concurrent feedback periods for the lengthy Hydrogen Leakage Assessment Draft Report, and Plan for Applicable Safety Requirements Draft Report. This is deeply concerning because these reports require substantial time and effort to review and respond to.

I. Environmental Review Concerns

The lack of data and analysis in the Environmental Presentation precludes us from providing substantive feedback. CBE appreciates that a more substantive CEQA and NEPA environmental review process is planned for later in phase 2 but questions whether this pared down analysis is sufficient to provide a basis for determining if the project should continue.

Further, CBE questions the blanket application of the geographic barrier of one hundred feet on either side of the corridor for all the analyzed topic areas. In particular, the 200-foot corridor is not likely to provide an adequate basis for analysis in the noted topic areas of air quality, greenhouse gas emissions, hydrology, and water quality.

II. Environmental Social Justice

CBE requests that SoCalGas promptly post higher quality, individual PDF files of the ESJ maps provided in the Environmental Presentation. Further, to facilitate meaningful discussion at the July workshops, CBE requests that SoCalGas publish maps that break up the larger map of Southern California into more distinct regions, so that impacted communities along the proposed pipeline can be better identified.

The lack of data and analysis provided to support the purported findings in the Environmental Presentation is unacceptable. For example, slide 22 of the Environmental Presentation, titled “Preliminary Findings Routing and ESJ,” states as a finding that “Angeles Link has the potential to reduce greenhouse gas emissions, improve air quality, create union jobs, grow small and diverse businesses, and generate millions of dollars in community benefits.” No support has been provided for the five distinct and significant findings lauded in this bullet point, and it is concerning that these statements seem to be drawn directly from SoCalGas’ Angeles Link project (ALP) promotional materials. As discussed by CBE and several other parties, any impacts of the ALP in these areas depend heavily on project design, and, in many cases, significant negative impacts are expected. While the ALP has the potential to impact the abovementioned areas, listing potential benefits in a vacuum, without both balancing perspectives and supporting these conclusions with definite evidence is unproductive at best.

III. Commitment to Green Hydrogen

An essential assumption missing from the Environmental Presentation’s environmental and environmental social justice assumptions and introductory analysis is whether and how SoCalGas has committed to supplying green hydrogen.

SoCalGas’s own promotional materials for the project state that the pipeline will exclusively supply green hydrogen to hard-to-electrify sources.[4] However, when pushed to define the extent of SoCalGas’s commitment to transporting only green hydrogen, SoCalGas has outright refused to commit even to compliance

[4] *See* How does it work? Tab on SoCalGas, Angeles Link homepage at https://www.socalgas.com/sustainability/hydrogen/angeles-link

with the "three pillars of hydrogen."[5] In SoCalGas's May 6, 2024 letter to Environmental Justice Partners, SoCalGas states only that "SoCalGas supports clean renewable hydrogen production from non-fossil feedstocks" in compliance with the PUC's memorandum authorization requiring that SoCalGas analyze only the feasibility of hydrogen transport that does not use fossil fuels in its production process. [6] This statement and others made by SoCalGas neither defines, nor commits to limiting transported hydrogen to green hydrogen that is produced by means of electrolysis using surplus water and additional renewable electricity.

As a hydrogen transportation pipeline in this early phase in development of a hydrogen market, the ALP is likely to have a relational impact on production sources, siting, and development. If SoCalGas is truly committed to their vision of green hydrogen and decarbonization in line with the Equity Principles for Hydrogen, SoCalGas must commit to a definition of green hydrogen that constitutes truly green hydrogen. Doing so is an essential part of providing robust and complete feasibility studies. Committing to the role of transportation only does not absolve SoCalGas of the responsibility of clearly rejecting production of hydrogen that contributes to worsening air quality or climate pollution and damages the supply of scarce water resources in already water strapped communities.

IV. Conclusion

CBE appreciates the opportunity to provide feedback on these matters. However, as emphasized in our prior feedback, neither the format nor minimal substantive information provided in the preliminary findings Environmental Presentation allows CBE, or other interested stakeholders, to understand the many necessary studies SoCalGas must undertake if it intends to move the ALP forward.

Respectfully Submitted.

Lauren Gallagher
Theo Caretto
Communities for a Better Environment

CC:
Emily Grant, SoCalGas
Chester Britt, Arellano Associates
Alma Marquez, Lee Andrews Group
Angeles Link PAG Service List

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[5] *See* Rachel Fakhry, New Analysis: The 3 Pillars Will Support Large Hydrogen Deployment, June 20, 2023, NRDC, https://www.nrdc.org/bio/rachel-fakhry/new-analysis-3-pillars-will-support-large-hydrogen-deployment.
[6] Q4 2023 Quarterly Report Appendices, released May 15, 2024, p. 208.

June 26, 2024

Chester Britt
Planning Advisory Group Facilitator

Emily Grant
Angeles Link Senior Public Affairs Representative
Southern California Gas Company

Alisa Lykens
Director
Insignia Environmental

Subject: Environmental Defense Fund and Natural Resources Defense Council Comments on Hydrogen Leakage Assessment Draft Report

Environmental Defense Fund (EDF) and the Natural Resources Defense Council (NRDC) share the following comments to the hydrogen leakage assessment draft report shared by the Southern California Gas Company (SoCalGas) and the Angeles Link Planning Advisory Group Facilitator team.

EDF and NRDC (hereafter, the commenters) note and appreciate SoCalGas' efforts to directly address stakeholder comments and input in the draft report, including those provided by the comments. Leakage risks and impacts will be an important part of assessing the efficacy and appropriateness of the proposed Angeles Link project as a potential decarbonization tool for California. The commenters look forward to providing continued feedback on the issue; and reviewing updates to the greenhouse gas (GHG) studies that account for hydrogen leakage impacts.[1]

Additionally, the commenters highlight that currently there is no discussion of last-mile leakage risks in either the hydrogen leakage draft report or other parallel studies conducted as a part of Angeles Link Project Phase 1. Through SoCalGas representative comments in Planning Advisory Group (PAG) sessions and preliminary study results shared with the PAG members, it

[1] Hydrogen Leakage Assessment Draft Report at 8.

has become clear that SoCalGas expects a significant portion of any hydrogen throughput supplied through a potential Angeles Link pipeline to serve the mobility sector—and heavy-duty vehicle traffic associated with the Ports of Los Angeles and Long Beach in particular. SoCalGas has also acknowledged that meeting such demand will require last-mile delivery of hydrogen beyond the Angeles Link Project, potentially in the form of hydrogen liquefaction and delivery to refueling stations.[2] Each additional step in the hydrogen value chain increases possible points of leakage; particularly, both liquefaction of hydrogen supplied through Angeles Link and the transfer of liquified hydrogen to end users carry significant risks of leakage.[3] SoCalGas states that leakage impacts associated with end users—which would include last-mile delivery—was not incorporated into the draft report because "specific details…was not available" and "end users were considered out of scope".[4] The commenters find this argument inadequate and unconvincing. The end-uses of hydrogen supplied by a potential Angeles Link pipeline provide the justification and need for such a pipeline to be constructed in the first place; they have been described extensively and incorporated into demand studies provided by SoCalGas. End uses of hydrogen cannot be suddenly dismissed as "out-of-scope" when their impacts would raise concerns on the feasibility of a potential Angeles Link pipeline.

EDF's comments on March 28, 2024, highlighted how the lack of consensus figures and details on leakage should not be an excuse for the lack of leakage estimates.[5] In response to such stakeholder comments, SoCalGas has provided high-level preliminary leakage estimates in the draft report.[6] Furthermore, SoCalGas has also provided various other concrete figures related to the potential Angeles Link pipeline such as expected throughput and costs, which have served as the basis for PAG discussions. Therefore, **EDF and NRDC strongly recommend SoCalGas to conduct similar high-level assessments of leakage impacts associated with end-use of hydrogen supplied through a potential Angeles Link pipeline**, including impacts of last-mile delivery for mobility sector use.

[2] Angeles Link PAG Meeting, June 21, 2024.
[3] Esquivel-Elizondo, Sofia, Alejandra Hormaza Mejia, Tianyi Sun, Eriko Shrestha, Steven P. Hamburg and Ilissa B. Ocko, 2023, Wide Range in Estimates of Hydrogen Emissions from Infrastructure, Frontiers in Energy Research Vol. 11: 1207208, https://www.frontiersin.org/articles/10.3389/fenrg.2023.1207208/full.
[4] Hydrogen Leakage Assessment Draft Report at 52.
[5] EDF Comments on GHG Emissions and Leakage Preliminary Reports at 2.
[6] Hydrogen Leakage Assessment Draft Report at 40.

Respectfully,

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COMMUNITIES FOR A BETTER ENVIRONMENT
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June 26, 2024

Southern California Gas Company
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Submitted via email to ALP1_Study_PAG_Feedback@insigniaenv.com

Feedback for Southern California Gas Company on Hydrogen Leakage Assessment Draft Report

Communities for a Better Environment (CBE) submits this letter of feedback to Southern California Gas Company (SoCalGas) on the Hydrogen Leakage Assessment Draft Report (the "Report") provided on May 29, 2024. This letter discusses serious oversights and omissions which distort the Report's conclusions and corrode its value as a feasibility assessment document. CPUC Decision 22-12-055 emphasizes the importance of stakeholder engagement. Meaningful engagement is impossible where key data, studies, and environmental risk are not included in project study documents and information is presented in a misleading manner. Particularly, the Report:

I. Improperly Excludes Leakage from Delivery, End-uses, and Large Leakage Events
II. Draws Unsubstantiated and Misleading Improper Assumptions and Conclusions
III. Draws Unreasonably Favorable Conclusions in the Absence of Adequate Data

I. The Report Improperly Excludes Leakage from Delivery, End-uses, and Large Leakage Events

The study of hydrogen leakage is critical to understanding climate and environmental impacts of the Angeles Link Project (ALP), one of the core requirements of D.22-12-055. Hydrogen is an indirect greenhouse gas; its presence in the atmosphere increases the concentration of climate warming air pollution such as methane and stratospheric water vapor. Several studies, including some cited in the Report explain that quantifying total, "well-to-gate" hydrogen leakage is a prerequisite of understanding hydrogen's climate impacts. At present, the draft Report omits or appears to omit several sources of hydrogen leakage, artificially driving down leakage estimates and undermining the reliability of its results. CBE understands that ALP Phase 1 reports are preliminary in nature, however that does not excuse the lack of data and analysis SoCalGas can and should include. Critically, the Report does not examine leakage from end-uses, fails to clearly examine leakage from delivery or supply of hydrogen (i.e. connection between the ALP terminus and the end-user), and completely excludes large scale leakage events.

The Report's failure to examine hydrogen emissions from delivery and end-use is not excusable. Not only do studies on hydrogen end-use leakage rates exist, but several are cited in the Report. Both Cooper Jasmin, Luke Dubey, Semra Bakkaloglu, Adam Hawkes, as well as Esquivel-Elizondo, Sofia, et al., examine end-uses. In fact, SoCalGas itself is, concurrently with the ALP, studying hydrogen end-uses at California ratepayer expense in the hydrogen blending proceeding (Application 22-09-006). Not only does SoCalGas have data available to examine these emissions, but their existing demand study also cited in the Report breaks down estimated hydrogen demand of the ALP by end-use. Despite this, the Report confusingly states that end-use is "out of scope for this assessment."

The Report also does not address, or even mention, large-scale leakage, such as leakage from catastrophic events or undetected equipment failures. While such events can be difficult to quantify, their public health, and climate impacts cannot be ignored. The Report must, at minimum, look at this risk, identify risk factors and where they fall across a hydrogen infrastructure network.

II. The Report Draws Unsubstantiated and Misleading Improper Assumptions and Conclusions

Feasibility study results must be presented in clear and unambiguous terms to ensure that they are accessible to participants and compliant with D. 22-12-055's prohibition against marketing. To foster meaningful conversations, as SoCalGas has stated is their goal with ALP stakeholder engagement, data examined in reports should be accurately and clearly stated. The Report falls short in this way at several points. Specifically, the Report truncates national methane leakage estimates, relies on data which assumes flaring is 100% efficient in mitigating hydrogen emissions, and mischaracterizes their responsibility to mitigate leakage.

When examining feasibility, it is critical that all parties can examine the data available. Unfortunately, on page 16 the Report, SoCalGas paraphrases another study, which cites a U.S. gas infrastructure methane leakage rate of 2%, rather than the true number in the cited study which is 2.3%.[1] With a range of even higher U.S. estimates, it is misleading to include only a lowest estimate that explicitly omits some sources of leakage.

The Report also severely mischaracterizes the relationship between regulators and SoCalGas.

[1] Alvarez, et al., Science (2018); https://doi.org/10.1126/science.aar7204.

Regulations can impact the potential for leakage via design requirements and mitigation measures. The inclusion of hydrogen pipelines within PHMSA's proposed LDAR regulation may increase the speed at which leaks are detected and repaired, and minimize the total volume of gas leaked, by requiring regular leak detection monitoring and by providing structured requirements around how quickly repairs are required.

While regulations are critical to setting legal minimum safety standards, which can impact leakage, nobody other than SoCalGas is in a better position to undertake safety and leak preventions measures. It is entirely the gas company's responsibility to determine what measures, beyond the legal minimum, are necessary and the negative impacts which stem from lack of action fall on SoCalGas' shoulders.

Ensuring environmental justice involves safeguarding everyone's right to have and access a clean, healthy, and safe environment by taking affirmative steps beyond the bare minimum. Should SoCalGas wish to take environmental justice seriously, it should consider how the toxic legacy of the fossil fuel industry which has and does disproportionately impacted poor communities and communities of color, Los Angeles' history of redlining, and the fossil fuel industry's history of exploiting tribal lands, in addition to public health and safety risks posed by gas infrastructure leakage.

III. The Report Draws Unreasonably Favorable Conclusions in the Absence of Adequate Data

There is no commercially accessible technology for measuring and mitigating hydrogen leakage for many links in the "hydrogen value chain" according to research cited in the Report.[2] This unacknowledged shortcoming leads to a critical lack of direct hydrogen leakage data. The Report's failure to discuss pipeline conditions, leakage data, or lessons learned from the 1600 miles of existing hydrogen pipeline within the country further emphasizes its glaring lack of data. Concerningly, the Report instead relies substantially on non-hydrogen leakage and emissions data and ignores research showing that hydrogen has the potential to leak 1.3-4.6 times more than methane.[3]

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[2] National Petroleum Council, April 2024, "Harnessing Hydrogen: A Key Element of the U.S. Energy Future, Report Summary", https://harnessinghydrogen.npc.org/downloads.php; M. Penchev et al.

[3] Makhijani, Arjun & Hersbach Thom, "Hydrogen: What Good is it? A technical exploration of the potential of hydrogen to contribute to a decarbonized energy system" Institute for Energy and Environmental Research, January 2024, https://ieer.org/wp/wp-content/uploads/2024/06/What-Good-Is-Hydrogen-IEER-report-for-Just-Solutions-January-2024.pdf; National Petroleum Council, April 2024, "Harnessing Hydrogen: A Key Element of the U.S. Energy Future, Chapter 1: Role of Low Carbon Intensity Hydrogen in the United States"; "Hydrogen Blending Impacts Study Final Report", California Public Utilities Commission, Agreement Number 19NS1662, 2022, https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M493/K760/493760600.PDF.

The absence of adequate existing leakage measurement and mitigation technology also throws into doubt the Report's wildly speculative leakage reduction potential figures. These figures, which rely on natural gas as a proxy, do not account for the difference in leakage potential between hydrogen and methane. Further, the analysis does not discuss leakage mitigation cost, availability, or even feasibility of hydrogen specific mitigation technology. The U.S. EPA's new methane leakage rule aims to reduce methane emissions by 30% by 2030 and will cost several billion dollars. Diminishing returns mean that as reductions approach 100% every incremental gain will be costlier and more difficult. In light of this and the Report's lack of supportive data and analysis, it is entirely unclear how SoCalGas came to their conclusions regarding leakage reduction. While it would be reassuring to believe the Report's optimistic outlook for leakage reductions, the figures presented are unsubstantiated, and extraordinarily misleading.

Sincerely,

Theo Caretto
Lauren Gallagher

Communities for a Better Environment

CC:
Emily Grant, SoCalGas
Chester Britt, Arellano Associates
Alma Marquez, Lee Andrews Group
Angeles Link service list

June 26, 2024

Submitted via email to ALP1_Study_PAG_Feedback@insigniaenv.com.

RE: Feedback on Hydrogen Leakage Assessment Draft Report

Food & Water Watch, as part of the Community Based Organization Stakeholder Group (CBOSG), submits this letter of feedback regarding the Hydrogen Leakage Assessment Draft Report for the Angeles Link Project by the Southern California Gas Company (SoCalGas). Concerns relating to the Hydrogen Leakage Assessment Draft Report are as follows:

The Hydrogen Leakage Assessment Draft Report fails to examine leakage from delivery, end-uses, and large leakage events. The report also fails to address safety and leak prevention measures that SoCalGas plans to implement, instead shifting responsibility onto regulators. The report also fails to consider the current lack of accessible technology for measuring and mitigating hydrogen leakage.

Due to these critical factors being omitted in the report, it is questionable as to how SoCalGas came to the conclusions that it did in this report.

Sincerely,

Andrea Vega
Southern California Senior Organizer
Food & Water Watch

Angeles Link Phase 1
Quarterly Report (Q2 2024)
Appendix 3: SoCalGas Response to Comments

TABLE OF CONTENTS

Acronyms and Abbreviations

Acronym/Abbreviation	Definition
ARCHES	Alliance for Clean Renewable Hydrogen Energy System
CAAQS	California Ambient Air Quality Standards
CalGEM	Conservation's Geological Energy Management Division
CARB	California Air Resources Board
CBOSG	Community Based Stakeholder Group
CCS	Carbon Capture and Sequestration
CEC	California Energy Commission
CEQA	California Environmental Quality Act
CPUC	California Public Utilities Commission
D.	Decision
DAC	Disadvantaged Communities
DOE	Department of Energy
EPA	Environmental Protection Agency
ESJ	Environmental Social Justice
GHG	Greenhouse Gas
GWP	Global Warming Potential
H2	Hydrogen
LCOH	Levelized Cost of Hydrogen
LCOE	Levelized Cost of Electricity
LDAR	Leak Detection And Repair
MMTPY	Million Metric Tonnes Per Year
MW	Megawatt
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NOx	Nitrogen Oxide
OSHA	Occupational Safety and Health Administration
PAG	Planning Advisory Group
PHMSA	Pipeline and Hazardous Materials Safety and Administration
ROW	Right-of-Way
SB	Senate Bill
SCAQMD	South Coast Air Quality Management District
TCR	Tribal Cultural Resources
TCO	Total Cost of Ownership
UCD	University of California, Davis
VOC	Volatile Organic Compound

1 Overview

Appendix 3 to the Quarterly Report includes the written comment letters received from the Planning Advisory Group (PAG) and Community Based Stakeholder Group (CBOSG) during the second quarter (April to June) of 2024, and SoCalGas's responses to the comment letters. SoCalGas's responses below address stakeholder feedback based on available information as of the submittal date of this quarterly report, unless otherwise noted. During this time period, there were four distinct groups of comment letters submitted to SoCalGas by PAG and CBOSG members. The grouping of comments is based on the batches of materials released and the corresponding document review period. The first group of comments were on SoCalGas's Preliminary Data and Findings for the following studies: Preliminary Routing/Configuration Analysis, including Right-of-Way [ROW] and Franchise (Routing Analysis), Production Planning & Assessment (Production Study), Plan for Applicable Safety Requirements (Safety Study), Workforce Planning & Training Evaluation (Workforce Study), and High-Level Feasibility Assessment & Permitting Analysis (Permitting Analysis). The second group of comments were on SoCalGas's Preliminary Data and Findings for the following studies: Pipeline Sizing & Design Criteria (Design Study), Project Options and Alternatives (Alternatives Study), and High-Level Economic Analysis & Cost Effectiveness (Cost Effectiveness Study). The third group of comments were provided on SoCalGas's Preliminary Data and Findings for Environmental Analysis & the Environmental Social Justice (ESJ) Analysis (renamed to ESJ Screening and subsequently broken out from the Environmental Analysis as explained further herein). The last group of comments were provided on SoCalGas's draft Hydrogen Leakage Assessment (Leakage Study).

Table 1: Index of Comment Letters Received During Q2 2024

Comment Letter	Date of Letter	Commenter	Response No.
Preliminary Data and Findings (Routing Analysis, Production Study, Safety Study, Workforce Study, and Permitting Analysis) (Comment Period April 17 – May 3, 2024)			
1	May 3	Air Products	1-1 to 1-11
2	May 3	Cal Advocates	2-1 to 2-13
3	May 3	Communities for a Better Environment	3-1 to 3-11
4	May 3	Food and Water Watch	4-1 to 4-3
5	May 1	Protect Playa Now	5-1 to 5-8
Preliminary Data and Findings (Design Study, Alternatives Study, and Cost Effectiveness Study) (Comment Period May 21 – June 4, 2024)			
6	May 30	Green Hydrogen Coalition	6-1 to 6-5
7	June 4	Cal Advocates	7-1 to 7-9
8	June 4	Communities for a Better Environment	8-1 to 8-15
9	June 4	Food and Water Watch	9-1
10	June 4	Protect Playa Now	10-1 to 10-4
Preliminary Data and Findings (Environmental Analysis & the ESJ Screening) (Comment Period June 11 – June 25, 2024)			
11	June 25	Communities for a Better Environment	11-1 to 11-5

Comment Letter	Date of Letter	Commenter	Response No.
Draft Study (Leakage Study) (Comment Period May 29 – June 26, 2024)			
12	June 26	Environmental Defense Fund and Natural Resources Defense Council	12-1 to 12-2
13	June 26	Communities for a Better Environment	13-1 to 13-9
14	June 26	Food and Water Watch	14-1

All written comment letters from PAG and CBOSG members have been assigned a number to facilitate identification and tracking (see Table 1). These comment letters were reviewed and divided into individual comments, based on themes, issues, and concerns. Individual comments and the responses to them were assigned corresponding numbers (e.g., 1-1, 1-2, etc.). To aid readers and commenters, electronically bracketed comments have been applied to this document, with the corresponding responses provided immediately following the comments.

Global responses were prepared to address similar issues that were raised in multiple comment letters. These responses are provided below. These include:

Global Response 1 – Stakeholder Engagement Process

Global Response 2 – Hydrogen Leakage

1.1 Global Response 1 – Stakeholder Engagement Process

SoCalGas is appreciative of the opportunity to collaborate with PAG and CBOSG members and the California Public Utilities Commission (CPUC)'s Energy Division to create a meaningful stakeholder engagement process for both SoCalGas and the PAG and CBOSG members.

Some PAG and CBOSG members have expressed concerns about the stakeholder engagement process to date. For example, some PAG and CBOSG members stated in comment letters that SoCalGas did not include sufficient details or analysis in its preliminary findings. During this reporting period, SoCalGas provided key preliminary findings in a summary format with a two-week feedback window. The preliminary findings were intended to convey the key takeaways that were emerging in preparation of the draft reports with the understanding that more detailed analysis and assumptions would be provided in the full draft reports when they became available. The summary format in the preliminary findings also addressed the different needs of differing stakeholders, some of whom requested high-level summaries.[1] After presenting the preliminary findings and receiving input at PAG and CBOSG meetings,[2] SoCalGas released the full draft reports with a four-week feedback window for each Phase 1 feasibility study. The full draft reports provide the details and assumptions supporting the analysis in each feasibility study.

Some PAG and CBOSG members generally stated that SoCalGas did not provide adequate time for comments. SoCalGas acknowledges that a lot of information has been provided to the PAG and CBOSG members, including through the preliminary findings during this reporting period and through the more detailed draft reports released in this reporting period and in Q3. However, no PAG or CBOSG stakeholders requested additional time for feedback for the preliminary findings or draft reports released in Q2. SoCalGas also staggered the release of information whenever possible aiming to complete Phase 1 in a 12-18 month period, as SoCalGas's Phase 1 application stated that the process would be completed in that timeframe and is working diligently to comply with its deliverables on time and on budget. Given the volume of material analyzed in Phase 1, SoCalGas solicited feedback on the feasibility studies as they were being completed, including in separate milestones on the scopes of work, technical approaches, preliminary findings, and draft reports. For review of the draft studies, SoCalGas also attempted to bundle the release of similar studies so PAG and CBOSG members had relevant information at the same time for studies that may be interdependent or related. To further facilitate review, the draft studies also provide an executive summary, key findings relevant to the CPUC's expectations for Phase 1, and a summary of stakeholder comment integration. Some draft studies also include a section summarizing future considerations related to those studies, where applicable.

Some PAG and CBOSG members also commented that SoCalGas should provide more evidence on how stakeholder feedback is being incorporated into the studies. Each draft feasibility study includes a summary section summarizing the key stakeholder feedback related to that study along with an explanation of how the feedback was incorporated into the study. In addition, the responses to comments attached to the quarterly reports explain where stakeholder feedback will be incorporated into the reports, where applicable. SoCalGas intends for the final Phase 1 feasibility reports to include a summary of the key stakeholder comments received on the draft reports and summaries explaining how those comments were addressed in the final studies, as applicable.

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[1] PAG and CBOSG members had opportunities to provide feedback on two other milestones for the feasibility studies as they developed, including on the scopes of work and technical approach summaries for each study provided earlier in Phase 1. SoCalGas set forth a process at the initiation of Phase 1 activities to provide key milestones including 1) scope of work; 2) technical approach; 3) preliminary findings; and 4) draft report.

[2] Meeting transcripts are included as attachments and posted to the Living Library.

Some PAG and CBOSG commenters also stated that certain materials presented included promotional language. SoCalGas recognizes the distinction outlined in Decision D.22-12-055 between permissible stakeholder engagement activities and prohibited promotional work from being recorded to the Angeles Link Memorandum Account. SoCalGas's interactions with PAG and CBOSG members, including material provided, staff involvement, and contractor engagement, are focused on enhancing stakeholder engagement. SoCalGas reviews all materials through the lens and intent of providing fact-based information free of promotional language and appreciates when PAG and CBOSG members highlight if they think SoCalGas is not maintaining that lens.

In response to PAG and CBOSG comments suggesting general concerns about the stakeholder feedback process, SoCalGas will continue to provide and enhance an iterative and transparent stakeholder engagement process that is both structured and nimble. The PAG and CBOSG were kicked-off in March 2023. Since then, SoCalGas has routinely amended its process based on feedback from participants. A summary of the current engagement efforts, including some changes made in response to specific feedback, is summarized below:

- **Accessible Meetings:** PAG and CBOSG meetings include in-person and virtual attendance options. Additionally, agendas and select meeting materials are provided at least one week in advance, if possible.

- **Inclusive Participation:** SoCalGas took stakeholders' suggestions on PAG and CBOSG participation, and subsequently invited additional organizations into the process. Membership requirements for the CBOSG were also modified based on participants' feedback.

- **Comprehensive Library**: SoCalGas created a "Living Library" to host documents, which, as of the submittal date of this Q2 Angeles Link quarterly report, includes more than 200 informational materials (e.g., preliminary data and findings, draft reports, presentations, meeting recordings, meeting transcripts from the PAG and CBOSG quarterly meetings and workshops, PAG and CBOSG rosters, and comment letters. This library is available to all PAG and CBOSG participants.

- **Publicly Posted Quarterly Reports:** All court reporter transcripts and meeting recordings of the PAG and CBOSG quarterly meetings and workshops, as well as the presentation materials from those meetings and comment letters received, are provided in the Angeles Link Quarterly Reports, posted on the SoCalGas Angeles Link website.

- **Meeting Workshops:** Added interim workshops and one-on-one meetings per the stakeholders' request to receive presentations and information on more studies.

- **Responsive Presentations:** Reprioritized presentations for the CBOSG to focus less on technical aspects, and more on CBOSG priorities of safety, cost, workforce, health, and environmental justice/environmental social justice.

- **Predictable Schedule:** SoCalGas created a deadline matrix attached to each email to PAG and CBOSG members, which communicated process steps and deadlines for feedback.

SoCalGas will continue to focus on transparency, for example, by:

- Summarizing key stakeholder feedback in respective study presentations, as well as providing full comment letters and responses to individual comments in each quarterly report, posted on the SoCalGas Angeles Link website and "Living Library".

- Addressing stakeholder feedback in quarterly meetings and workshops. Court reporter transcripts and meeting recordings of the PAG and CBOSG quarterly meetings and workshops can be found in the "Living Library" and Angeles Link quarterly reports.

- Providing materials in different formats depending on the level of detail stakeholders requested (e.g., preliminary findings decks, including executive summaries in detailed studies, providing full draft reports with appendices/workpapers where applicable, etc.).

- All 65 comments letters were posted to the "Living Library" within days of the respective feedback deadlines.

- Stakeholders requested SoCalGas open the PAG and CBOSG groups statewide at two points in time (March 2023 and March 2024), especially as preferred route options were being defined. SoCalGas accommodated this request each time, opening the PAG and CBOSG membership to groups statewide outside of SoCalGas's service territory to include specific groups identified by certain PAG and CBOSG members.

1.2 Global Response 2 – Hydrogen Leakage

Some commenters stated a concern about lack of detail in the Hydrogen Leakage Assessment – Draft Report (Leakage Study) which was issued for stakeholder review in May 2024. Specifically, some commenters expressed a concern about 1) lack of detailed information; 2) not including an estimate of potential leakage at end users; 3) potential leakage associated with last mile delivery; and 4) potential for leakage associated with a large leakage event. The following paragraphs provide a high-level response to these comments.

Pursuant to the CPUC's Phase 1 Decision, SoCalGas is assessing the risks and mitigations for potential hydrogen leakage associated with Angeles Link.[3] The Leakage Study examines the possibility of hydrogen leakage related to new hydrogen infrastructure, such as clean renewable hydrogen transmission and compression, as well as third-party production and third-party storage. The Leakage Study also explores opportunities to minimize the potential for hydrogen leakage (see Leakage Study, Section 4.4 Opportunities to Minimize Leakage).

The Hydrogen Leakage Assessment focused on estimating potential leakage from hydrogen infrastructure (third-party production, third-party storage, compression, and transmission). Where specific information related to leakage of hydrogen was not available, estimates based on availability of related data, such as correlations to natural gas, or documented assumptions were developed by the scientific studies that were reviewed in the literature. Local air districts, California Air Resources Board (CARB), and the U.S. Environmental Protection Agency (EPA) have primarily focused on minimizing natural gas leakage for storage and transmission including compression. For example, the CARB Oil & Gas Rule[4] has stringent leak detection and repair (LDAR) requirements for natural gas storage fields and transmission compressor stations.

Lack of Detailed Information

Comments received on the Leakage Study noted the lack of available detailed information about leakage. The Leakage Study has summarized the limited information that is available, as highlighted by the following articles. As an article referenced by one stakeholder, entitled *Wide Range in Estimates of Hydrogen Emissions from Infrastructure*,[5] states "It is virtually unknown how much H_2 is emitted intentionally and unintentionally from hydrogen systems since, to date, these emissions have not been measured, mainly because the instrumentation to measure H_2 emissions at low-level concentrations has been lacking." The article goes on to state: "Over the past two decades, several studies have attempted to estimate total value chain and component-level H2 emissions to assess the risk of large-scale hydrogen use on the climate." The article explains that "estimation methods are heavily dependent on assumptions, calculations via proxies, laboratory experiments, or theoretically based models or simulations." The article concludes that "more robust data is required to have confidence in the H2 emissions rates for each value chain or its components."

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3 D.22-12-055, Ordering Paragraph (OP) 6(g).

4 CARB, 2024, California Code of Regulations, Title 17, Division 3, Chapter 1, Subchapter 10 Climate Change, Article 4, Subarticle 13: Greenhouse Gas Emission Standards for Crude Oil and Natural Gas Facilities, https://ww2.arb.ca.gov/resources/documents/oil-and-gas-regulation

5 Esquivel-Elizondo, Sofia, Alejandra Hormaza Mejia, Tianyi Sun, Eriko Shrestha, Steven P. Hamburg and Ilissa B. Ocko, 2023, Wide Range in Estimates of Hydrogen Emissions from Infrastructure, Frontiers in Energy Research Vol. 11: 1207208, https://www.frontiersin.org/articles/10.3389/fenrg.2023.1207208/full

Another article mentioned in stakeholders' comments, entitled, *Hydrogen emissions from the hydrogen value chain-emissions profile and impact to global warming,*[6] concludes that if hydrogen is used and traded the way natural gas is, then hydrogen emissions are considerably smaller in comparison. The article states that this is because "H2 has a significantly smaller global warming potential (GWP), and a higher mass energy density meaning a smaller mass needs to be transferred for the same end use and any emissions that do occur have a lesser effect."

End Users

Given the feasibility stage of Phase 1, the Leakage Study focused on the information available at the time the Leakage Study was released to assess new hydrogen infrastructure. While requested by stakeholders, additional information would be required to expand the scope of the Leakage Study beyond assessing the risks and mitigations for hydrogen leakage infrastructure as set forth in the CPUC's Phase 1 Decision. Specifically, information related to projected hydrogen leakage rates for each sub-sector within the three primary sectors of potential end-users (mobility, power generation, and hard-to-electrify industrial) would be required to evaluate potential leakage associated with end users. The Phase 1 analysis was conducted using a top-down approach, at a high level, rather than at a granular facility level and equipment specific level.

In terms of end users, for the mobility sector, the sub-sectors evaluated in the Greenhouse Gas (GHG) Emissions Evaluation (GHG Study)[7] and the draft Nitrogen Oxide (NOx) and other Air Emissions Assessment (NOx Study)[8] were heavy-duty vehicles, medium-duty vehicles, buses, agriculture, commercial harbor craft, cargo handling equipment, ground support equipment, and construction and mining equipment. The GHG and NOx emissions calculations focused on the GHG and NOx emissions reductions associated with the displacement of diesel and gasoline fuel with hydrogen fuel cells.

With respect to the power generation sector, the sub-sectors evaluated in the draft GHG Study[9] and the draft NOx Study[10] were peaker and baseload and cogeneration. For the hard-to-electrify industrial sector, the sub-sectors evaluated in the draft GHG Study[11] and the draft NOx Study[12] were refineries, food & beverage, metals, stone/glass/cement, paper, aerospace & defense, and chemicals. Local air districts such as South Coast Air Quality Management District (South Coast AQMD) have requirements regarding leakage from fugitive components for specific industries such as petroleum facilities, marine terminals, and chemical plants;[13] and fugitive emissions from petroleum facilities;[14] and fugitive emissions from above ground organic liquid storage tanks.[15] However, these requirements are specific

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[6] Cooper, Jasmin, Luke Dubey, Semra Bakkaloglu, Adam Hawkes, 2022, Hydrogen Emissions from the Hydrogen Value Chain - Emissions Profile and Impact to Global Warming, Science of the Total Environment Vol. 380: 154624, July 15, https://www.sciencedirect.com/science/article/pii/S004896972201717X#s0070

[7] GHG Emissions Evaluation - Draft Report, Sections 5.2.1 and 7.2.1

[8] Draft NOx Study, Sections 7.3.1 and 8.3.1

[9] Draft GHG Study, Sections 5.2.2 and 7.2.2

[10] Draft NOx Study, Sections 7.3.2 and 8.3.2

[11] Draft GHG Study, Sections 5.2.3 and 7.2.3

[12] Draft NOx Study, Sections 7.3.3 and 8.3.3

[13] South Coast AQMD, 2009, Rule 1173, "Control of Volatile Organic Compound Leaks and Releases from Components at Petroleum Facilities and Chemical Plants," https://www.aqmd.gov/docs/default-source/rule-book/reg-xi/rule-1173.pdf?sfvrsn=4

[14] South Coast AQMD, 2023, Rule 1178 "Further Reductions of VOC Emissions from Storage Tanks at Petroleum Facilities," https://www.aqmd.gov/docs/default-source/rule-book/reg-xi/rule-1178.pdf?sfvrsn=4

[15] South Coast AQMD, 2024, Rule 463 "Organic Liquid Storage." https://www.aqmd.gov/docs/default-source/rule-book/rule-iv/rule-463.pdf?sfvrsn=4

to control of volatile organic compound (VOC) leaks for light and heavy liquids and releases rather than hydrogen which does not contain VOCs.

SoCalGas welcomes specific information regarding end user leakage data sources and estimation methodologies from stakeholders for consideration during Phase 2 of Angeles Link.

Last Mile Delivery

Potential leakage associated with last mile delivery was not analyzed in the Leakage Study or any of the Phase 1 studies; that analysis may be included in future phases of Angeles Link.

Large Leakage Event

The projected volume of a theoretical hydrogen release related to a force majeure event would be speculative.[16] Given that it is not possible to predict the extent of a potential force majeure event, potential leakage for an extraordinary event (i.e., "large leakage event") is not included in the scope of the Leakage Study. The potential risk in terms of the likelihood for such an event to occur at third-party production vs. third-party storage vs. transmission is unknown. Potential considerations regarding the transportation of hydrogen by pipeline as well as potential risk management are addressed in the Safety Study.[17] The Safety Study demonstrates that Angeles Link can be safely designed, constructed, operated, and maintained in accordance with existing regulations and industry standards and best practices pertaining to hydrogen; adapting corollary safety regulations and industry standards and best practices to suit the specific properties and characteristics of hydrogen; and developing new standards and practices specific to the transport of hydrogen.

[16] Force majeure refers to an extraordinary unforeseeable and unavoidable catastrophe such as the result of an unusually severe or unexpected weather event.

[17] Plan for Applicable Safety Requirements - Draft Report, Sections 6 and 8.

2 Stakeholder Comment Letters

2.1 Comment Letter 1 – Air Products

Comment Letter 1

Air Products and Chemicals, Inc.
1940 Air Products Blvd.
Allentown, PA 18106-5500
www.airproducts.com

May 3, 2024

VIA EMAIL TO
ALP1_PAG_FEEDBACK@INSIGNIAENV.COM

Emily Grant
Angeles Link Senior Public Affairs Manager
Southern California Gas Company
555 West Fifth Street
Los Angeles, CA 90013

Re: Angeles Link Planning Advisory Group (PAG) Feedback of Air Products and Chemicals Inc. on the Preliminary Routing/Configuration, Franchise, and Right-of-Way Analyses; Production Planning & Assessment; and Plan for Applicable Safety Requirements

Air Products and Chemicals, Inc. ("Air Products") submits the following feedback concerning the Preliminary Findings of three of the five Angeles Link technical studies that were made available on April 11: Preliminary Routing/Configuration, Franchise and Right-of-Way Analyses; Production Planning and Assessment, and Plan for Applicable Safety Requirements.

Air Products expects that the below feedback will be addressed in the final Studies and in Southern California Gas Company's (SoCalGas) quarterly reporting. Air Products also welcomes any response that SoCalGas may wish to provide to the comments below.

General Comments

Comment 01-01

Air Products continues to have concerns about the lack of substance in the materials that Southern California Gas Company (SoCalGas) is presenting for the Phase 1 studies. The Preliminary Findings released on April 11 contain little of substance and defer many of the details to future phases of study. The lack of detail prevents meaningful review and input on the Phase 1 studies by members of the Angeles Link Planning Advisory Group and will limit the value of the final Phase 1 studies. Though titled "Preliminary Data and Findings," the information consists of simple slide decks that range from six to sixteen slides, with at least half of the slides consisting of an introduction and other non-substantive material. There was even less substance presented on these important subjects than the five previously released preliminary findings reports.

Comments on Specific Preliminary Findings

Air Products provides the following feedback on the Preliminary Routing/Configuration, Franchise and Right-of-Way Analyses, Production Planning and Assessment, and Plan for Applicable Safety Requirements.

<u>Preliminary Routing/Configuration, Franchise, and Right-of-Way Analyses</u>

Air Products provides the following feedback on the April 2024 Preliminary Routing/Configuration Analysis, Including Right-of-Way and Franchise: Preliminary Data and Findings (Routing Analysis).

Comment 01-02

Though the Routing Analysis (p. 5) claims that the Analysis considered the ARCHES Initiatives, much of what is under development by the private sector for new hydrogen infrastructure does not align with the Link studies and proposed utility hydrogen pipelines, nor do the Link studies overlap with ARCHES published plans. The Link mapping proposal with routes from the Pacific Ocean to the eastern state border are designed to track the existing SoCalGas rights of way for current gas transmission and distribution lines, and not necessarily drawn to compliment or supplement long-term future potential delivery needs. Instead, the Link preferred routes appear to duplicate or compete with existing dedicated pipelines that have been in service for decades and have been identified for expansion in ARCHES and with end users in the Los Angeles basin. While some of the ARCHES production is generally shown along with end uses in the mapping and preferred routing for the Link, the preliminary findings slide deck did not make clear that some of these hydrogen consumers are already being serviced by existing hydrogen service providers with plans in place for buttressing existing hydrogen pipeline use and truck transport to support new users in the Los Angeles, Long Beach port complex and surrounding industrial areas. The Link PAG materials that map multiple pipeline segments into the Los Angeles coastal areas and weave throughout the California desert leave the PAG participants to assume that the SoCalGas Link is included in the ARCHES framework, when in fact it appears from public ARCHES documents and brief treatment during the presentation that only two small portions of the proposed Link have been identified as pipelines that may be located in the San Joaquin Valley and near Lancaster for longer-term potential development.

The ARCHES systems analysis on the other hand identifies production, end uses, and delivery points developed by a variety of ARCHES partners that will be the underpinning framework to support hydrogen market lift-off in California. There are more than 400 hydrogen entities in ARCHES working together to plan near term infrastructure investments to advance renewable hydrogen supply and delivery. The ARCHES systems plan is a living document borne out of a public-private partnership, supported by industry and academia, including the University of California Office of the President and Lawrence Livermore Labs. The United States Department of Energy recognized the ARCHES collective effort as one of the more advanced national hubs with more than 30 Tier 1 project proponents working diligently to finalize the $1.2 billion

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statewide award. These ARCHES partners include entities who have decades of hydrogen experience, who are actively advancing their projects, including new supply, new fueling stations, expanding existing dedicated hydrogen pipelines and hydrogen delivery fleets to serve new users statewide, including the Long Beach - Los Angeles port complex and regional industrial users including new electric sector users. The new green renewable hydrogen supply, new fueling (stationary and mobile) capability for maritime, ports, industrial and power needs are in various stages of development and permitting – well ahead of the timeline envisioned for the Link and SoCalGas' current process to move from studying and learning how hydrogen markets and systems work to requesting authority to transition to a hydrogen utility. Comment 01-02

Air Products recommends that SoCalGas' withdraw the proposal to advance more than 400 miles of proposed hydrogen pipelines and limit review to the small segments referenced in the ARCHES framework, as 1) none of the proposed Link is needed in the near-term for hydrogen market lift-off, 2) SoCalGas studies released to date have flaws showing a lack of technical understanding and 3) the studies do not result in a demonstrated need for such a significant ratepayer investment in a major new hydrogen pipeline system. Comment 01-03

<u>Production Planning and Assessment</u>

Air Products provides the following feedback on the April 2024 Production Planning & Assessment: Preliminary Data and Findings (Production Planning).

The Production Planning analysis assumes that approximately 240,000 acres will be needed to support the assumed throughput volume of 1.5 MMTPY, which is approximately 11% of the land identified as suitable for solar generation in the three production areas. On what data is SoCalGas relying upon in developing these assumptions and estimates? And does the land usage requirement include all land needed for power production and hydrogen production, or solely for the required solar panels? Comment 01-04

While the 11% statistic makes this seem feasible, it should be noted that 240,000 acres is about 2/3rds the size of Los Angeles. Even if subdivided into three separate locations as proposed, this is a substantial amount of land. To enable better public understanding, the final report should provide a comparison to the largest solar farms that exist in California today and discuss what competition exists for this land relative to grid connected solar projects for SB 100 compliance or other uses. Comment 01-05

The Production Planning assessment also makes no reference to battery energy storage systems. Do the space requirements account for energy storage needs, or are the electrolyzers assumed to only run intermittently based upon solar production? What utilization rates have been assumed for the electrolyzers and has this utilization been factored into the number of electrolyzers and solar needed, both of which factor into the acreage requirements? Comment 01-06

The assessment also references the importance of hydrogen storage—do the acreage estimates include the land needed for aboveground hydrogen storage? For example, a working storage Comment 01-07

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capacity of 0.125 MMT, the smallest estimate provided, would require approximately 360 of the largest proven spherical tanks (5,000 m3) for liquid hydrogen manufactured today. Are space requirements for tanks and related piping/liquefaction facilities included in the acreage estimates? If it is assumed to be underground storage, what storage locations have been evaluated for suitability? Aside from land requirements at the production sites, what land is needed for liquefaction and/or purification for end uses at customer sites? **Comment 01-07**

The preliminary findings state that there will be no grid connection which further increases intermittency, production equipment cycling, which ultimately impacts reliability. The final report should detail what measures will be taken to ensure reliable supply of hydrogen to the proposed pipeline given this constraint. **Comment 01-08**

Lastly, there is no discussion of the purity requirements (pipeline specification) for the 3rd-party produced hydrogen. Given the diverse set of end uses, including fuel cells, a tight purity specification would be required. This specification will dictate the types of production equipment required and a thorough discussion of this should be included in the final report. **Comment 01-09**

Plan for Applicable Safety Requirements

Air Products provides the following feedback on the April 2024 Preliminary Data and Findings: Plan for Applicable Safety Requirements (Safety Plans).

The preliminary Safety Plan references the fact that odorization is feasible and features this as a safety measure to ensure detection of hydrogen leaks. To what extent has SoCalGas evaluated whether proposed end uses can tolerate odorants? For example, fuel cell applications require very high purity hydrogen. As mentioned above, the Safety Plan Study should set forth the purity specification that SoCalGas intends to maintain for production into the pipeline and explain how the purity required for each end user will be maintained if odorization is to be used for safety. **Comment 01-10**

In addition, more details on what types of odorants are being contemplated and confirmation that there are no adverse reactions with either the hydrogen or the piping component materials needs to be provided in the final report. Lastly, the final report should include a discussion of the efficacy of various odorants given the more rapid diffusion of hydrogen relative to the odorant. It is possible that in a leak situation, the hydrogen diffuses faster than the odorant and could create a hazardous condition in an area before the odorant is detected. **Comment 01-11**

Conclusion

Air Products appreciates the opportunity to provide this feedback concerning the Preliminary Routing/Configuration, Franchise and Right-of-Way Analyses; Production Planning and Assessment, and Plan for Applicable Safety Requirements.

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Respectfully,

Miles Heller Director, Global Greenhouse Gas,
Hydrogen, and Utility Regulatory Policy

AIR PRODUCTS COMMENT 1-1

Air Products continues to have concerns about the lack of substance in the materials that Southern California Gas Company (SoCalGas) is presenting for the Phase 1 studies. The Preliminary Findings released on April 11 contain little of substance and defer many of the details to future phases of study. The lack of detail prevents meaningful review and input on the Phase 1 studies by members of the Angeles Link Planning Advisory Group and will limit the value of the final Phase 1 studies. Though titled "Preliminary Data and Findings," the information consists of simple slide decks that range from six to sixteen slides, with at least half of the slides consisting of an introduction and other non-substantive material. There was even less substance presented on these important subjects than the five previously released preliminary findings reports.

SOCALGAS RESPONSE TO COMMENT 1-1

As of the date of this submittal, all of the draft studies with additional detail have been submitted for PAG and CBOSG review. As an example, stakeholders requested additional information on greenhouse gas emissions related to water conveyance. The Water Resources Evaluation (WRE) incorporated a supplemental chapter to address at a desktop level GHGs from water conveyance. Please also refer to Global Response 1.

AIR PRODUCTS COMMENT 1-2

Though the Routing Analysis (p. 5) claims that the Analysis considered the ARCHES Initiatives, much of what is under development by the private sector for new hydrogen infrastructure does not align with the Link studies and proposed utility hydrogen pipelines, nor do the Link studies overlap with ARCHES published plans. The Link mapping proposal with routes from the Pacific Ocean to the eastern state border are designed to track the existing SoCalGas rights of way for current gas transmission and distribution lines, and not necessarily drawn to compliment or supplement long-term future potential delivery needs. Instead, the Link preferred routes appear to duplicate or compete with existing dedicated pipelines that have been in service for decades and have been identified for expansion in ARCHES and with end users in the Los Angeles basin. While some of the ARCHES production is generally shown along with end uses in the mapping and preferred routing for the Link, the preliminary findings slide deck did not make clear that some of these hydrogen consumers are already being serviced by existing hydrogen service providers with plans in place for buttressing existing hydrogen pipeline use and truck transport to support new users in the Los Angeles, Long Beach port complex and surrounding industrial areas. The Link PAG materials that map multiple pipeline segments into the Los Angeles coastal areas and weave throughout the California desert leave the PAG participants to assume that the SoCalGas Link is included in the ARCHES framework, when in fact it appears from public ARCHES documents and brief treatment during the presentation that only two small portions of the proposed Link have been identified as pipelines that may be located in the San Joaquin Valley and near Lancaster for longer-term potential development.

The ARCHES systems analysis on the other hand identifies production, end uses, and delivery points developed by a variety of ARCHES partners that will be the underpinning framework to support hydrogen market lift-off in California. There are more than 400 hydrogen entities in ARCHES working together to plan near term infrastructure investments to advance renewable hydrogen supply and delivery. The ARCHES systems plan is a living document borne out of a public-private partnership, supported by industry and academia, including the University of California Office of the President and Lawrence Livermore Labs. The United States Department of Energy recognized the ARCHES collective effort as one of the more advanced national hubs with more than 30 Tier 1 project proponents working diligently to finalize the $1.2 billion statewide award. These ARCHES partners include entities who have decades of hydrogen experience, who are actively advancing their projects, including new supply, new fueling stations, expanding existing dedicated hydrogen pipelines and hydrogen delivery fleets to serve new users statewide, including the Long Beach - Los Angeles port complex and regional industrial users including new electric sector users. The new green renewable hydrogen supply, new fueling (stationary and mobile) capability for maritime, ports, industrial and power needs are in various stages of development and permitting – well ahead of the timeline envisioned for the Link and SoCalGas' current process to move from studying and learning how hydrogen markets and systems work to requesting authority to transition to a hydrogen utility.

SOCALGAS RESPONSE TO COMMENT 1-2

SoCalGas joined the Alliance for Clean Renewable Hydrogen Energy Systems (ARCHES), a California's public-private partnership, in October 2022 and was included in the proposal under ARCHES application to the Department of Energy (DOE) for federal funding of a clean hydrogen hub. In October 2023, the DOE announced it will award California up to $1.2 billion for the development and construction of the clean hydrogen hub. On July 17, 2024, ARCHES and the DOE announced the signing of a formal $12.6 billion cooperative agreement, including up to $1.2 billion of cost share from the DOE and $11.4 billion in public and private matching funds, to build and expand clean energy infrastructure across California.

As indicated by ARCHES, this investment, which will directly reduce California's reliance on fossil fuels, marks a major step forward in the state's efforts to achieve a carbon-neutral economy by 2045 and follows California's selection last October as one of seven awardees of the DOE's Regional Clean Hydrogen Hubs (H2Hubs)–catalyzing a national network of clean hydrogen producers, consumers, and connective infrastructure.

Angeles Link includes two pipeline segments (one 80-mile segment located in San Joaquin Valley and one 45-mile segment from Lancaster to LA Basin), that are part of this California H2Hub. Angeles Link aims to help meet the State's need for at-scale, open access pipeline transport system dedicated to public use connecting multiple sources of clean renewable hydrogen supply with all potential end-users in Central and Southern California, inclusive of but not limited to the ARCHES segments. As envisioned, Angeles Link could support the integration of more renewable electricity resources like solar and wind and could significantly reduce greenhouse gas emissions from electric generation, industrial processes, heavy-duty trucks, and other hard-to-electrify sectors of the Central and Southern California economy. In the near term, portions of Angeles Link (e.g., ARCHES segments) would provide necessary connections to help launch California's hydrogen economy, and the broader Angeles Link project will help scale to support expected demand, promote the transport of clean renewable hydrogen to end users, and leverage expansion of H2Hub as hydrogen is adopted more widely.

As California navigates the energy transition, building a clean renewable hydrogen energy pipeline system would allow SoCalGas to deliver a new source of reliable and clean energy to customers, and it would help California achieve its clean energy and climate goals.

Contrary to Air Products' assertions, available information does not indicate that Angeles Link is duplicative, as Angeles Link is intended to serve anticipated short- and longer-term needs for open access, non-discriminatory pipeline transportation of clean renewable hydrogen. Air Products' comments are opaque and lack detailed information. Without that detail, these assertions cannot be evaluated by SoCalGas or the PAG.

AIR PRODUCTS COMMENT 1-3

Air Products recommends that SoCalGas' withdraw the proposal to advance more than 400 miles of proposed hydrogen pipelines and limit review to the small segments referenced in the ARCHES framework, as 1) none of the proposed Link is needed in the near-term for hydrogen market lift-off, 2) SoCalGas studies released to date have flaws showing a lack of technical understanding, and 3) the studies do not result in a demonstrated need for such a significant ratepayer investment in a major new hydrogen pipeline system.

SOCALGAS RESPONSE TO COMMENT 1-3

Please refer to Response to Comment 1-2.

Angeles Link presents an opportunity to move hydrogen at-scale between the geographical areas where it will be produced to the areas of most concentrated demand. As supported by the findings of various Phase 1 feasibility studies, it is critical that the ARCHES segments be developed in conjunction with the broader Angeles Link from both a design and operational perspective, not only for resource efficiency but to realize the delivery of large quantities of clean renewable hydrogen to places in Central and Southern California, such as the Los Angeles Basin.

As the Demand Study illustrates, there is a demonstrated need for investment in Angeles Link. As detailed in the Demand Study, in its service territory, SoCalGas projects potential demand for 1.9 million (M) tonnes per year (TPY) of hydrogen by 2045 in its conservative scenario, 3.2M TPY in the moderate scenario, and 5.9M TPY in the ambitious scenario. This conservative to ambitious range of potential demand scenarios is similar to an April 2024 report from the National Petroleum Council, which estimated that nationwide demand for low carbon intensity hydrogen could increase by anywhere from 100% to upwards of 550% by 2050 depending on policy scenario (projected increase from 11M metric tons to 21M metric tons under a "stated policies scenario" and from 11M to 75M metric tons under a Net Zero by 2050 scenario).[18]

Demand for hydrogen in SoCalGas's service territory is projected to come from a wide range of end uses across the mobility, power generation, and industrials sectors. For example, in the Los Angeles Basin, the Los Angeles City Council recently approved the conversion of two units at an existing Los Angeles Department of Water and Power (LADWP) generating station from natural gas plants to hydrogen-ready plants. LADWP is currently planning similar conversions at other gas plants in light of its goal to achieve 100% carbon-free generation by 2035. The CARB 2022 Scoping Plan also forecasts that roughly 9 GW of incremental hydrogen capacity will be needed as an electricity resource in California by 2045 to meet the state's climate goals. Additionally, California's legislative and regulatory measures focused on decarbonization in the mobility sector could significantly accelerate the adoption of hydrogen fuel cell and battery technologies. SoCalGas's analysis shows potential demand in the mobility sector ranging from 1M TPY in the conservative scenario to 1.7M TPY in the ambitious scenario by 2045. The vast majority of this mobility sector demand is driven by on-road applications, which is particularly significant given that SoCalGas's service territory includes the dense population center around Los Angeles, which contains roughly 50% of the state's population.

[18] Accessible at: harnessinghydrogen.npc.org/files/H2-CH_5-Demand_Drivers-2024-04-30.pdf; The Working Draft Report Summary states, "This is a working document solely for the review and use of the members of the National Petroleum Council and participants of this study. Data, conclusions, and recommendations contained herein are preliminary and subject to substantive change. The text and graphics are subject to final editing. This draft material has not been considered by the National Petroleum Council and is not a report nor advice of the Council" (harnessinghydrogen.npc.org/files/H2-Preface-Executive_Summary-2024-04-23.pdf).

AIR PRODUCTS COMMENT 1-4

The Production Planning analysis assumes that approximately 240,000 acres will be needed to support the assumed throughput volume of 1.5 MMTPY, which is approximately 11% of the land identified as suitable for solar generation in the three production areas. On what data is SoCalGas relying upon in developing these assumptions and estimates? And does the land usage requirement include all land needed for power production and hydrogen production, or solely for the required solar panels?

SOCALGAS RESPONSE TO COMMENT 1-4

The study relied on ArcGIS software to identify potential land available for hydrogen production. The data, assumptions, and estimates are described in the draft Production Planning & Assessment (Production Study), in the following sections:

- Section 9.3 discusses hydrogen facility scope assumptions, including land area required for the hydrogen production and solar facility (estimated at 6 acres per megawatt (MW) of solar output).
- Section 10.2 and 10.3 discusses the land assessment methodology.

In response to the second question, the land requirement estimates assume all land needed for both power production (solar power) and hydrogen production (electrolyzer).

AIR PRODUCTS COMMENT 1-5

While the 11% statistic makes this seem feasible, it should be noted that 240,000 acres is about 2/3rds the size of Los Angeles. Even if subdivided into three separate locations as proposed, this is a substantial amount of land. To enable better public understanding, the final report should provide a comparison to the largest solar farms that exist in California today and discuss what competition exists for this land relative to grid connected solar projects for SB 100 compliance or other uses.

SOCALGAS RESPONSE TO COMMENT 1-5

Please refer to the draft Production Study, Appendix A - Renewable Energy Technology Assessment for Hydrogen Production, subsection A.6 Renewable Power – CA Market Assessment, Tables 13.2, 13.5, and 13.6, which provides additional details considering the feedback provided, including known renewable projects such as solar, average project sizes, maximum project sizes, as well as potential future projects proposed and/or under development in SoCalGas's service territory. This information served as a reference to better understand the California market for renewable power as well as certain characteristics such as the scalability of different technologies.

AIR PRODUCTS COMMENT 1-6

The draft Production Study also makes no reference to battery energy storage systems. Do the space requirements account for energy storage needs, or are the electrolyzers assumed to only run intermittently based upon solar production? What utilization rates have been assumed for the electrolyzers and has this utilization been factored into the number of electrolyzers and solar needed, both of which factor into the acreage requirements?

SOCALGAS RESPONSE TO COMMENT 1-6

Please refer to the draft Production Study, Section 9 for a discussion of the hydrogen production facility design basis, including assumptions on storage (i.e., no storage is assumed at the production site), electrolyzer utilization rates (i.e., hydrogen facility utilization rate of 36%), solar requirements, and land requirements. In addition, Section 6 provides analysis to assess the potential impact on hydrogen production if the production facility includes battery electric storage systems.

AIR PRODUCTS COMMENT 1-7

The assessment also references the importance of hydrogen storage—do the acreage estimates include the land needed for aboveground hydrogen storage? For example, a working storage capacity of 0.125 MMT, the smallest estimate provided, would require approximately 360 of the largest proven spherical tanks (5,000 m3) for liquid hydrogen manufactured today. Are space requirements for tanks and related piping/liquefaction facilities included in the acreage estimates? If it is assumed to be underground storage, what storage locations have been evaluated for suitability? Aside from land requirements at the production sites, what land is needed for liquefaction and/or purification for end uses at customer sites?

SOCALGAS RESPONSE TO COMMENT 1-7

See Response to Comment 1-6 related to land assumptions for third-party hydrogen production facilities. In addition, the draft Production Study Section 8 and Appendices B & C include details on potential third party underground storage options. Land requirements for storage, liquefaction, and purification at end use sites were not in the scope of this Phase 1 Production Study. However, land requirements for some ancillary facilities are discussed in the draft Alternatives Study. As noted in Section 4.5.1 of the draft Design Study, while storage is not currently part of Angeles Link and was excluded from the hydraulic analysis, connections to potential storage locations in Lancaster, San Joaquin Valley and Blythe were modeled to evaluate potential pipeline requirements and to develop cost estimates.

AIR PRODUCTS COMMENT 1-8

The preliminary findings state that there will be no grid connection which further increases intermittency, production equipment cycling, which ultimately impacts reliability. The final report should detail what measures will be taken to ensure reliable supply of hydrogen to the proposed pipeline given this constraint.

SOCALGAS RESPONSE TO COMMENT 1-8

The draft Production Study clarifies that “no grid connection” refers to high voltage transmission lines that could be used by the electrolyzer to produce hydrogen. No transmission grid connection for the hydrogen production facilities in the draft Production Study is assumed in order to conservatively estimate potential production costs; however, if a production facility were connected to the grid and curtailed renewables or grid power is used by producers in the future, that could increase the amount of production on a potentially smaller amount of land as well as support reliability. For reliability purposes, the Production Study assumes a utility power feed is required to support minimum power needs to enable startup and shutdown of the electrolyzer as described in Section 9.2.8 Auxiliary Electrical Supply.

AIR PRODUCTS COMMENT 1-9

Lastly, there is no discussion of the purity requirements (pipeline specification) for the 3rd-party produced hydrogen. Given the diverse set of end uses, including fuel cells, a tight purity specification would be required. This specification will dictate the types of production equipment required and a thorough discussion of this should be included in the final report.

SOCALGAS RESPONSE TO COMMENT 1-9

Please refer to Section 4.3.1 Electrolyzer Technology Comparison Table in the draft Production Study, which compares various electrolyzer technologies and the expected hydrogen purity and other operating characteristics for different electrolyzer technologies. Additionally, refer to Section 9 for the expected purity at the third-party production facility assumed for evaluation in the design basis. Section 3.4 of the draft Design Study indicates the gas composition, or purity level, of hydrogen assumed for hydraulic modeling purposes.

AIR PRODUCTS COMMENT 1-10

The preliminary Safety Plan references the fact that odorization is feasible and features this as a safety measure to ensure detection of hydrogen leaks. To what extent has SoCalGas evaluated whether proposed end uses can tolerate odorants? For example, fuel cell applications require very high purity hydrogen. As mentioned above, the Safety Plan Study should set forth the purity specification that SoCalGas intends to maintain for production into the pipeline and explain how the purity required for each end user will be maintained if odorization is to be used for safety.

SOCALGAS RESPONSE TO COMMENT 1-10

Odorant is one of the potential mechanisms to help safely manage hydrogen operations. Odorization of gas is a practice common in the natural gas industry but is not currently used today in the transportation of hydrogen. The hydrogen industry recognizes the challenges to odorizing hydrogen such as the negative effects of contaminants in various end-use processes (i.e., hydrogen fuel cells). However, there continues to be research testing and identifying potential odorants that can be used in various hydrogen applications, as well as technology to scrub odorant from hydrogen before it is used in end use applications. In addition, other safety mechanisms and methods are leveraged during design and operation to incorporate safety, such as installing hydrogen compatible materials, monitoring, application of leak detection technologies, and increased survey frequency. Please refer to Section 8.0: Specifications, Standards & Procedures Evaluation: Potential for Future Odorization in the draft Safety Study for additional information regarding odorants and certain end uses. For the purposes of modeling, a gas composition of pure hydrogen (100%) was assumed for the hydraulic analysis in the draft Design Study. Setting purity specifications and requirements of each potential end user is outside the scope of Phase 1 and not addressed in the draft Safety Study. SoCalGas will continue to evaluate options for odorant and as noted in the Safety Study, “the criteria in §192.625(b) will determine the requirements for odorization.”

AIR PRODUCTS COMMENT 1-11

In addition, more details on what types of odorants are being contemplated and confirmation that there are no adverse reactions with either the hydrogen or the piping component materials needs to be provided in the final report. Lastly, the final report should include a discussion of the efficacy of various odorants given the more rapid diffusion of hydrogen relative to the odorant. It is possible that in a leak situation, the hydrogen diffuses faster than the odorant and could create a hazardous condition in an area before the odorant is detected.

Conclusion - Air Products appreciates the opportunity to provide this feedback concerning the Preliminary Routing/Configuration, Franchise and Right-of-Way Analyses; Production Planning and Assessment, and Plan for Applicable Safety Requirements.

SOCALGAS RESPONSE TO COMMENT 1-11

Please refer to Response to Comment 1-10. Please refer to section 8.0 Potential for Future Odorization in the draft Safety Study for the efficacy of odorants that have been researched and tested for use in hydrogen applications. One such study, conducted by DNV GL in 2022 for Stedin and Gaz Reseau Distribution France (GRDF) (DNV GL 2022), identified three sulfur free odorants and their suitability for hydrogen in the gas grid. Due to the disadvantages of using THT in hydrogen such as for fuel cell systems, alternative sulfur-free odorants were investigated for hydrogen distribution. The odorant 2-hexyne was found not to have an adverse effect on the performance of fuel cells and was able to maintain stability in hydrogen, therefore appeared suitable for use as a sulfur-free odorant in hydrogen.

2.2 Comment Letter 2 – Public Advocates Office

Comment Letter 2

The Public ADVOCATES OFFICE

May 3, 2024

Informal Comments of the Public Advocates Office on Southern California Gas Company's Preliminary Routing/Configuration Analysis Findings and Preliminary Production Planning Findings for the Angeles Link Hydrogen Project

Comment 02-01

The Public Advocates Office at the California Public Utilities Commission (Cal Advocates) provides these comments on Southern California Gas Company's (SoCalGas) *Angeles Link Preliminary Production Planning Findings and Preliminary Routing/Configuration Analysis Finding* issued in April11, 2024.

The following comments are intended to provide direction on how the draft studies can be more informative for stakeholders and satisfy the intent of the Commission's decision. Currently the draft studies lack the detailed analysis needed for stakeholders to provide appropriate detailed analysis.

Preliminary Production Planning Findings

Comment 02-02

The Future Draft Production Study Should Clearly Describe and Analyze the Roles of Storage and Curtailed Renewable Generation.

The preliminary production findings indicate that curtailed renewable energy and storage also provide opportunities for hydrogen production, but the preliminary production findings do not provide any detailed or supporting information. The preliminary production findings only note that if production facilities are connected to the grid, "the curtailed renewable energy is expected to be used opportunistically to produce hydrogen."[1] However, that expectation is belied by the parenthetical comments which note that the Angeles Link design case is not considering production facilities connected to the grid. Even if production facilities are connected to the grid, it is not clear that grid energy can meet any of the definitions of green hydrogen. The preliminary production findings go on to claim that third-party storage "will play an important role to balance hydrogen supply with demand."[2] But there is no information about the type of third-party storage, the amount needed, the expected demand profiles, or how curtailment may impact storage needs. Essentially, as currently presented, the curtailment and storage claims are vague and contradictory. The draft production study should present

[1] Preliminary Production Findings at slide 6.
[2] Preliminary Production Findings at slide 6.

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scenarios that clearly describe and analyze the respective roles of both storage and curtailed generation from the grid. Comment 02-02

Consultations with the Counties of the San Joaquin Valley, California Energy Commission, and Bureau of Land Management are Necessary to Establish the Feasibility of Siting 240,000 acres of Solar Dedicated to Hydrogen.

The preliminary production findings identify the need for at least 240,000 acres of solar photovoltaics[3] (which equates to between 35-40 GW of generation capacity) to be identified, developed, and dedicated to hydrogen production in the regions of Blythe, Lancaster, and the San Joaquin Valley.[4] The preliminary findings lack critical information on the underlying definitions and assumptions, which makes it difficult to assess the feasibility of developing 240,000 acres.[5] Regardless, the feasibility assessment for siting 35-40 GW of solar in the San Joaquin Valley and the Mojave Desert must be based on the application of existing permitting authority, the regional tolerance for solar development, and existing land use management plans. Comment 02-03

Permitting authority for the lands in question are primarily vested in the counties in these regions, the California Energy Commission (CEC), and the Bureau of Land Management (BLM). There are several different possible permitting strategies for developers that can involve varying combinations of local, county, state, and federal authorities. While some counties such as Kings County[6] are likely to regard solar development positively, others may not. By way of example, San Bernardino County placed a moratorium on development of solar in 2013, which was renewed in 2019.[7] Subsequently, as an alternative to the county permitting route, authority to permit solar PV was granted to the CEC by AB 205 in 2022.[8] Because of the varying tolerance for development, permitting strategies of developers will vary. It will be essential to consult with both the counties and the CEC to fully assess the feasibility of further solar development in both the Lancaster area and the San Joaquin Valley. Comment 02-04

Similarly, the primary land manager for most of the land suitable for solar development near Blythe is BLM. BLM issued a Land Use Plan Amendment (LUPA) adopting the Desert Renewable Energy Conservation Plan (DRECP) in 2016.[9] The LUPA identifies 148,000 acres in Riverside County within which solar generation development is eligible for a streamlined permitting process.[10,11] This does not, however, mean that all 148,000 Comment 02-05

[3] Preliminary Production Findings at slide 6.
[4] Preliminary Production Findings at slide 6.
[5] Preliminary Production Findings at slide 6.
[6] CalMatters - *Wrangling over renewables: Counties push back on Newsom administration usurping local control*. Accessed April 26, 2024, https://calmatters.org/environment/2022/08/renewable-energy-california-counties/
[7] Los Angeles Times - *California's San Bernardino County slams the brakes on big solar projects* February 28, 2019. Accessed April26, 2024, https://www.latimes.com/business/la-fi-san-bernardino-solar-renewable-energy-20190228-story.html
[8] Public Resource Code Sec. 25545.
[9] DRECP LUPA Record of Decision. September 2016.
Accessed: April 26, 2024, https://eplanning.blm.gov/eplanning-ui/project/66459/570
[10] Desert Renewable Conservation Plan Land Use Plan Amendment at 56.
Accessed April 26, 2024, https://eplanning.blm.gov/public_projects/lup/66459/133474/163144/DRECP_BLM_LUPA.pdf
[11] DRECP LUPA at 59.

acres can be developed.[12] The DRECP Environmental Impact Statement preferred alternative states that up to 38,000 acres of permanent disturbance is anticipated from solar projects (equivalent to about 6 GW).[13] To fully demonstrate the feasibility of developing solar dedicated to hydrogen production, it will be important to understand a) how much development has already been undertaken, and b) the implications of exceeding the levels of disturbance analyzed in the EIS. It is essential to understand whether exceeding these disturbance levels would be beyond the scope of the LUPA, and whether exceeding the scope would render any development infeasible. Comment 02-05

The preliminary production analysis does not indicate whether consultation with permitting agencies and land use managers has been undertaken to assess the fundamental feasibility of putting solar facilities in the areas identified. Ultimately, the production study needs to identify whether there are any legal or land use policy limitations that would impact production and in turn inform the size and location of a transmission pipeline. Comment 02-06

Preliminary Routing/Configuration Analysis Findings

Hydrogen Pipeline Corridors must be broad enough to enable significant variation from existing transmission pipeline routes.

SoCalGas states that it would evaluate "pipeline corridors or rights-of-way, other known existing rights-of-way, franchise rights, designated federal energy corridors or rights-of-way, and the need for new rights-of-way."[14] SoCalGas has an extensive network of rights of way and easements throughout its territory, which are necessary to serve its customers. However, the preliminary findings present a range of pipeline corridors that appear to be mostly identical to existing gas transmission pipelines.[15] Comment 02-07

The focus on existing transmission lines means that the proposed corridors may be overly narrowed and are prematurely limiting alternative routes. In some locations the corridor is limited to a single option. For example, routing from the San Joaquim Valley south to central Los Angeles is limited to a single alternative adjacent to I5 freeway.

Routing is complex and the Commission has, in the past, modified proposed routes following community consultation; the Sunrise Power Link is a classic example of this scenario.[16] For a corridor to demonstrate that it is feasible it must be broad enough to enable the Commission to analyze potential alternatives that safely minimize impacts to communities, avoid environmental impacts, and serve future off-takers. This means that a corridor needs to be broad enough to support multiple variations on routes between suppliers and off-takers. Comment 02-08

[12] DRECP Proposed LUPA and Final EIS at II.3-4 Table II.3-1 fn4. Accessed April 26, 2024, https://eplanning.blm.gov/public_projects/lup/66459/20012404/250016892/II.3_Preferred_Alternative.pdf
[13] DRECP Proposed LUPA and Final EIS at II.3-82 Table II.3-5.
[14] Preliminary Routing Findings at slide 2.
[15] Preliminary Routing Findings at slide 8.
[16] Sunrise Powerlink Accessed: April 26, 2024, https://files.cpuc.ca.gov/Environment/info/aspen/sunrise/sunrise.htm

Narrow corridors run the risk of missing communities that may be impacted by routing decisions later in the siting and permitting process. Failure to engage all potentially impacted communities could result in an unforeseen and potentially inequitable siting decision that could delay the pipeline or lead to permit denial. Outreach reach by SoCalGas should be undertaken to the broadest range of communities that could be impacted by a pipeline from the earliest feasible moment. **Comment 02-09**

SoCalGas should identify corridors that provide latitude to modify the pipeline routes and demonstrate that SoCalGas is systematically considering all potential corridors.[17] Therefore, the routing study should: a) identify all corridors that have been considered; b) demonstrate that multiple routes are feasible with a given corridor; c) clearly rank the suitability of corridors; and d) provide a clear explanation of the factors driving the ranking. **Comment 02-10**

Conclusion

In summary, understanding and analyzing the roles of storage, and curtailed energy, will be essential in assessing the quantity of renewable generation that has to be dedicated to hydrogen production, which will influence the locations that can be developed and ultimately the production side location for any future pipeline. As such, the draft production study should clearly analyze the anticipated role and potential availability of both storage and curtailed energy in each production region. **Comment 02-11**

Furthermore, the distribution of feasible solar development needed for hydrogen production will be vital when ranking the likely sequence of potential corridors for pipeline development. To demonstrate where 240,000 acres of solar can feasibly be permitted, it is essential that SoCalGas consults with the primary land use permitting authorities, to understand what development is already being undertaken and the limits in existing land use plans. **Comment 02-12**

Finally, transmission corridors from the most eligible production locations must be broad enough to allow the Commission the ability to modify the routes without resulting in impacts to communities that have not been part of SoCalGas outreach. Overley narrow corridors, may result in late notification and inclusion of communities in the siting process, which makes siting harder and can result unnecessary delays. To ensure that the corridor is fit for purpose, multiple possible routes within each proposed corridor should be identified in the draft routing study. **Comment 02-13**

[17] Preliminary Routing Findings at slide 2.

CAL ADVOCATES COMMENT 2-1

The Public Advocates Office at the California Public Utilities Commission (Cal Advocates) provides these comments on Southern California Gas Company's (SoCalGas) Angeles Link Preliminary Production Planning Findings and Preliminary Routing/Configuration Analysis Finding issued in April 11, 2024.

The following comments are intended to provide direction on how the draft studies can be more informative for stakeholders and satisfy the intent of the Commission's decision. Currently the draft studies lack the detailed analysis needed for stakeholders to provide appropriate detailed analysis.

SOCALGAS RESPONSE TO COMMENT 2-1

As of the date of this submittal, all of the draft studies with additional detail have been submitted for PAG and CBOSG review. Please also refer to Global Response 1.

CAL ADVOCATES COMMENT 2-2

The Future Draft Production Study Should Clearly Describe and Analyze the Roles of Storage and Curtailed Renewable Generation. The preliminary production findings indicate that curtailed renewable energy and storage also provide opportunities for hydrogen production, but the preliminary production findings do not provide any detailed or supporting information. The preliminary production findings only note that if production facilities are connected to the grid, "the curtailed renewable energy is expected to be used opportunistically to produce hydrogen."FN1 However, that expectation is belied by the parenthetical comments which note that the Angeles Link design case is not considering production facilities connected to the grid. Even if production facilities are connected to the grid, it is not clear that grid energy can meet any of the definitions of green hydrogen. The preliminary production findings go on to claim that third-party storage "will play an important role to balance hydrogen supply with demand."FN2 But there is no information about the type of third-party storage, the amount needed, the expected demand profiles, or how curtailment may impact storage needs. Essentially, as currently presented, the curtailment and storage claims are vague and contradictory. The draft production study should present scenarios that clearly describe and analyze the respective roles of both storage and curtailed generation from the grid.

FN1 and FN2 – Preliminary Production Findings at slide 6.

SOCALGAS RESPONSE TO COMMENT 2-2

Please refer to additional details that are provided in the draft Production Study on the potential role of curtailed energy from the grid and storage. Specifically:

- Appendix A - Renewable Energy Technology Assessment for Hydrogen Production, subsection A.8 Renewable Curtailments, and
- Section 8 and Appendix B & C provide an evaluation of potential third-party hydrogen storage, including an assessment of the interplay between storage and two potential production configurations in 2045.

CAL ADVOCATES COMMENT 2-3

Consultations with the Counties of the San Joaquin Valley, California Energy Commission, and Bureau of Land Management are Necessary to Establish the Feasibility of Siting 240,000 acres of Solar Dedicated to Hydrogen. The preliminary production findings identify the need for at least 240,000 acres of solar photovoltaics FN3 (which equates to between 35-40 GW of generation capacity) to be identified, developed, and dedicated to hydrogen production in the regions of Blythe, Lancaster, and the San Joaquin Valley. FN4 The preliminary findings lack critical information on the underlying definitions and assumptions, which makes it difficult to assess the feasibility of developing 240,000 acres. FN5 Regardless, the feasibility assessment for siting 35-40 GW of solar in the San Joaquin Valley and the Mojave Desert must be based on the application of existing permitting authority, the regional tolerance for solar development, and existing land use management plans.

FN 3, FN4 and FN5 – Preliminary Production Findings at slide 6.

SOCALGAS RESPONSE TO COMMENT 2-3

Please refer to the response to Comment 1-4 for more details on the methodology and assumptions included in the identification of potential locations that may be developed by third-party producers considering resource availability (i.e., strength of solar and land availability).

Certain land use considerations such as the location of national and state parks, government refuges, preserves, and military ranges as well as setbacks from culturally and environmentally sensitive areas are considered (refer to Section 10.2 Land Assessment Methodology of the draft Production Study). As local and state jurisdictions assess paths to reach their decarbonization goals, SoCalGas expects that third-party producers would perform these types of assessments considering the unique parameters of their production projects. As a result, consultations with Counties and other agencies such as the Bureau of Land Management was considered out of scope of this draft Production Study.

CAL ADVOCATES COMMENT 2-4

Permitting authority for the lands in question are primarily vested in the counties in these regions, the California Energy Commission (CEC), and the Bureau of Land Management (BLM). There are several different possible permitting strategies for developers that can involve varying combinations of local, county, state, and federal authorities. While some counties such as Kings County FN6 are likely to regard solar development positively, others may not. By way of example, San Bernardino County placed a moratorium on development of solar in 2013, which was renewed in 2019. FN7 Subsequently, as an alternative to the county permitting route, authority to permit solar PV was granted to the CEC by AB 205 in 2022. FN8 Because of the varying tolerance for development, permitting strategies of developers will vary. It will be essential to consult with both the counties and the CEC to fully assess the feasibility of further solar development in both the Lancaster area and the San Joaquin Valley.

FN 6 – CalMatters - Wrangling over renewables: Counties push back on Newsom administration usurping local control. Accessed April 26, 2024, https://calmatters.org/environment/2022/08/renewable-energy-california-counties/
FN 7 – Los Angeles Times - California's San Bernardino County slams the brakes on big solar projects February 28, 2019. Accessed April 26, 2024, https://www.latimes.com/business/la-fi-san-bernardino-solar-renewable-energy-20190228story.html
FN 8 – Public Resource Code Sec. 25545.

SOCALGAS RESPONSE TO COMMENT 2-4

Please refer to response to Comment 2-3.

CAL ADVOCATES COMMENT 2-5

Similarly, the primary land manager for most of the land suitable for solar development near Blythe is BLM. BLM issued a Land Use Plan Amendment (LUPA) adopting the Desert Renewable Energy Conservation Plan (DRECP) in 2016. FN9 The LUPA identifies 148,000 acres in Riverside County within which solar generation development is eligible for a streamlined permitting process. FN10, FN11 This does not, however, mean that all 148,000 acres can be developed. FN12 The DRECP Environmental Impact Statement preferred alternative states that up to 38,000 acres of permanent disturbance is anticipated from solar projects (equivalent to about 6 GW). FN13 To fully demonstrate the feasibility of developing solar dedicated to hydrogen production, it will be important to understand a) how much development has already been undertaken, and b) the implications of exceeding the levels of disturbance analyzed in the EIS. It is essential to understand whether exceeding these disturbance levels would be beyond the scope of the LUPA, and whether exceeding the scope would render any development infeasible.

FN 9 – DRECP LUPA Record of Decision. September 2016. Accessed: April 26, 2024, https://eplanning.blm.gov/eplanning-ui/project/66459/570
FN 10 – Desert Renewable Conservation Plan Land Use Plan Amendment at 56. Accessed April 26, 2024, https://eplanning.blm.gov/public_projects/lup/66459/133474/163144/DRECP_BLM_LUPA.pdf
FN 11 – DRECP LUPA at 59.
FN 12 – DRECP Proposed LUPA and Final EIS at II.3-4 Table II.3-1 fn4. Accessed April 26, 2024, https://eplanning.blm.gov/public_projects/lup/66459/20012404/250016892/II.3_Preferred_Alternative.pdf
FN 13 – DRECP Proposed LUPA and Final EIS at II.3-82 Table II.3-5.

SOCALGAS RESPONSE TO COMMENT 2-5

Please refer to response to Comments 1-5 and 2-3 for information regarding development that has already been undertaken and land use considerations. The production locations will be one consideration for the preferred route of Angeles Link, which will be determined in a future phase.

CAL ADVOCATES COMMENT 2-6

The preliminary production analysis does not indicate whether consultation with permitting agencies and land use managers has been undertaken to assess the fundamental feasibility of putting solar facilities in the areas identified. Ultimately, the production study needs to identify whether there are any legal or land use policy limitations that would impact production and in turn inform the size and location of a transmission pipeline.

SOCALGAS RESPONSE TO COMMENT 2-6

Please refer to responses to Comments 2-3. The draft Production Study Section 10.2 describes the land use considerations performed as part of our Phase 1 feasibility study. Direct outreach to permitting agencies and land use managers to further assess the potential legal or land use policy limitations is expected to be performed by third-party producers and was outside the scope of the Production Study.

CAL ADVOCATES COMMENT 2-7

Hydrogen Pipeline Corridors must be broad enough to enable significant variation from existing transmission pipeline routes. SoCalGas states that it would evaluate “pipeline corridors or rights-of-way, other known existing rights-of-way, franchise rights, designated federal energy corridors or rights-of-way, and the need for new rights-of-way.” FN14 SoCalGas has an extensive network of rights of way and easements throughout its territory, which are necessary to serve its customers. However, the preliminary findings present a range of pipeline corridors that appear to be mostly identical to existing gas transmission pipelines. FN15

The focus on existing transmission lines means that the proposed corridors may be overly narrowed and are prematurely limiting alternative routes. In some locations the corridor is limited to a single option. For example, routing from the San Joaquim Valley south to central Los Angeles is limited to a single alternative adjacent to I-5 freeway.

FN 14 – Preliminary Routing Findings at slide 2.
FN 15 – Preliminary Routing Findings at slide 8.

SOCALGAS RESPONSE TO COMMENT 2-7

The draft Routing Analysis evaluated existing pipeline corridors and ROWs and identified four potential preferred routes and one variation (Route Variation 1), which may reduce route mileage through communities considered to be disadvantaged. The further evaluation and street-level alignment for each potential preferred route in future phases will consider factors, including engineering factors of whether the pipelines could be feasibly constructed in designated corridors. In addition, alternative route alignments will be considered, including those that may be outside of existing pipeline corridors to account for geographical, social, and environmental considerations. Pipeline routing will be refined throughout Phase 2 following an iterative engineering process. Preferred routes identified within the draft Routing Analysis are relatively high-level and may look like bold lines on a map. In Phase 2, during pre-FEED, SoCalGas will identify a preferred system route, and refine the routing to identify the potential specific alignments where the pipeline and related facilities may be located. During FEED, the pipeline route will be further refined to identify the pipeline and facilities placement within that alignment within tens of feet. See Section 6.1 of the draft Routing Analysis.

Please refer to the following sections of the draft Routing Analysis for information in response to this comment, including:

- Section 1.1 – Analysis Overview
- Section 3.3.3 – Configuration Narrowed
- Section 3.3.4 – Preferred Routes Identified
- Section 6.1 – Route Optimization

CAL ADVOCATES COMMENT 2-8

Routing is complex and the Commission has, in the past, modified proposed routes following community consultation; the Sunrise Power Link is a classic example of this scenario. FN16 For a corridor to demonstrate that it is feasible it must be broad enough to enable the Commission to analyze potential alternatives that safely minimize impacts to communities, avoid environmental impacts, and serve future off-takers. This means that a corridor needs to be broad enough to support multiple variations on routes between suppliers and off-takers.

FN 16 – Sunrise Powerlink Accessed: April 26, 2024,
https://files.cpuc.ca.gov/Environment/info/aspen/sunrise/sunrise.htm

SOCALGAS RESPONSE TO COMMENT 2-8

To clarify, corridor examination in the Phase 1 Routing Analysis, includes consideration of pathways that may contain existing or future rights-of-way that have been identified for preliminary evaluation for hydrogen gas transmission lines. Consistent with these overarching elements and the purpose and need set forth for Angeles Link, future analysis would consider the following factors to further optimize the Angeles Link preferred pipeline route and execute refinement through efficient use of resources and to minimize potential community and environmental impacts and serve future off-takers. The following factors would be incorporated in the proposed routing criteria utilized to evaluate route variations and ultimately to further refine a preferred route in Phase 2.

- Follow generally accepted principles for siting infrastructure.
- Avoid unnecessary impacts to the disadvantaged communities (DAC) and the environment, where feasible.
- Allow for safe and efficient construction and testing activities.
- Provide all-weather accessibility for operations, maintenance, and emergency response.
- Meet current and near-term energy needs

Please also refer to Section 6.1 of the draft Routing Analysis.

CAL ADVOCATES COMMENT 2-9

Narrow corridors run the risk of missing communities that may be impacted by routing decisions later in the siting and permitting process. Failure to engage all potentially impacted communities could result in an unforeseen and potentially inequitable siting decision that could delay the pipeline or lead to permit denial. Outreach by SoCalGas should be undertaken to the broadest range of communities that could be impacted by a pipeline from the earliest feasible moment.

SOCALGAS RESPONSE TO COMMENT 2-9

See Response to Comment 2-7 and 2-8.

Pipeline routes and alignment will be further refined in subsequent phases. Broader stakeholder and community input along potential routes would be solicited during Phase 2 and would be considered when making alignment decisions. Please refer to Section 1.1 of the draft Routing Analysis.

Decision (D.) 22-12-055 limited Phase 1 stakeholder engagement that could be recorded to the memorandum account to PAG and CBOSG activities only. SoCalGas intends to conduct additional and more targeted community engagement in Phase 2 as well as implement its draft Environmental and Social Justice Community Engagement Plan (ESJ Plan). The ESJ Plan aims to actively involve ESJ communities, collaborate with them, gather their input, and provide them with the information they need to empower them to be active contributors to the project.

CAL ADVOCATES COMMENT 2-10

SoCalGas should identify corridors that provide latitude to modify the pipeline routes and demonstrate that SoCalGas is systematically considering all potential corridors. FN17 Therefore, the routing study should: a) identify all corridors that have been considered; b) demonstrate that multiple routes are feasible with a given corridor; c) clearly rank the suitability of corridors; and d) provide a clear explanation of the factors driving the ranking.

FN 17 – Preliminary Routing Findings at slide 2.

SOCALGAS RESPONSE TO COMMENT 2-10

Chapter 2 of the draft Routing Analysis outlines the various agency data sets which were leveraged to develop initial corridors considered and evaluated within the Phase 1 feasibility studies. See Section 2.1 and Section 2.3.1 within the draft Routing Analysis. Additionally, see Section 6.3 for discussion on future weighted ranking evaluation.

Alignment and route optimization, including new variations, will be conducted in Phase 2. See also response to Comments 2-7 and 2-8.

CAL ADVOCATES COMMENT 2-11

In summary, understanding and analyzing the roles of storage, and curtailed energy, will be essential in assessing the quantity of renewable generation that has to be dedicated to hydrogen production, which will influence the locations that can be developed and ultimately the production side location for any future pipeline. As such, the draft production study should clearly analyze the anticipated role and potential availability of both storage and curtailed energy in each production region.

SOCALGAS RESPONSE TO COMMENT 2-11

Please refer to the response to Comment 2-2 and the draft Production Study on the potential role of curtailed energy from the grid and third-party storage. The analysis performed was a higher level system analysis and did not focus on specific production regions.

CAL ADVOCATES COMMENT 2-12

Furthermore, the distribution of feasible solar development needed for hydrogen production will be vital when ranking the likely sequence of potential corridors for pipeline development. To demonstrate where 240,000 acres of solar can feasibly be permitted, it is essential that SoCalGas consults with the primary land use permitting authorities, to understand what development is already being undertaken and the limits in existing land use plans.

SOCALGAS RESPONSE TO COMMENT 2-12

Please refer to responses to Comments 2-3 and 2-5.

CAL ADVOCATES COMMENT 2-13

Finally, transmission corridors from the most eligible production locations must be broad enough to allow the Commission the ability to modify the routes without resulting in impacts to communities that have not been part of SoCalGas outreach. Overley narrow corridors, may result in late notification and inclusion of communities in the siting process, which makes siting harder and can result unnecessary delays. To ensure that the corridor is fit for purpose, multiple possible routes within each proposed corridor should be identified in the draft routing study.

SOCALGAS RESPONSE TO COMMENT 2-13

Please refer to responses to Comments 2-7, 2-8, 2-9, and 2-10.

2.3 Comment Letter 3 – Communities for Better Environment

Comment Letter 3

COMMUNITIES
FOR A BETTER
ENVIRONMENT
established 1978

May 3, 2024

Southern California Gas Company
555 West Fifth Street
Los Angeles, CA 90013

Submitted via email to ALP1_Study_PAG_Feedback@insigniaenv.com.

Re: Feedback for Southern California Gas Company on Preliminary Findings Presentations

Communities for a Better Environment (CBE) submits this letter of feedback to Southern California Gas Company (SoCalGas) on the following matters and documents:

I. Updated Preliminary Findings Presentation Format;
II. Preliminary Data and Findings: Plan for Applicable Safety Requirements;
III. Preliminary Routing/Configuration Analysis, Including Right-of-Way and Franchise: Preliminary Data and Findings;
IV. Production Planning & Assessment Preliminary Data and Findings;
V. Preliminary Data and Findings: Workforce Planning & Training Evaluation; and
VI. Preliminary Data and Findings: High Level Feasibility Assessment & Permitting Analysis.

These comments specifically pertain to the preliminary findings presented in the abbreviated power point presentations provided on April 16, 2024. As CBE stated at the April 23, 2024 joint PAG and CBOSG meeting, CBE expects that a separate, complete draft of the data, analysis, and findings for these topics will be released at an unknown later date. These preliminary presentations lack basic data, let alone the analysis parties need to provide feedback, and these comments cannot, and do not, comprise the entire scope of feedback from CBE on any of the topics presented.

I. Updated Preliminary Findings Presentation Format

As an initial matter, the format and content of the above-listed preliminary findings are unusable, since they offer neither data nor analysis, and do not even allow a clear understanding of the methodological approach SoCalGas envisions undertaking to develop the data and analysis. The preliminary findings fail to include quantitative data and have little qualitative analysis. Each presentation file only has a few slides with substantive information, many slides include images with little to no explanatory text. Most of the presentations in their entirety

Comment 03-01

contain less than two pages of bullet pointed text. Despite the presentations title identifying them as "data and findings," the presentations contain no data, or related analysis to support the findings presented therein. It is concerning that with the lack of data and analysis provided, these presentations, and the findings favorable to SoCalGas presented therein, more readily resemble PUC prohibited public relations materials than feasibility studies.[1] Further, SoCalGas's failure to provide data does not comply with the CPUC Decision D.22-12-055 (hereinafter "CPUC Decision"), part 7 which requires SoCalGas to "make the data, findings, and results of Phase One feasibility studies…available to the public and not redacted unless SoCalGas is granted confidentiality of data."[2]

Comment 03-01

Because the presentations do not include data or analysis, providing feedback on the findings presented is particularly challenging. The CPUC Decision emphasized the importance of stakeholder engagement to identify potential impacts of the project on disadvantaged and environmental justice communities.[3] Failing to provide data and analysis in the presentation of these findings stymies meaningful engagement—communities cannot interact with findings if we do not know the facts on which they are based. SoCalGas stated that the data and analysis for these topics will be released at an undisclosed later date when the draft studies are completed. This implies that the statements made in these presentations are presented entirely without completed research, despite the presentations being labelled as including both preliminary data and findings.

SoCalGas represented the presentation format as both an accessible means of further opportunity for community engagement, and a means by which SoCalGas can direct community members to targeted areas for feedback. CBE rejects this characterization; the accessibility of information does not equate to incomplete and unsupported presentations of facts. Further, meaningful community engagement should concern all matters and concerns that community members seek to engage in, not those directed by SoCalGas.

II. Preliminary Data and Findings: Plan for Applicable Safety Requirements

In the Preliminary Data and Findings: Plan for Applicable Safety Requirements ("Safety Plan Presentation") SoCalGas limits its scope of review to the topics of regulation, construction, and communication. The limited scope Safety Plan Presentation glaringly omits any kind of preliminary risk analysis. In contrast to the lack of risk analysis, the Safety Plan Presentation asserts that a comprehensive framework of safety requirements can mitigate risks. It is unclear how a comprehensive framework could be conceived of, let alone created without any form of risk analysis. Any comprehensive safety plan at base needs to address the risks of the Angeles Link Project in relation to associated safety requirements. Further, the Safety Plan Presentation does not mention safety considerations for the major risks of leakage, exposure, flammability,

Comment 03-02

[1] CPUC Decision D.22-12-055 (hereinafter CPUC Decision), pg. 38.
[2] CPUC Decision, Order No. 7 pg. 77.
[3] CPUC Decision, pg. 80. See also pg. 58 "Stakeholder engagement, including those from CBOs, ESJ groups, and disadvantaged communities (DAC) groups, are important to the planning process."

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storage, explosion, and end-use related health risks posed by hydrogen use and transportation or safety risks associated with the use of hydrogen in existing methane gas systems. Comment 03-02

The Safety Plan Presentation identifies only three study considerations, "1. Pipelines can be a safe and efficient method of transporting large volumes of gas over long distances 2. A comprehensive framework of safety requirements can mitigate hydrogen transport risks 3. SoCalGas has an existing safety framework" without providing any details regarding if or how pipelines can be safe or unsafe, what elements may be required in a comprehensive framework to mitigate risks, or the details of SoCalGas's existing safety plan and how it can or cannot extend to cover hydrogen transportation. Parties must have the opportunity to engage with a comprehensive safety analysis, which identifies all potential personal, community, and environmental health and safety risks associated with hydrogen and the steps necessary to mitigate these risks. Without providing a clear and transparent safety analysis it is impossible for SoCalGas to meaningfully engage with environmental justice communities on the impacts of the project. Comment 03-03

The Safety Plan Presentation's assertions that "leak detection equipment is available and can be utilized for hydrogen detection" and "studies show odorization of pure hydrogen gas is feasible" are presented without any evidence. These are significant points of safety that should be thoroughly supported with research, especially at the preliminary, feasibility stage. Failing to provide support for these claims raises serious questions as to the validity of SoCalGas's feasibility studies, and research integrity generally, and the integrity of the Safety Plan Presentation. Comment 03-04

The final slide, labeled "25" despite being ninth in a nine-slide deck, is perhaps most surreal. It purports to present "safety study preliminary findings." Instead, the slide shows a pyramid, listing what may be standards applied by different regulatory agencies. It does not show any findings or, on its face, appear to reference a safety study. This slide is emblematic of the flaws inherent in the new SoCalGas approach to engaging community. Comment 03-05

III. Preliminary Routing/Configuration Analysis, Including Right-of-way and Franchise: Preliminary Data and Findings

The content in the Preliminary Routing/Configuration Analysis, Including Right-of-Way and Franchise: Preliminary Data and Findings ("Preliminary Routing Analysis") is vague and uninformative. One slide states: "Based on preliminary pipeline routing information, there are 60 municipalities with which SoCalGas has franchise agreements and approximately 50% of the potential routes are proximate to ROWs for existing facilities." This statement is probably the most 'specific' included in this slide deck since it at least includes a few numbers, but it still leaves the reader in the dark about specific names of municipalities and ROWs, however tentative they may be. The page about Evaluation Components merely lists several vague factors like "production," "demand," and "environmental" without elaborating on any of them. Comment 03-06

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IV. Production Planning & Assessment Preliminary Data and Findings

The Production Planning and Assessment Preliminary Data and Findings ("Production Presentation") fails to address significant environmental justice concerns relating to hydrogen production in heavily impacted communities. The three potential communities where production is being explored listed on seventh and final slide of the presentation include the San Joaquin Valley, Lancaster, and Blythe. The Production Presentation does not mention the environmental justice implications of production planning in these communities despite the communities at these potential sites of production ranking in the 80th to 100th percentile on CalEnviroScreen. The San Joaquin Valley is a region covering over 27,000 square miles of California from Bakersfield (138 miles from the port of Los Angeles) with census tracts that rank in the 100th percentile of CalEnviroScreen overall, 97th percentile in pollution burden, and 95th percentile in ozone.[4] Communities in and around Lancaster (98 miles from the port of Los Angeles) rank in the 89th percentile of CalEnviroScreen, with ozone in the 89th percentile.[5] Blythe (235 miles from the port of Los Angeles) is in the 92nd percentile overall for CalEnviroScreen, and 80th percentile in pollution burden.[6] The Production Presentation's failure examine the impact of production sites on these already impacted communities of the San Joaquin Valley, Lancaster, or Blythe, let alone begin outreach in these communities is unacceptable. The slide deck does not discuss any analysis of onsite or near-site production as an alternative to building massive pipelines connecting environmental justice production-hosting communities. **Comment 03-07**

As mentioned in the CPUC Decision, significant water use is of particular concern in hydrogen production.[7] The only potential production method explored in the Production Presentation is solar powered electrolysis hydrogen production which SoCalGas identifies but does not commit to as a primary source of clean renewable hydrogen production. Despite solar electrolysis hydrogen production being known to require a significant amount of water, water use is not mentioned once in the Production Presentation. Nor is the fact that the San Joaquin Valley, Lancaster, and Blythe are water strapped communities. **Comment 03-08**

V. Preliminary Data and Findings: Workforce Planning & Training Evaluation

The content in the Workforce Preliminary Data and Findings is too minimal to be useful. We strongly recommend that workforce studies and findings should include requirements for local hires, including members of disadvantaged communities and people of color. The preliminary data and findings make no mention of local hire preferences. Slide 6 refers to "Workforce training for safety and regulatory compliance." The Workforce Preliminary Data and Findings should include references to worker safety concerns related to transporting 100% hydrogen by pipeline like those in the Safety Plan Presentation discussed above. **Comment 03-09**

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[4] See CalEnviroScreen 4.0, Census Tract 6029002500
[5] See CalEnviroScreen 4.0, Census Tract 6037900300 and Census Tract 6037900602
[6] See CalEnviroScreen 4.0, Census Tract 6065046200
[7] CPUC Decision, Order No. 6 Subd. (b), pg. 76.

VI. Preliminary Data and Findings: High Level Feasibility Assessment & Permitting Analysis

The High Level Feasibility Assessment and Permitting Analysis Preliminary Data and Findings ("Permitting Presentation") purports to be in alignment with the CPUC Decision "OP 6 (i)", a notation that may refer to part 6 subdivision (i) of the CPUC Decision Order beginning on page 73. However, more confusingly, part 6, subdivision (i) of the Order, requires SoCalGas to provide findings from its phase one feasibility studies for the purpose of "identification and comparison of possible routes and configurations."[8] The Permitting Assessment Presentation provides a rudimentary outline of likely necessary legal requirements broadly for Federal, State, and Local permitting and land use requirements but does not identify where any of these generalized permitting requirements may apply or on what timeline. The Permitting Presentation's main finding on slide seven states that "permitting timing assumptions range from months to several years." Without identifying any potential routes in relation to permitting, it is impossible to discern from the array of potential permitting and regulatory requirements which permitting requirements, constraints, and timing considerations will be significant factors in limitation of the project's development.

Comment 03-10

VII. Conclusion

CBE appreciates the opportunity to provide feedback on SoCalGas's new attempt at presenting information for feedback. Neither the format nor the extremely minimal substantive information allows CBE, or other interested stakeholders, to understand the many necessary studies SoCalGas must undertake if it intends to move forward the Angeles Link project.

Comment 03-11

Respectfully Submitted.

Lauren Gallagher & Jay Parepally

Communities for a Better Environment

CC:
Emily Grant, SoCalGas
Chester Britt, Arellano Associates
Alma Marquez, Lee Andrews Group
Angeles Link PAG Service List

[8] CPUC Decision, Order No. 6 Subd. (i), p. 76.

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COMMUNITIES FOR BETTER ENVIRONMENT COMMENT 3-1

As an initial matter, the format and content of the above-listed preliminary findings are unusable, since they offer neither data nor analysis, and do not even allow a clear understanding of the methodological approach SoCalGas envisions undertaking to develop the data and analysis. The preliminary findings fail to include quantitative data and have little qualitative analysis. Each presentation file only has a few slides with substantive information, many slides include images with little to no explanatory text. Most of the presentations in their entirety contain less than two pages of bullet pointed text. Despite the presentations title identifying them as "data and findings," the presentations contain no data, or related analysis to support the findings presented therein. It is concerning that with the lack of data and analysis provided, these presentations, and the findings favorable to SoCalGas presented therein, more readily resemble PUC prohibited public relations materials than feasibility studies. FN1 Further, SoCalGas's failure to provide data does not comply with the CPUC Decision D.22-12-055 (hereinafter "CPUC Decision"), part 7 which requires SoCalGas to "make the data, findings, and results of Phase One feasibility studies…available to the public and not redacted unless SoCalGas is granted confidentiality of data." FN2

Because the presentations do not include data or analysis, providing feedback on the findings presented is particularly challenging. The CPUC Decision emphasized the importance of stakeholder engagement to identify potential impacts of the project on disadvantaged and environmental justice communities. FN3 Failing to provide data and analysis in the presentation of these findings stymies meaningful engagement—communities cannot interact with findings if we do not know the facts on which they are based. SoCalGas stated that the data and analysis for these topics will be released at an undisclosed later date when the draft studies are completed. This implies that the statements made in these presentations are presented entirely without completed research, despite the presentations being labelled as including both preliminary data and findings.

SoCalGas represented the presentation format as both an accessible means of further opportunity for community engagement, and a means by which SoCalGas can direct community members to targeted areas for feedback. CBE rejects this characterization; the accessibility of information does not equate to incomplete and unsupported presentations of facts. Further, meaningful community engagement should concern all matters and concerns that community members seek to engage in, not those directed by SoCalGas.

FN1 – CPUC Decision D.22-12-055 (hereinafter CPUC Decision), pg. 38.
FN2 – CPUC Decision, Order No. 7 pg. 77.
FN3 – CPUC Decision, pg. 80. See also pg. 58 "Stakeholder engagement, including those from CBOs, ESJ groups, and disadvantaged communities (DAC) groups, are important to the planning process."

SOCALGAS RESPONSE TO COMMENT 3-1

The preliminary findings were intended to present information in a summary format with the understanding that more detailed analysis and assumptions would be provided in the full draft reports when they were available. As of the date of this submittal, all of the draft studies with additional detail have been submitted for PAG and CBOSG review. Please also refer to Global Response 1.

COMMUNITIES FOR BETTER ENVIRONMENT COMMENT 3-2

In the Preliminary Data and Findings: Plan for Applicable Safety Requirements ("Safety Plan Presentation") SoCalGas limits its scope of review to the topics of regulation, construction, and communication. The limited scope Safety Plan Presentation glaringly omits any kind of preliminary risk analysis. In contrast to the lack of risk analysis, the Safety Plan Presentation asserts that a comprehensive framework of safety requirements can mitigate risks. It is unclear how a comprehensive framework could be conceived of, let alone created without any form of risk analysis. Any comprehensive safety plan at base needs to address the risks of the Angeles Link Project in relation to associated safety requirements. Further, the Safety Plan Presentation does not mention safety considerations for the major risks of leakage, exposure, flammability, storage, explosion, and end-use related health risks posed by hydrogen use and transportation or safety risks associated with the use of hydrogen in existing methane gas systems.

SOCALGAS RESPONSE TO COMMENT 3-2

The preliminary findings were intended to present information in a summary format with the understanding that more detailed analysis and assumptions would be provided in the full draft reports when they were available. Please refer to section 6.0 Risk Management in the draft Safety Study that describes SoCalGas's enterprise risk management model and the descriptions of preliminary potential risk and risk management regarding the transportation of fuel by pipeline. The Risk Management table in the study outlines the potential consequences associated with the design, construction, operations and maintenance of Angeles Link which includes risk of leakage, flammability concerns, and explosions, along with potential management considerations. See Table 1 in section 5.0 Physical and Chemical Properties of Hydrogen that describes how hydrogen gas is colorless, odorless, non-toxic and is considered a simple asphyxiant. In addition, the draft Safety Study evaluates the transportation of hydrogen by pipeline, assuming new infrastructure for hydrogen transportation. Angeles Link does not propose to transport clean renewable hydrogen in existing natural gas systems and, therefore, safety risks associated with the use of hydrogen in existing natural gas systems is outside the scope of the Phase 1 studies. Further risk analysis may be conducted in subsequent phases as more detailed information is available.

Please refer to the draft Leakage Study for more information on potential hydrogen leakage.

COMMUNITIES FOR BETTER ENVIRONMENT COMMENT 3-3

The Safety Plan Presentation identifies only three study considerations, “1. Pipelines can be a safe and efficient method of transporting large volumes of gas over long distances 2. A comprehensive framework of safety requirements can mitigate hydrogen transport risks 3. SoCalGas has an existing safety framework” without providing any details regarding if or how pipelines can be safe or unsafe, what elements may be required in a comprehensive framework to mitigate risks, or the details of SoCalGas’s existing safety plan and how it can or cannot extend to cover hydrogen transportation. Parties must have the opportunity to engage with a comprehensive safety analysis, which identifies all potential personal, community, and environmental health and safety risks associated with hydrogen and the steps necessary to mitigate these risks. Without providing a clear and transparent safety analysis it is impossible for SoCalGas to meaningfully engage with environmental justice communities on the impacts of the project.

SOCALGAS RESPONSE TO COMMENT 3-3

The preliminary findings were intended to present information in a summary format with the understanding that more detailed analysis and assumptions would be provided in the full draft reports when they were available. For additional details on the safety analysis, please see section 6.0 Risk Management and section 4.0 Safety Management System in the draft Safety Study. Further analysis of comprehensive safety risks will be conducted in subsequent phases.

COMMUNITIES FOR BETTER ENVIRONMENT COMMENT 3-4

The Safety Plan Presentation's assertions that "leak detection equipment is available and can be utilized for hydrogen detection" and "studies show odorization of pure hydrogen gas is feasible" are presented without any evidence. These are significant points of safety that should be thoroughly supported with research, especially at the preliminary, feasibility stage. Failing to provide support for these claims raises serious questions as to the validity of SoCalGas's feasibility studies, and research integrity generally, and the integrity of the Safety Plan Presentation.

SOCALGAS RESPONSE TO COMMENT 3-4

The preliminary findings were intended to present information in a summary format with the understanding that more detailed analysis and assumptions would be provided in the full draft reports when they were available. For additional information on the safety analysis, please see sections 8.0 Potential for Future Odorization and Leak Detection in the draft Safety Study.

COMMUNITIES FOR BETTER ENVIRONMENT COMMENT 3-5

The final slide, labeled "25" despite being ninth in a nine-slide deck, is perhaps most surreal. It purports to present "safety study preliminary findings." Instead, the slide shows a pyramid, listing what may be standards applied by different regulatory agencies. It does not show any findings or, on its face, appear to reference a safety study. This slide is emblematic of the flaws inherent in the new SoCalGas approach to engaging community.

SOCALGAS RESPONSE TO COMMENT 3-5

SoCalGas understands this comment concerning the information presented in the preliminary findings. The preliminary findings were intended to present information in a summary format with the understanding that more detailed analysis and assumptions would be provided in the full draft reports when they were available. As of the date of this submittal, all of the draft studies with additional detail have been submitted for PAG and CBOSG review. Please also refer to Global Response 1.

For additional information on the safety analysis, please see section 7.0 Key Safety Codes Regulations in the draft Safety for further clarification and context.

COMMUNITIES FOR BETTER ENVIRONMENT COMMENT 3-6

The content in the Preliminary Routing/Configuration Analysis, Including Right-of-Way and Franchise: Preliminary Data and Findings ("Preliminary Routing Analysis") is vague and uninformative. One slide states: "Based on preliminary pipeline routing information, there are 60 municipalities with which SoCalGas has franchise agreements and approximately 50% of the potential routes are proximate to ROWs for existing facilities." This statement is probably the most 'specific' included in this slide deck since it at least includes a few numbers, but it still leaves the reader in the dark about specific names of municipalities and ROWs, however tentative they may be. The page about Evaluation Components merely lists several vague factors like "production," "demand," and "environmental" without elaborating on any of them.

SOCALGAS RESPONSE TO COMMENT 3-6

The preliminary findings were intended to present information in a summary format with the understanding that more detailed analysis and assumptions would be provided in the full draft reports when they were available. As of the date of this submittal, all of the draft studies with additional detail have been submitted for PAG and CBOSG review. Please also refer to Global Response 1 and the following chapters in the Routing Analysis for specific evaluation details:

- Chapter 2 – System Evaluation for considerations on the role of system, zone development, and initial corridors.
- Chapter 3 – Route Evaluation for pipeline features evaluation, land rights, and route analysis.
- Chapter 5 – Route Characterization for preferred route descriptions.

COMMUNITIES FOR BETTER ENVIRONMENT COMMENT 3-7

The Production Planning and Assessment Preliminary Data and Findings ("Production Presentation") fails to address significant environmental justice concerns relating to hydrogen production in heavily impacted communities. The three potential communities where production is being explored listed on seventh and final slide of the presentation include the San Joaquin Valley, Lancaster, and Blythe. The Production Presentation does not mention the environmental justice implications of production planning in these communities despite the communities at these potential sites of production ranking in the 80th to 100th percentile on CalEnviroScreen. The San Joaquin Valley is a region covering over 27,000 square miles of California from Bakersfield (138 miles from the port of Los Angeles) with census tracts that rank in the 100th percentile of CalEnviroScreen overall, 97th percentile in pollution burden, and 95th percentile in ozone. FN4 Communities in and around Lancaster (98 miles from the port of Los Angeles) rank in the 89th percentile of CalEnviroScreen, with ozone in the 89th percentile. FN5 Blythe (235 miles from the port of Los Angeles) is in the 92nd percentile overall for CalEnviroScreen, and 80th percentile in pollution burden. FN6 The Production Presentation's failure examine the impact of production sites on these already impacted communities of the San Joaquin Valley, Lancaster, or Blythe, let alone begin outreach in these communities is unacceptable. The slide deck does not discuss any analysis of onsite or near-site production as an alternative to building massive pipelines connecting environmental justice production-hosting communities.

FN4 – See CalEnviroScreen 4.0, Census Tract 6029002500
FN5 – See CalEnviroScreen 4.0, Census Tract 6037900300 and Census Tract 6037900602
FN6 – See CalEnviroScreen 4.0, Census Tract 6065046200

SOCALGAS RESPONSE TO COMMENT 3-7

Environmental justice considerations of third-party production locations is out of scope in the Production Study, and SoCalGas expect third-party producers to evaluate such considerations when developing specific production projects.

For purposes of this Phase 1 feasibility stage, SoCalGas conducted an Environmental Social Justice Screening (ESJ Screening), which provides information concerning disadvantaged community (DAC) designation information and other demographic information along the potential preferred routes identified in Phase 1. In addition, SoCalGas has prepared a draft ESJ Plan that provides a framework for engaging ESJ communities during Phase 2 of Angeles Link. For more information, please refer to the draft document provided to the PAG and CBOSG for feedback—the draft ESJ Plan and ESJ Screening.

In response to the comment concerning the analysis of onsite or near-site production facilities, a localized hydrogen hub within the Los Angeles Basin was analyzed as a project alternative that would connect in-basin production and/or production in close proximity to multiple in-basin end users and storage. More information on analysis of a localized hydrogen hub can be found in the following draft reports provided to the PAG and CBOSG for feedback: (1) Alternatives Study (Section 7.1.1 Localized Hub Definition and Section 4.3.1. Evaluation of Hydrogen Delivery Alternatives); (2) the Cost Effectiveness Study (Section 4.1 Cost Effectiveness of Angeles Link & Hydrogen Delivery Alternatives); and (3) the Environmental Analysis.

COMMUNITIES FOR BETTER ENVIRONMENT COMMENT 3-8

As mentioned in the CPUC Decision, significant water use is of particular concern in hydrogen production.FN7 The only potential production method explored in the Production Presentation is solar powered electrolysis hydrogen production which SoCalGas identifies but does not commit to as a primary source of clean renewable hydrogen production. Despite solar electrolysis hydrogen production being known to require a significant amount of water, water use is not mentioned once in the Production Presentation. Nor is the fact that the San Joaquin Valley, Lancaster, and Blythe are water strapped communities.

FN7 – CPUC Decision, Order No. 6 Subd. (b). pg.76.

SOCALGAS RESPONSE TO COMMENT 3-8

In regards to potential water availability for hydrogen production, the draft Production Study (Section 9.2.5) refers to the separate Phase 1 WRE, which analyzes potential water availability for third-party clean renewable hydrogen production. The WRE was released to the PAG/CBSOG on July 5, 2024.

The WRE report evaluates potential water availability for third-party hydrogen production; describes the water quality requirements for water treatment to meet the technical requirements of electrolyzers; provides a high-level cost estimate for key aspects of water sources for production (i.e., acquisition, conveyance, and treatment); and describes potential challenges and opportunities for the development of water supply sources that may support third-party clean renewable hydrogen production. The WRE consists of five separate chapters: (1) Chapter 1: Water Availability Study; (2) Chapter 2: Water Quality Requirements; (3) Chapter 3: Acquisition and Purification Costs; (4) Chapter 4: Challenges and Opportunities; (5) Chapter 5: Supplemental Desktop Analysis – Greenhouse Gas Emissions Associated with Water Treatment and Conveyance.

The key findings of the WRE are:

- Water required for the portion of clean renewable hydrogen production that Angeles Link could transport is a small percentage (approximately 0.02 to 0.10 percent) of California's total water usage each year.
- Multiple water supply sources can be identified to meet water demand for the clean renewable hydrogen production that Angeles Link could transport, including existing water supplies and new water supplies that could be developed.
- Third-party producers may use different mechanisms to acquire water supplies to meet production needs, including exchange agreements, local water agencies, and water markets, or through acquisition of land purchase with water rights.
- Shifting water demands and obligations may present opportunities for development of new water supplies.
- The menu of water sources that feed specific production projects can be further evaluated on a case-by-case basis as more details on specific production projects develop.

COMMUNITIES FOR BETTER ENVIRONMENT COMMENT 3-9

The content in the Workforce Preliminary Data and Findings is too minimal to be useful. We strongly recommend that workforce studies and findings should include requirements for local hires, including members of disadvantaged communities and people of color. The preliminary data and findings make no mention of local hire preferences. Slide 6 refers to “Workforce training for safety and regulatory compliance.” The Workforce Preliminary Data and Findings should include references to worker safety concerns related to transporting 100% hydrogen by pipeline like those in the Safety Plan Presentation discussed above.

SOCALGAS RESPONSE TO COMMENT 3-9

SoCalGas understands this comment concerning the information presented in the preliminary findings. The preliminary findings were intended to present information in a summary format with the understanding that more detailed analysis and assumptions would be provided in the full draft reports when they were available. As of the date of this submittal, all of the draft studies with additional detail have been submitted for PAG and CBOSG review. Please also refer to Global Response 1. For additional information on the workforce analysis, please see the draft Workforce Study, section 3.2 Education, Operator Qualifications, and Training and in section 7.0 Community Engagement and Employment where SoCalGas specifies recruitment efforts will be focused on communities along the potential Angeles Link route(s). For additional information related to the safety analysis, which includes employee and contractor safety, please refer to section 8.0 Specifications, Standards, & Procedures Evaluation in the draft Safety Study.

COMMUNITIES FOR BETTER ENVIRONMENT COMMENT 3-10

The High-Level Feasibility Assessment and Permitting Analysis Preliminary Data and Findings ("Permitting Presentation") purports to be in alignment with the CPUC Decision "OP 6 (i)", a notation that may refer to part 6 subdivision (i) of the CPUC Decision Order beginning on page 73. However, more confusingly, part 6, subdivision (i) of the Order, requires SoCalGas to provide findings from its phase one feasibility studies for the purpose of "identification and comparison of possible routes and configurations." FN8 The Permitting Assessment Presentation provides a rudimentary outline of likely necessary legal requirements broadly for Federal, State, and Local permitting and land use requirements but does not identify where any of these generalized permitting requirements may apply or on what timeline. The Permitting Presentation's main finding on slide seven states that "permitting timing assumptions range from months to several years." Without identifying any potential routes in relation to permitting, it is impossible to discern from the array of potential permitting and regulatory requirements which permitting requirements, constraints, and timing considerations will be significant factors in limitation of the project's development.

FN8 – CPUC Decision, Order No. 6 Subd. (i), p. 76.

SOCALGAS RESPONSE TO COMMENT 3-10

SoCalGas understands this comment concerning the information presented in the preliminary findings. The preliminary findings were intended to present information in a summary format with the understanding that more detailed analysis and assumptions would be provided in the full draft reports when they were available. As of the date of this submittal, all of the draft studies with additional detail have been submitted for PAG and CBOSG review. Please also refer to Global Response 1.

In addition to the draft Permitting Analysis released to the PAG and CBOSG on July 19, the draft Routing Analysis was also released on July 19. The Routing Analysis provides information on several possible preferred routes during the feasibility stage of Angeles Link. The draft Permitting Analysis, which provides a summary of anticipated permits, authorizations, and associated timelines based on the conceptual pipeline routes from the Routing Analysis. Providing information on all of the conceptual routes analyzed, the Permitting Analysis provides analysis comparing possible routes and configurations for Angeles Link.

COMMUNITIES FOR BETTER ENVIRONMENT COMMENT 3-11

CBE appreciates the opportunity to provide feedback on SoCalGas's new attempt at presenting information for feedback. Neither the format nor the extremely minimal substantive information allows CBE, or other interested stakeholders, to understand the many necessary studies SoCalGas must undertake if it intends to move forward the Angeles Link project.

SOCALGAS RESPONSE TO COMMENT 3-11

SoCalGas understands this comment concerning the information presented in the preliminary findings. The preliminary findings were intended to present information in a summary format with the understanding that more detailed analysis and assumptions would be provided in the full draft reports when they were available. As of the date of this submittal, all of the draft studies with additional detail have been submitted for PAG and CBOSG review. Please also refer to Global Response 1.

2.4 Comment Letter 4 – Food and Water Watch

Comment Letter 4

May 3, 2024

Submitted via email to ALP1_Study_PAG_Feedback@insigniaenv.com.

RE: Feedback on the Preliminary Findings of the Angeles Link Project and CBOSG Process

Food & Water Watch, as part of the Community Based Organization Stakeholder Group (CBOSG), submits this letter of feedback regarding the preliminary data and findings of the Angeles Link Project by the Southern California Gas Company (SoCalGas) and the CBOSG process.

The most recent documents sent to the CBOSG were insufficient to provide substantial feedback to and we hope that slide decks in place of findings reports will not become the norm from SoCalGas. This format and content, or rather lack thereof, offers no real analysis. Rather than expecting the CBOSG to submit feedback to a series of slide decks, SoCalGas should be sending us actual reports.

During the most recent meeting, held on April 23, 2024, representatives from SoCalGas stated that the reports would be available in a few months (no date of release was specified). In that same meeting, it was clear that SoCalGas has grossly misconstrued the criticism that groups in the CBOSG have been raising for the past year. The feedback windows should be extended, we need reports with detailed analysis along with detailed descriptions of the methodologies used, and SoCalGas should be providing evidence as to how stakeholder group feedback is being incorporated.

Comment 04-01

We also need an evaluation of alternative scenarios or options, and how those alternatives compare with the Angeles Link Project in terms of adhering to demand projections from state agencies like the California Energy Commission and the California Air Resources Board. Given that SoCalGas has a vested financial interest in this project, independent third-party research would provide an impartial analysis of the project.

Comment 04-02

We would also like to stress our concern over how a year into the project, SoCalGas has failed to engage with local tribal leaders and communities, which conflicts with the California Public Utilities Commission's emphasis on inclusive stakeholder engagement. This concern has been raised multiple times during the CBOSG meetings by multiple stakeholders.

Comment 04-03

We hope that all of these concerns will be taken into consideration and the necessary changes will be made.

Sincerely,

Andrea Vega
Southern California Senior Organizer
Food & Water Watch

FOOD AND WATER WATCH COMMENT 4-1

Food and Water Watch, as part of the Community Based Organization Stakeholder Group (CBOSG), submits this letter of feedback regarding the preliminary data and findings of the Angeles Link Project by the Southern California Gas Company (SoCalGas) and the CBOSG process.

The most recent documents sent to the CBOSG were insufficient to provide substantial feedback to and we hope that slide decks in place of findings reports will not become the norm from SoCalGas. This format and content, or rather lack thereof, offers no real analysis. Rather than expecting the CBOSG to submit feedback to a series of slide decks, SoCalGas should be sending us actual reports.

During the most recent meeting, held on April 23, 2024, representatives from SoCalGas stated that the reports would be available in a few months (no date of release was specified). In that same meeting, it was clear that SoCalGas has grossly misconstrued the criticism that groups in the CBOSG have been raising for the past year. The feedback windows should be extended, we need reports with detailed analysis along with detailed descriptions of the methodologies used, and SoCalGas should be providing evidence as to how stakeholder group feedback is being incorporated.

SOCALGAS RESPONSE TO COMMENT 4-1

SoCalGas understands this comment concerning the information presented in the preliminary findings. The preliminary findings were intended to present information in a summary format with the understanding that more detailed analysis and assumptions would be provided in the full draft reports when they were available. As of the date of this submittal, all of the draft studies with additional detail have been submitted for PAG and CBOSG review. Please also refer to Global Response 1.

FOOD AND WATER WATCH COMMENT 4-2

We also need an evaluation of alternative scenarios or options, and how those alternatives compare with the Angeles Link Project in terms of adhering to demand projections from state agencies like the California Energy Commission and the California Air Resources Board. Given that SoCalGas has a vested financial interest in this project, independent third-party research would provide an impartial analysis of the project.

SOCALGAS RESPONSE TO COMMENT 4-2

Please refer to the Q1 2024 Response to Comments, Global Response 2.1 which references California hydrogen demand projections from the CARB, the California Energy Commission (CEC), the ARCHES and the University of California, Davis (UCD).

With respect to alternatives to Angeles Link, please refer to the draft Alternatives Study (Section 4, Framework for Evaluation of Project Alternatives) for an evaluation of the identified alternatives, including electrification and a localized hub, and the draft Cost Effectiveness Study (Section 4.2 Cost Effectiveness of Angeles Link & Non-Hydrogen Alternatives) for a cost comparison of the alternatives to Angeles Link. The Alternatives Study and Cost Effectiveness Study were released to the PAG and CBOSG on July 26, 2024.

FOOD AND WATER WATCH COMMENT 4-3

We would also like to stress our concern over how a year into the project, SoCalGas has failed to engage with local tribal leaders and communities, which conflicts with the California Public Utilities Commission’s emphasis on inclusive stakeholder engagement. This concern has been raised multiple times during the CBOSG meetings by multiple stakeholders.

SOCALGAS RESPONSE TO COMMENT 4-3

SoCalGas has three members of its CBOSG who represent tribal interests. In response to PAG and CBOSG feedback, SoCalGas reached out to tribal governments and other organizations who represent tribal interests in Los Angeles and the Central Valley and extended invitations for them to join the PAG and/or CBOSG in Phase 1 or subsequent phases of the project. As a result, SoCalGas added the Fernandeño Tataviam Band of Mission Indians to its PAG in June of 2024 to increase tribal representation on the PAG. In addition, SoCalGas has prepared a draft ESJ Plan and ESJ Screening. The draft ESJ Plan provides a framework for engaging ESJ Communities during Phase 2 of Angeles Link and describes how SoCalGas’s strategies align with the goals of the CPUC’s Environmental and Social Justice Action Plan. As set forth in that plan, SoCalGas intends to engage additional stakeholders who live, work, or own businesses in the community, public health organizations and local health departments schools; labor organizations; academic researchers; additional technical experts; federal, state, and tribal decision-making bodies; and local representatives. The draft ESJ Plan was released to the PAG and CBOSG for comment on July 19, 2024.

2.5 Comment Letter 5 – Protect Playa Now

Comment Letter 5

May 1st, 2024
California Public Utilities Commission (CPUC)
505 Van Ness
Avenue San Francisco, CA 94102

RE: Protect Playa Now Feedback for Angeles Link and CBO Stakeholder Group

To the California Public Utilities Commission (CPUC),

I am writing to express Protect Playa Now's concerns and to provide feedback on the preliminary data and findings documents related to the Angeles Link project, as prepared and presented by SoCalGas. The documents we have reviewed have raised significant issues that we believe must be addressed to ensure the transparency, accuracy, and comprehensiveness of the ongoing evaluations of the Angeles Link project.

Comment 05-01

Preliminary Data and Findings Documents:

Lack of Detailed Analytical Content: The documents present high-level overviews without the necessary detailed analytical content, making it difficult for stakeholders to assess feasibility and impacts thoroughly.

Overuse of Promotional Language: The documents often use promotional language that seems aimed at advocating for the project rather than critically evaluating it.

Insufficient Data: There is a notable lack of specific data or detailed impact assessments for environmental considerations..

Comment 05-02

Maps and Visuals Lack Detail: Maps and other visual aids lack sufficient detail, such as labels and explanatory notes, hindering stakeholders' ability to fully understand the project's implications.

Comment 05-03

Absence of Methodological Transparency: There is an absence of detailed descriptions of the methodologies used for assessments, leading to doubts about the validity of the findings.

Confusing Comment Periods: The process includes two distinct periods for commenting, one for the executive summary and another for the detailed data, which can confuse and hinder comprehensive feedback.

Overall Process Feedback:

Inadequate Tribal and Community Engagement (Still): The lack of robust engagement with local tribal leaders and communities directly conflict with the CPUC's emphasis on inclusive stakeholder engagement and the need for consent from tribal communities for projects of this nature. This oversight undermines the trust and collaborative potential crucial for the success of projects with significant environmental and social footprints. Comment 05-03

Discrepancies in Demand Projections: The demand projections by SoCalGas do not align with findings from authoritative bodies like the California Energy Commission and the California Air Resources Board, raising questions about the accuracy and reliability of SoCalGas's projections. Comment 05-04

Limited Stakeholder Engagement Evidence: The documents do not clearly show how stakeholder feedback has been incorporated, indicating a gap between provided feedback and subsequent revisions. Comment 05-05

Unclear Evaluation of Alternatives: The documents often fail to address or evaluate alternative scenarios or options sufficiently, a crucial aspect of feasibility studies to ensure all potential outcomes are considered. Comment 05-06

Absence of Supporting Calculations: Critical spreadsheet calculations for key studies like the demand study and the NOx study have not been provided, preventing stakeholders from verifying the accuracy or reliability of the findings. Comment 05-07

Need for Contract Transparency: Stakeholders have requested to see contracts with subcontractors and consultants to understand the scope of what SoCalGas has asked these external parties to provide, crucial for assessing the impartiality and depth of the studies conducted.

Concerns About Feedback Window Durations: Community concerns about the shortening of feedback windows may not provide sufficient time for thorough review and comprehensive feedback.

Demand for Public Accessibility of Documents: Court reporter documents and detailed analysis should be made publicly accessible to ensure transparency and facilitate community engagement in the review process. Comment 05-08

<u>Regarding April 23, 2024 Meeting:</u>

I was unable to attend the SoCalGas Angeles Link PAG & CBOSG Joint Update meeting on April 23, 2024, and had an alternate representative attend in my place. After reviewing the report from my representative and watching the full meeting recording, I observed a notable lack of transparency and inadequate responses to feedback regarding the project. During the meeting, SoCalGas consistently defended their process choices and appeared dismissive of significant issues raised by stakeholders. There is a distinct difference between the challenge of balancing the needs of all members involved in this process and the failure to respond effectively to serious concerns and questions related to this project.

Conclusion:

Comment 05-08

In conclusion, the concerns raised by stakeholders regarding the Angeles Link project highlight a significant need for improved transparency and responsiveness from SoCalGas. Moving forward, we expect a more robust engagement strategy that not only listens to but also integrates stakeholder feedback into the project's planning and execution phases.

Sincerely,
Faith Myhra (she/they)
Member
Protect Playa Now
protectplayanow@gmail.com
Writing from the traditional, ancestral, and unceded territory of the Tongva, Kizh, and Chumash People.

PROTECT PLAYA NOW COMMENT 5-1

I am writing to express Protect Playa Now's concerns and to provide feedback on the preliminary data and findings documents related to the Angeles Link project, as prepared and presented by SoCalGas. The documents we have reviewed have raised significant issues that we believe must be addressed to ensure the transparency, accuracy, and comprehensiveness of the ongoing evaluations of the Angeles Link project.

Lack of Detailed Analytical Content: The documents present high-level overviews without the necessary detailed analytical content, making it difficult for stakeholders to assess feasibility and impacts thoroughly.

Overuse of Promotional Language: The documents often use promotional language that seems aimed at advocating for the project rather than critically evaluating it. Insufficient Data: There is a notable lack of specific data or detailed impact assessments for environmental considerations.

SOCALGAS RESPONSE TO COMMENT 5-1

SoCalGas understands this comment concerning the information presented in the preliminary findings. The preliminary findings were intended to present information in a summary format with the understanding that more detailed analysis and assumptions would be provided in the full draft reports when they were available. As of the date of this submittal, all of the draft studies with additional detail have been submitted for PAG and CBOSG review. Please also refer to Global Response 1.

PROTECT PLAYA NOW COMMENT 5-2

Maps and Visuals Lack Detail: Maps and other visual aids lack sufficient detail, such as labels and explanatory notes, hindering stakeholders' ability to fully understand the project's implications.

SOCALGAS RESPONSE TO COMMENT 5-2

As mentioned in the Q1 2024 Angeles Link Quarterly Report (Comment 10-10), SoCalGas released additional maps on May 3, 2024 in response to comments received during the April 23 joint CBOSG/PAG meeting. On July 19 additional maps were also released as part of the ESJ Screening and within the draft Routing Analysis. Maps provided in the draft Routing Analysis illustrate the identified preferred routes and variations and include counties, cities, highway infrastructure and topographical information in response to stakeholder input. Maps provided in the ESJ Screening show DAC areas located near the various pipeline segments analyzed as part of the draft Routing Analysis. Additional maps are provided in the draft Environmental Analysis released to the PAG and CBOSG on July 26. A street-level alignment evaluation of each pipeline was not conducted in Phase 1 and is expected to occur in subsequent phases of Angeles Link.

PROTECT PLAYA NOW COMMENT 5-3

Absence of Methodological Transparency: There is an absence of detailed descriptions of the methodologies used for assessments, leading to doubts about the validity of the findings.

Confusing Comment Periods: The process includes two distinct periods for commenting, one for the executive summary and another for the detailed data, which can confuse and hinder comprehensive feedback.

Inadequate Tribal and Community Engagement (Still): The lack of robust engagement with local tribal leaders and communities directly conflict with the CPUC's emphasis on inclusive stakeholder engagement and the need for consent from tribal communities for projects of this nature. This oversight undermines the trust and collaborative potential crucial for the success of projects with significant environmental and social footprints.

SOCALGAS RESPONSE TO COMMENT 5-3

As of the date of this submittal, all of the draft studies with additional detail have been submitted for PAG and CBOSG review. Please also refer to Global Response 1 and Response to Comment 4-3.

PROTECT PLAYA NOW COMMENT 5-4

Discrepancies in Demand Projections: The demand projections by SoCalGas do not align with findings from authoritative bodies like the California Energy Commission and the California Air Resources Board, raising questions about the accuracy and reliability of SoCalGas's projections.

SOCALGAS RESPONSE TO COMMENT 5-4

Please refer to the Q1 2024 Response to Comments, Global Response 2.1 which provided California hydrogen demand projections from the CARB, CEC, ARCHES, and UCD. These demand projections are in line with SoCalGas's conservative and moderate demand projections.

PROTECT PLAYA NOW COMMENT 5-5

Limited Stakeholder Engagement Evidence: The documents do not clearly show how stakeholder feedback has been incorporated, indicating a gap between provided feedback and subsequent revisions.

SOCALGAS RESPONSE TO COMMENT 5-5

As of the date of this submittal, all of the draft studies with additional detail have been submitted for PAG and CBOSG review. The draft studies each highlight key stakeholder feedback received to date and summarize how that key stakeholder feedback was incorporated. In addition, the quarterly reports provide responses to each individual written comment received on the study documents. Where applicable, those responses further explain how key stakeholder feedback has been incorporated. For additional information on the stakeholder engagement process, please also refer to Global Response 1.

PROTECT PLAYA NOW COMMENT 5-6

Unclear Evaluation of Alternatives: The documents often fail to address or evaluate alternative scenarios or options sufficiently, a crucial aspect of feasibility studies to ensure all potential outcomes are considered.

SOCALGAS RESPONSE TO COMMENT 5-6

Please refer to the draft Alternatives Study, Section 4 - Framework for Evaluation of Project Alternatives for details on how the alternative options and alternatives were analyzed.

PROTECT PLAYA NOW COMMENT 5-7

Absence of Supporting Calculations: Critical spreadsheet calculations for key studies like the demand study and the NOx study have not been provided, preventing stakeholders from verifying the accuracy or reliability of the findings.

SOCALGAS RESPONSE TO COMMENT 5-7

The preliminary findings are intended to convey the key takeaways that are emerging in preparation of the draft report. Supporting detail, including detailed spreadsheets, is provided with the draft studies and included as appendices where applicable. Please refer to the draft NOx Study as it provides detailed information and descriptions regarding how the emission factors were developed, including assumptions and data used to prepare the calculations (see Appendix C). The draft Demand Study also includes a technical appendix that summarizes the methodology and key assumptions supporting the analysis.

PROTECT PLAYA NOW COMMENT 5-8

Need for Contract Transparency: Stakeholders have requested to see contracts with subcontractors and consultants to understand the scope of what SoCalGas has asked these external parties to provide, crucial for assessing the impartiality and depth of the studies conducted.

Concerns About Feedback Window Durations: Community concerns about the shortening of feedback windows may not provide sufficient time for thorough review and comprehensive feedback.

Demand for Public Accessibility of Documents: Court reporter documents and detailed analysis should be made publicly accessible to ensure transparency and facilitate community engagement in the review process.

I was unable to attend the SoCalGas Angeles Link PAG & CBOSG Joint Update meeting on April 23, 2024, and had an alternate representative attend in my place. After reviewing the report from my representative and watching the full meeting recording, I observed a notable lack of transparency and inadequate responses to feedback regarding the project. During the meeting, SoCalGas consistently defended their process choices and appeared dismissive of significant issues raised by stakeholders. There is a distinct difference between the challenge of balancing the needs of all members involved in this process and the failure to respond effectively to serious concerns and questions related to this project.

In conclusion, the concerns raised by stakeholders regarding the Angeles Link project highlight a significant need for improved transparency and responsiveness from SoCalGas. Moving forward, we expect a more robust engagement strategy that not only listens to but also integrates stakeholder feedback into the project's planning and execution phases.

SOCALGAS RESPONSE TO COMMENT 5-8

In response to the comment requesting contracts with consultants supporting the Phase 1 feasibility studies, SoCalGas provided summary descriptions of the scopes of work and technical approaches for each study for PAG and CBOSG feedback in previous milestones during Phase 1. Execution of the scopes of work and contracting details with the consultants supporting the Phase 1 feasibility studies are proprietary to SoCalGas and the consultants. SoCalGas will continue to respond to and incorporate additional feedback on the draft studies as appropriate and will document those responses in the final draft reports and Q3 2024 Quarterly Report to be submitted later this year.

In response to accessibility of court reporter transcripts from the quarterly meetings and workshops, meeting transcripts are posted to the Living Library and are included as an appendix in the quarterly reports, please refer to Appendix 5 in this Q2 2024 Angeles Link Quarterly Report for the meeting transcripts from this quarter.

In response to the comment concerning the comment duration windows and for more information related to the stakeholder engagement process, please refer to Global Response 1.

2.6 Comment Letter 6 – Green Hydrogen Coalition

Comment Letter 6

GREEN HYDROGEN COALITION

May 30, 2024

Southern California Gas Company
555 West Fifth Street
Los Angeles, CA 90013

Submitted via email to: ALP1_Study_PAG_Feedback@insigniaenv.com

RE: Feedback for Southern California Gas Company on Preliminary Findings Presentations for June 2 Quarterly Report

The Green Hydrogen Coalition ('GHC') is appreciative of SoCalGas' effort to implement Angeles Link, the nation's first dedicated common carrier renewable hydrogen pipeline, as it is an essential component of California's goal of economy wide decarbonization and our transition away from fossil fuels. The GHC is a California educational 501(c)(3) non-profit organization that was formed in 2019 to recognize the game-changing potential of "green hydrogen" to accelerate multi-sector decarbonization and combat climate change. The GHC's mission is to facilitate policies and practices that advance green hydrogen production and use across all sectors of the economy to accelerate a carbon-free energy future and a just energy transition.

From 2020-2023 the GHC launched and completed HyBuild Los Angeles, a multi stakeholder independent system planning effort to determine if it is commercially and technically possible to create a mass-scale green hydrogen ecosystem to displace fossil fuels across multiple sectors. (final public report attached) This effort was geared toward first identifying potential multi-sectoral buyers/demand for the renewable hydrogen and then architecting the needed scaled production and transport infrastructure to serve that demand. Findings from this effort were highly encouraging. The GHC found that achieving a mass-scale green hydrogen economy to rapidly displace fossil fuels in several hard to abate sectors is indeed technically and commercially possible. It will require shared, scaled infrastructure; namely green hydrogen pipeline transport connected to underground geologic storage of hydrogen. This infrastructure combination affords the lowest cost pathway to achieving mass-scale supply assurance and low delivered cost to enable widespread adoption of GH2. The successful implementation of Angeles Link is thus a gating factor for Southern California's realization of a green hydrogen economy and a faster transition away from fossil fuels economywide.

Comment 06-01

Green Hydrogen Coalition

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GREEN HYDROGEN COALITION

Key findings from HyBuild LA include:

1. LA can achieve $2.05/kg delivered green electrolytic hydrogen by 2030, and <$1/kg delivered with federal tax incentives. This forecast is based on a robust system plan to serve 1.4 million metric tons of demand per year and can only be achieved by reducing hydrogen transport cost via dedicated green hydrogen pipeline connected to underground geologic storage of hydrogen. The GHC system plan investigated an alternative GH2 local in-basin production option (that sited electrolysis production in the LA basin) but found that there was insufficient local renewable electricity resource/land availability and insufficient electric transmission capacity (now and in the future) for transporting the large quantity of renewable electricity that would be required to meet the forecasted demand for electrolytic green hydrogen.
2. At the $2.05/kg forecasted, at-scale delivered cost, green hydrogen will be highly competitive with fossil fuels in many applications, and will enable a faster, more accelerated energy transition away from fossil fuels. Widespread adoption requires that off-takers have certainty of supply and are able to sign long-term contracts. This is only possible with appropriate pipeline infrastructure to deliver mass scale, cost competitive green hydrogen.
3. Significant demand (1.4 MMT per year by 2030) was identified across a number of sectors in Southern California, including on/off-road heavy-duty vehicles/equipment, aviation, shipping, and the power sector. Specific off takers were interviewed, and many expressed an interest/willingness to convert from fossil fuels provided GH2 or its fuel derivatives could be procured at sufficient scale and prices competitive with fossil alternatives. Both of these conditions will ultimately require pipeline transport as there is simply not enough space/room or renewable electricity resource located in the LA basin to produce the quantities of green electrolytic hydrogen needed locally.
4. California has sufficient renewable resources and potential for recycled wastewater resources to produce electrolytically produce green hydrogen at the scale to meet the forecasted demand.

Comment 06-01

HyBuild LA findings are consistent with the preliminary findings from the Angeles Link work to date, including the Angeles Link forecasted demand scenarios for the pipeline sizing (0.5, 1.0 and 1.5 million metric tons per year). Additionally, the GHC found that there was

Comment 06-02

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significant renewable resource in the locations identified by Socalgas for third party clean renewable hydrogen production, including locations in the San Joaquin Valley, and near Lancaster CA. GHC also applauds SoCalGas' thorough evaluation of potential geologic storage options for green hydrogen, including not only commercially available salt dome storage but also the potential for hydrogen storage in depleted oil and gas fields. Comment 06-02

HyBuild LA also identified significant air quality, public health and economic development opportunities that will result from a scaled green hydrogen economy for Southern California, largely due its ability to displace the combustion of diesel fuel. The impact of reduced emissions is significant - for a single winter month in 2045 the value of public health benefits exceeded $350 million for the LA Basin, representing 27 fewer premature deaths, 964 fewer hospitalizations for respiratory and cardiovascular illness and 7,500 fewer work loss days. GHC concurs with Socalgas that the NOx emissions reductions will largely be driven by conversion of medium to heavy duty trucks and other existing diesel-combustion equipment in the mobility and logistics sectors that cannot be converted to battery electrics due to their duty cycle and hauling loads. Comment 06-03

Building a scaled GH2 economy for southern California will also generate diversely skilled jobs, exceeding the quantity of jobs from incumbent fossil fuel industries. The GHC looks forward to Socalgas's future workforce job estimates and encourages Socalgas to ensure that it is comprehensive in its job forecasts to include job creation possible from related infrastructure (eg wastewater treatment) and end use infrastructure (eg. fueling stations) that a common carrier pipeline such as Angeles Link will uniquely enable. Importantly, GHC views the establishment of a scaled green hydrogen economy for California as a key enabler to invest in and upgrade needed infrastructure in adjacent sectors, such as wastewater treatment. On their own, these needed public benefit infrastructure investments may be difficult to finance solely by taxpayers. Including these investments as part of a larger, highly valuable green hydrogen ecosystem can help enable these needed investments. Again, the key infrastructure that makes a green hydrogen ecosystem possible – to achieve mass scale, low delivered GH2 cost -- is shared pipeline transport and storage. Additionally, the GHC's HyBuild LA system planning study found that if California's geologic storage requires connection to out of state salt domes, this connection will need to occur through Southern California due to the difficulty of pipeline siting through the northern part of the Sierra Nevada mountain range. If Angeles Link is to be the first H2 pipeline to connect California to out of state salt dome H2 storage, it will also be critically important for balancing supply Comment 06-04

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GREEN HYDROGEN COALITION

and demand to northern California as well. It is for this reason that Angeles Link is strategic and necessary for the entire state of California. Comment 06-04

Finally, with regard to safety, the GHC applauds Socalgas' approach that includes ongoing collaboration with the Center for Hydrogen Safety. This work should also be closely coordinated with emerging new studies and approaches on the direct measurement of hydrogen leakage and potential solutions to mitigate its occurrence and risks, including potential new technological solutions to remedy these concerns as appropriate/ needed.[1] The GHC appreciates Socalgas' acknowledgement of work that EDF has been conducting with Aerodyne research to better understand the and quantify hydrogen emissions. Comment 06-05

The GHC looks forward to participating in the June 21 Quarterly PAG meeting and to the opportunity to further comments as additional analyses are completed.

[1] One such example that is worth noting is "Safety Pipe" sweep gas technology: https://www.h2clipper.com/solutions/safety-pipe

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GREEN HYDROGEN COALITION COMMENT 6-1

The Green Hydrogen Coalition ("GHC") is appreciative…….#4 California has sufficient renewable resources and potential for recycled wastewater resources to produce electrolytically produce green hydrogen at the scale to meet the forecasted demand.

SOCALGAS RESPONSE TO COMMENT 6-1

The information provided by Green Hydrogen Coalition (GHC) is consistent with the findings from the Angeles Link feasibility analyses completed to date.

GREEN HYDROGEN COALITION COMMENT 6-2

HyBuild LA findings are consistent with the preliminary findings from the Angeles Link work to date, including the Angeles Link forecasted demand scenarios for the pipeline sizing (0.5, 1.0 and 1.5 million metric tons per year). Additionally, the GHC found that there was significant renewable resource in the locations identified by SoCalGas for third party clean renewable hydrogen production, including locations in the San Joaquin Valley, and near Lancaster CA. GHC also applauds SoCalGas' thorough evaluation of potential geologic storage options for green hydrogen, including not only commercially available salt dome storage but also the potential for hydrogen storage in depleted oil and gas fields.

SOCALGAS RESPONSE TO COMMENT 6-2

SoCalGas agrees that the Angeles Link draft Demand Study and draft Production Study preliminary findings are consistent with the findings in HyBuild LA.

GREEN HYDROGEN COALITION COMMENT 6-3

HyBuild LA also identified significant air quality, public health and economic development opportunities that will result from a scaled green hydrogen economy for Southern California, largely due its ability to displace the combustion of diesel fuel. The impact of reduced emissions is significant - for a single winter month in 2045 the value of public health benefits exceeded $350 million for the LA Basin, representing 27 fewer premature deaths, 964 fewer hospitalizations for respiratory and cardiovascular illness and 7,500 fewer work loss days. GHC concurs with SoCalGas that the NOx emissions reductions will largely be driven by conversion of medium to heavy duty trucks and other existing diesel-combustion equipment in the mobility and logistics sectors that cannot be converted to battery electrics due to their duty cycle and hauling loads.

SOCALGAS RESPONSE TO COMMENT 6-3

SoCalGas acknowledges GHC’s concurrence on the conclusions identified in the draft NOx Study.

GREEN HYDROGEN COALITION COMMENT 6-4

Building a scaled GH2 economy for southern California will also generate diversely skilled jobs, exceeding the quantity of jobs from incumbent fossil fuel industries. The GHC looks forward to SoCalGas's future workforce job estimates and encourages SoCalGas to ensure that it is comprehensive in its job forecasts to include job creation possible from related infrastructure (eg wastewater treatment) and end use infrastructure (eg. fueling stations) that a common carrier pipeline such as Angeles Link will uniquely enable. Importantly, GHC views the establishment of a scaled green hydrogen economy for California as a key enabler to invest in and upgrade needed infrastructure in adjacent sectors, such as wastewater treatment. On their own, these needed public benefit infrastructure investments may be difficult to finance solely by taxpayers. Including these investments as part of a larger, highly valuable green hydrogen ecosystem can help enable these needed investments. Again, the key infrastructure that makes a green hydrogen ecosystem possible – to achieve mass scale, low delivered GH2 cost -- is shared pipeline transport and storage. Additionally, the GHC's HyBuild LA system planning study found that if California's geologic storage requires connection to out of state salt domes, this connection will need to occur through Southern California due to the difficulty of pipeline siting through the northern part of the Sierra Nevada Mountain range. If Angeles Link is to be the first H2 pipeline to connect California to out of state salt dome H2 storage, it will also be critically important for balancing supply and demand to northern California as well. It is for this reason that Angeles Link is strategic and necessary for the entire state of California.

SOCALGAS RESPONSE TO COMMENT 6-4

An employment impact analysis was conducted to estimate the number of potential jobs that could be created by Angeles Link. Please see section 2.0 Employment Impact Analysis in the draft Workforce Study.

GREEN HYDROGEN COALITION COMMENT 6-5

Finally, with regard to safety, the GHC applauds SoCalGas' approach that includes ongoing collaboration with the Center for Hydrogen Safety. This work should also be closely coordinated with emerging new studies and approaches on the direct measurement of hydrogen leakage and potential solutions to mitigate its occurrence and risks, including potential new technological solutions to remedy these concerns as appropriate/ needed. FN1

The GHC appreciates SoCalGas' acknowledgement of work that EDF has been conducting with Aerodyne research to better understand the and quantify hydrogen emissions. The GHC looks forward to participating in the June 21 Quarterly PAG meeting and to the opportunity to further comments as additional analyses are completed.

FN1 – One such example that is worth noting is "Safety Pipe" sweep gas technology: https://www.h2clipper.com/solutions/safety-pipe.

SOCALGAS RESPONSE TO COMMENT 6-5

SoCalGas has submitted the draft Safety Study to the Hydrogen Safety Panel for review and comment and will be incorporating feedback in the study as appropriate and in the Q3 2024 Quarterly Report.

2.7 Comment Letter 7 – Public Advocates Office

Comment Letter 7

The Public ADVOCATES OFFICE

June 4, 2024

Informal Comments of the Public Advocates Office on
Southern California Gas Company's Angeles Link Pipeline Sizing Preliminary Findings Report

The Public Advocates Office at the California Public Utilities Commission (Cal Advocates) provides these comments on Southern California Gas Company's (SoCalGas) *Angeles Link Pipeline Sizing and Design Criteria Preliminary Data and Findings* (Design Findings), which was issued on May 21, 2024.

As a general matter, the Design Findings document is only 12 slides from a presentation which reveals little additional information on pipeline design that had not been discussed in prior PAG meetings. In addition, the Design Findings document raises new questions about possible shortfalls in the LA Basin and whether utilizing underground storage in California will be a viable option. Cal Advocates offers these comments and questions to inform and improve the draft Pipeline Sizing and Design Criteria study to be released later this year and to address the current shortfalls based on what SoCalGas has provided to date.

Comment 07-01

The Pipeline Sizing and Design Criteria Study Must Satisfy Commission Orders

The Design Findings document notes that although the Pipeline Sizing and Design Criteria study will "identif[y] specific materials for pipeline, fittings, and differences in operational equipment",[1] it does not identify the pipeline materials used for the proposed Angeles Link. This information is needed in order to evaluate the safety of the pipeline design. Commission Decision (D.) 22-12-055, Ordering Paragraph [OP] 6(f), requires that SoCalGas provide, as part of its Phase 1 Feasibility Studies, "Evaluations of safety concerns involved in pipeline transmission, storage, and transportation."[2] Therefore, this deficiency must be addressed in the draft study.

Comment 07-02

[1] Design Findings, at 2.
[2] D.22-12-055, Ordering Paragraph [OP] 6(f) – "Evaluations of safety concerns involved in pipeline transmission, storage, and transportation".

Angeles Link Pipeline is Being Sized and Designed to Below the Conservative Demand Scenario

The Design Findings document provides a high-level approach on how to design a pipeline solution to match in-basin demand from production sites[3] outside of the LA Basin. One of the principal study assumptions is that the pipeline is being designed for multiple scenarios to meet an annual throughput range of between 0.5 – 1.5 million metric tons per year (TPY).[4] This throughput range is compared to the estimated hydrogen demand for end users in-basin from Angeles Link's Demand Study draft report, summarized in Table 1:

Comment 07-03

Table 1 - Renewable Hydrogen Demand Scenarios for 2045 in SoCalGas' Service Territory in Millions of Tons per Year [5]

Conservative	Moderate	Ambitious
1.9M TPY	3.2M TPY	5.9M TPY

In both the Design Findings[6] and the *Production Planning & Assessment Preliminary Data and Findings* (Production Findings), [7] SoCalGas is planning for the delivery of 1.5M TPY. This is below even the most conservative demand scenario for 2045 from the Demand Study draft report. This leaves several questions which SoCalGas should address in its draft report:

Comment 07-04

- Is the Angeles Link pipeline solution, from the three production locations examined, expected to fall short of delivering to even the most conservative demand scenario estimate by 2045?
- Is the estimated production quantity constrained by the amount of green hydrogen which can be produced by the three production locations, the diameter and number of pipelines with which to transport hydrogen from production to end users in-basin, or other unnamed constraints?
- How does SoCalGas expect the remaining volume of gas not delivered by Angeles Link to be produced and delivered to meet forecasted 2045 demand in its draft Demand Study draft report?

[3] "Third-party clean renewable hydrogen production potentially located in San Joaquin Valley, Lancaster, and Blythe based on input from the Production Planning and Assessment study[.]" Design Findings, at 7.
[4] Design Findings, at 7.
[5] Angeles Link Demand Study draft report, at 5.
[6] Design Findings, at 7.
[7] In Production Findings, at 4, SoCalGas notes "Angeles Link is envisioned to potentially serve throughput scenarios of 0.5 - 1.5 million metric tonnes per year (MMTPY), which is a portion of the estimated 1.9 - 5.9 MMTPY* of hydrogen demand in SoCalGas service territory[.]"

- If the Ambitious demand scenario occurs, does SoCalGas expect that there may need to be additional pipelines constructed beyond this initial Angeles Link dual run[8] pipeline design? Comment 07-04

SoCalGas Should Clarify if its Analysis Shows Deliverability Constraints In-Basin

The Design Findings document notes that while the preliminary pipeline system will likely have a Maximum Allowable Operating Pressure (MAOP) of 1,200 pounds per square inch gauge (psig), the lowest delivery pressure found in the system would be to the Ports of Lost Angeles and Long Beach where pressure would be lowered to 200 psig. The document does not elaborate on how or where the pressure will be regulated from 1,200 to 200 psig, nor whether this lower pressure is a result of adequately meeting end-user demand or whether it is a result of pipeline design constraints[9] limiting hydrogen deliverability within the LA Basin. SoCalGas should elaborate on the reasons that drive the reduction in operational pressure, especially if these lower pressures begin to affect deliverability to end users in the LA Basin. Comment 07-05

The Feasibility and Value of Hydrogen Storage Resources near Production Sites Must be Quantified to Assess Primary Production Siting

The Design Findings document provides new, useful geospatial analysis on the available underground storage options across California, Utah, Arizona, and New Mexico.[10] Since the Angeles Link pipeline is being proposed as "an intrastrate hydrogen system that would transport clean renewable hydrogen between regional third-party production, storage, and end use areas within Central and Southern California",[11] several of the larger, out-of-state salt caverns would not be considered for use as hydrogen gas storage. What remains are the few, smaller in-state depleted oil and gas fields that offer a mixture of storage capabilities in the southern San Joaquin Valley and Los Angeles mountains. With SoCalGas looking to avoid use of its existing natural gas storage facilities[12] in and around Los Angeles, the San Joaquin Valley remains the main region capable of supporting underground hydrogen storage in California. Comment 07-06

In the separate *High-Level Economic Analysis and Cost Effectiveness* (Cost Findings) document, SoCalGas notes in a levelized cost of hydrogen analysis that it had "…assumed underground storage for Comment 07-07

[8] "Select pipelines modeled as two-parallel lines (dual run) for functional flexibility[.]" Design Findings, at 7.
[9] E.g. 49 CFR 192.5 Class Location constraints to the system MAOP, 49 CFR 192.903(c) Pipeline Impact Radius constraints to system MAOP and pipe diameter, etc.
[10] Design Findings, at 10.
[11] Design Findings, at 10.
[12] "While SoCalGas facilities were evaluated for geologic adequacy because they are located within the study area, they are not currently being considered as storage options for Angeles Link." Design Findings, at 11.

Angeles Link and trucking options, and above ground storage for the rest of the alternatives."[13] This cost assumption dramatically reduces the levelized cost of hydrogen for the Angeles Link pipeline solution, which saves between $1.38 - $2.03 per kg of H_2 compared to those scenarios that use aboveground storage.[14] For SoCalGas' cost assumption to make sense, the primary production location of a proposed Angeles Link pipeline must be located near underground storage options. The Lancaster or Blythe production locations fail to meet this requirement as there are no available storage options between these locations and demand in the LA basin. Instead, both Lancaster and Blythe production would have to rely on aboveground storage, a more costly solution.[15] Although the Blythe location has potential to connect to out-of-state salt storage, it is not evident from the preliminary filing whether this is expected. Of the options studied, only the San Joaquin Valley (SJV) site has the potential to use underground storage local to the production region. This also implies that any production scenario that does not include the SJV site[16] would similarly make the Angeles Link pipeline solution far less cost-effective compared to its hydrogen delivery alternatives.[17]

Comment 07-07

The existence and location of reliable hydrogen storage appears to be an impediment to the siting of primary production locations analyzed in the Design Findings document. Quantifying the suitability and storage capacity of depleted oil and gas fields for underground storage will be critically important to determine whether the proposed Angeles Link is as cost effective as stated.[18] In its draft report, SoCalGas must provide additional estimates of the storage capacities of California's depleted oil and gas fields for potential use as underground storage, so that stakeholders can properly assess the cost-effectiveness of the Angeles Link compared to other hydrogen delivery alternatives.

SoCalGas Must Cite Research of Safely Storing Hydrogen at Depleted Oil and Gas Fields

Separate from the issue of siting primary production near underground storage, there remains several unanswered safety questions raised specifically by utilizing depleted oil and gas fields for hydrogen storage. The California Public Utilities Commission, as part of its process to design safety thresholds for injecting hydrogen

Comment 07-08

[13] *Angeles Link High-Level Economic Analysis and Cost Effectiveness Preliminary Findings* (Cost Findings), at 8.
[14] Cost Findings, at 8, shows an estimated storage cost of **\$0.28/kg of H_2** for underground storage vs. **\$1.65/kg of H_2** for Liquid Hydrogen Shipping, the nearest cost competitor. Storage savings are even stronger for other alternatives analyzed as their assumed levelized cost was **\$2.31/kg of H_2**.
[15] Cost Findings, at 8, shows an estimated storage cost of **\$0.28/kg of H_2** for underground storage vs. **\$2.31/kg of H_2** for the storage cost of non-Angeles Link alternatives. Stakeholders are left to assume that aboveground storage costs for the Angeles Link pipeline solution would be comparable to these alternatives and that the difference in levelized storage cost is due to this aboveground/underground cost assumption.
[16] At page 9 of Findings document, Scenarios 2, 3, and 5 are all examples of production without SJV site, and therefore without access to local underground storage.
[17] Cost Findings, at 5.
[18] Cost Findings, at 8.

into the natural gas pipeline system in the Biomethane Rulemaking (R.13-02-008), commissioned the University of California Riverside (UCR) to perform a literature review of the issues associated with hydrogen blends. Although focused on blends specifically, the resulting research paper – the UCR Study – also assessed safety issues with the injection of hydrogen into depleted oil and gas reservoirs for long-term storage.[19] Among the concerns raised were twenty major issues involved with storing hydrogen inside of depleted oil and gas fields.[20] The UCR study later concluded that additional effort should be undertaken to "Conduct experimental and modeling work and analysis to develop strategies to mitigate or avoid known hydrogen impacts including underground storage facilities other than salt caverns…".[21] The Design Findings document does not address these risks, nor does it present new information which may have clarified these safety concerns. Cal Advocates recommends that SoCalGas include in its draft report all the information on the mitigation strategies for these known safety issues that SoCalGas intends to implement so that hydrogen storage at these depleted oil and gas field locations will be safe.

Comment 07-08

Conclusion

In summary, underground storage will be essential to influence the locations that can be developed for hydrogen production. Understanding and analysis of the viability of underground storage will determine whether a pipeline solution is safe and the most cost-effective solution for delivering hydrogen to demand in-basin. As such, the draft Pipeline Sizing and Design Criteria study should clearly answer the following questions:

- What are the specific materials for pipeline, fittings, and differences in operational equipment SoCalGas identifies for its pipeline?
- How is SoCalGas finding its deliverability to end users constrained by either production outside of the basin or design considerations in-basin?
- How is the use of depleted oil and gas fields as underground storage for hydrogen feasible from a safety mitigation and storage capacity perspective?

Comment 07-09

[19] UCR Study, at 15-16.
[20] "Hydrogen is known to have serious detrimental effects on underground porous reservoirs. Twenty different hydrogen related phenomena have been observed that have negative effects on porous reservoirs' performance as storage facilities for methane-hydrogen gas blends. The most serious of these is bacterial growth and activity, resulting in loss of gas volume, potential for H_2S production and damage to reservoir itself [44]." UCR Study, at 15.
[21] UCR Study, at 114.

CAL ADVOCATES COMMENT 7-1

The Public Advocates Office at the California Public Utilities Commission (Cal Advocates) provides these comments on Southern California Gas Company's (SoCalGas) Angeles Link Pipeline Sizing and Design Criteria Preliminary Data and Findings (Design Findings), which was issued on May 21, 2024.

As a general matter, the Design Findings document is only 12 slides from a presentation which reveals little additional information on pipeline design that had not been discussed in prior PAG meetings. In addition, the Design Findings document raises new questions about possible shortfalls in the LA Basin and whether utilizing underground storage in California will be a viable option. Cal Advocates offers these comments and questions to inform and improve the draft Pipeline Sizing and Design Criteria study to be released later this year and to address the current shortfalls based on what SoCalGas has provided to date.

SOCALGAS RESPONSE TO COMMENT 7-1

SoCalGas understands this comment concerning the information presented in the preliminary findings. The preliminary findings were intended to present information in a summary format with the understanding that more detailed analysis and assumptions would be provided in the full draft reports when they were available. As of the date of this submittal, all of the draft studies with additional detail have been submitted for PAG and CBOSG review. Please also refer to Global Response 1.

CAL ADVOCATES COMMENT 7-2

The Pipeline Sizing and Design Criteria Study Must Satisfy Commission Orders – The Design Findings document notes that although the Pipeline Sizing and Design Criteria study will "identif[y] specific materials for pipeline, fittings, and differences in operational equipment", FN1 it does not identify the pipeline materials used for the proposed Angeles Link. This information is needed in order to evaluate the safety of the pipeline design. Commission Decision (D.) 22-12-055, Ordering Paragraph [OP] 6(f), requires that SoCalGas provide, as part of its Phase 1 Feasibility Studies, "Evaluations of safety concerns involved in pipeline transmission, storage, and transportation." FN2 Therefore, this deficiency must be addressed in the draft study.

FN 1 – Design Findings, at 2.
FN 2 – D.22-12-055, Ordering Paragraph [OP] 6(f) – "Evaluations of safety concerns involved in pipeline transmission, storage, and transportation".

SOCALGAS RESPONSE TO COMMENT 7-2

In compliance with D.22-12-055, Chapter 5 of the draft Design Study evaluated a range of potential material specifications based on preliminary hydraulic analyses and considered construction logistics and maintenance practices to improve pipeline longevity and reliability. Additional pipeline materials compatibility and safety evaluation will be conducted as a preferred route and operating parameters are established in a future phase of Angeles Link.

CAL ADVOCATES COMMENT 7-3

Angeles Link Pipeline is Being Sized and Designed to Below the Conservative Demand Scenario – The Design Findings document provides a high-level approach on how to design a pipeline solution to match in-basin demand from production sites FN3 outside of the LA Basin. One of the principal study assumptions is that the pipeline is being designed for multiple scenarios to meet an annual throughput range of between 0.5 – 1.5 million metric tons per year (TPY). FN4 This throughput range is compared to the estimated hydrogen demand for end users in-basin from Angeles Link's Demand Study draft report, summarized in Table 1:

Table 1 – Renewable Hydrogen Demand Scenarios for 2045 in SoCalGas' Service Territory in Millions of Tons per Year FN5

Conservative	Moderate	Ambitious
1.9M TPY	3.2M TPY	5.9M TPY

FN 3 – "Third-party clean renewable hydrogen production potentially located in San Joaquin Valley, Lancaster, and Blythe based on input from the Production Planning and Assessment study[.]" Design Findings, at 7.
FN 4 – Design Findings, at 7.
FN 5 – Angeles Link Demand Study draft report, at 5.

SOCALGAS RESPONSE TO COMMENT 7-3

The Demand study analyzed total potential market demand for clean renewable hydrogen in SoCalGas' service territory through 2045 across the mobility, power generation, and industrial sectors. Angeles Link throughput scenarios range from 0.5 to 1.5 million tonnes per year (MMTPY) that could meet a portion of total demand as displayed in Table 1 above. Various combinations of achieving these 0.5, 1.0, and 1.5 MMTPY flowrates were modeled in the Design Study to analyze potential pathways to deliver hydrogen from the potential primary production locations to demand centers in the Central and Southern California, including the LA Basin.

CAL ADVOCATES COMMENT 7-4

In both the Design Findings FN6 and the Production Planning & Assessment Preliminary Data and Findings (Production Findings), FN7 SoCalGas is planning for the delivery of 1.5M TPY. This is below even the most conservative demand scenario for 2045 from the Demand Study draft report. This leaves several questions which SoCalGas should address in its draft report:

- Is the Angeles Link pipeline solution, from the three production locations examined, expected to fall short of delivering to even the most conservative demand scenario estimate by 2045?

- Is the estimated production quantity constrained by the amount of green hydrogen which can be produced by the three production locations, the diameter and number of pipelines with which to transport hydrogen from production to end users in-basin, or other unnamed constraints?

- How does SoCalGas expect the remaining volume of gas not delivered by Angeles Link to be produced and delivered to meet forecasted 2045 demand in its draft Demand Study draft report?

- If the Ambitious demand scenario occurs, does SoCalGas expect that there may need to be additional pipelines constructed beyond this initial Angeles Link dual run FN8 pipeline design?

FN 6 – Design Findings, at 7.
FN 7 – In Production Findings, at 4, SoCalGas notes "Angeles Link is envisioned to potentially serve throughput scenarios of 0.5 - 1.5 million metric tonnes per year (MMTPY), which is a portion of the estimated 1.9 - 5.9 MMTPY* of hydrogen demand in SoCalGas service territory[.]"
FN 8 – "Select pipelines modeled as two-parallel lines (dual run) for functional flexibility[.]" Design Findings, at 7.

SOCALGAS RESPONSE TO COMMENT 7-4

Please refer to response to Comment 7-3.

The Demand Study estimates the total potential market demand for hydrogen in SoCalGas's service territory to range from 1.9 to 5.9 million metric tonnes per year (MMTPY). As mentioned in response to Comment 7-3, the Angeles Link throughput scenarios of 0.5, 1, and 1.5 MMTPY were assessed to be a portion of the total market demand at various potential market penetration rates. These throughput scenarios represent substantial at scale delivery through Angeles Link that could support overall demand.

Furthermore, the draft Production Study considered land availability, solar resources, and the efficiency of electrolyzers as potential constraints to hydrogen production. Considering these assumptions and the expected throughput to be delivered via Angeles Link as will be addressed in the Demand Study, various production throughput scenarios were developed to inform potential pipeline sizing and routing. Please also refer to response to Comment 1-5 for more details.

SoCalGas considered various Angeles Link throughput scenarios as a starting point to show how an Angeles Link pipeline system could support the transportation of large-scale volumes of hydrogen. Additional pipelines and other delivery transportation modalities from producers to end users could complement the Angeles Link pipeline system to deliver hydrogen to end users, enabling the demand market to grow in parallel with the Angeles Link pipeline system.

The analysis performed in the draft Design Study considered throughput volumes of 0.5, 1.0, and 1.5 MMTPY. Single-run and mixed-run configurations were considered to support up to the 1.5 MMTPY scenario. An assessment of the pipeline system configurations required to meet the volumes identified in the Demand Study's ambitious scenario. This was not considered in scope of the feasibility phase of the Design Study.

CAL ADVOCATES COMMENT 7-5

SoCalGas Should Clarify if its Analysis Shows Deliverability Constraints In-Basin The Design Findings document notes that while the preliminary pipeline system will likely have a Maximum Allowable Operating Pressure (MAOP) of 1,200 pounds per square inch gauge (psig), the lowest delivery pressure found in the system would be to the Ports of Lost Angeles and Long Beach where pressure would be lowered to 200 psig. The document does not elaborate on how or where the pressure will be regulated from 1,200 to 200 psig, nor whether this lower pressure is a result of adequately meeting end-user demand or whether it is a result of pipeline design constraints FN9 limiting hydrogen deliverability within the LA Basin. SoCalGas should elaborate on the reasons that drive the reduction in operational pressure, especially if these lower pressures begin to affect deliverability to end users in the LA Basin.

FN 9 – E.g. 49 CFR 192.5 Class Location constraints to the system MAOP, 49 CFR 192.903(c) Pipeline Impact Radius constraints to system MAOP and pipe diameter, etc.

SOCALGAS RESPONSE TO COMMENT 7-5

Phase 1 aims to estimate a range of potential system design criteria based on possible routing configurations and input from other feasibility studies, which are subject to change with further evaluation in future phases. Chapter 3 of the draft Design Study provides the design parameters, including design pressure, for the preliminary hydraulic analysis. Specific end-user requirements are outside the scope of Phase 1 and not addressed in the draft Design Study. Future engineering and design development will be performed when definitive operating requirements such as flow rates and pressures, final preferred routing and geometry, and distinct location of end-users and third-party producers are determined.

CAL ADVOCATES COMMENT 7-6

The Feasibility and Value of Hydrogen Storage Resources near Production Sites Must be Quantified to Assess Primary Production Siting. The Design Findings document provides new, useful geospatial analysis on the available underground storage options across California, Utah, Arizona, and New Mexico. FN10 Since the Angeles Link pipeline is being proposed as “an intrastrate hydrogen system that would transport clean renewable hydrogen between regional third-party production, storage, and end use areas within Central and Southern California”, FN11 several of the larger, out-of-state salt caverns would not be considered for use as hydrogen gas storage. What remains are the few, smaller in-state depleted oil and gas fields that offer a mixture of storage capabilities in the southern San Joaquin Valley and Los Angeles mountains. With SoCalGas looking to avoid use of its existing natural gas storage facilities FN12 in and around Los Angeles, the San Joaquin Valley remains the main region capable of supporting underground hydrogen storage in California.

FN 10 & 11 – Design Findings, at 10.

FN 12 – “While SoCalGas facilities were evaluated for geologic adequacy because they are located within the study area, they are not currently being considered as storage options for Angeles Link.” Design Findings, at 11.

SOCALGAS RESPONSE TO COMMENT 7-6

In an effort to be responsive to stakeholder feedback to evaluate and identify storage technologies, potential third-party aboveground technologies and underground hydrogen storage geologic feasibility were evaluated at a high level and provided in the draft Production Study Appendix B. Potential third-party underground hydrogen storage locations that are located out of state -- in Arizona, New Mexico and Utah -- have been clearly marked.

The Angeles Link infrastructure system is proposed to be an intrastate pipeline system serving Central and Southern California; as such, potential regional underground and aboveground storage facilities are assumed to be third-party operated. As Angeles Link is further designed, and in alignment with the development of system requirements, the role of storage to support regional hydrogen producers and end users would be considered.

CAL ADVOCATES COMMENT 7-7

In the separate High-Level Economic Analysis and Cost Effectiveness (Cost Findings) document, SoCalGas notes in a levelized cost of hydrogen analysis that it had "…assumed underground storage for Angeles Link and trucking options, and above ground storage for the rest of the alternatives." FN13 This cost assumption dramatically reduces the levelized cost of hydrogen for the Angeles Link pipeline solution, which saves between $1.38 - $2.03 per kg of H2 compared to those scenarios that use aboveground storage. FN14 For SoCalGas' cost assumption to make sense, the primary production location of a proposed Angeles Link pipeline must be located near underground storage options. The Lancaster or Blythe production locations fail to meet this requirement as there are no available storage options between these locations and demand in the LA basin. Instead, both Lancaster and Blythe production would have to rely on aboveground storage, a more costly solution. FN15 Although the Blythe location has potential to connect to out-of-state salt storage, it is not evident from the preliminary filing whether this is expected. Of the options studied, only the San Joaquin Valley (SJV) site has the potential to use underground storage local to the production region. This also implies that any production scenario that does not include the SJV site FN16 would similarly make the Angeles Link pipeline solution far less cost-effective compared to its hydrogen delivery alternatives. FN17.

The existence and location of reliable hydrogen storage appears to be an impediment to the siting of primary production locations analyzed in the Design Findings document. Quantifying the suitability and storage capacity of depleted oil and gas fields for underground storage will be critically important to determine whether the proposed Angeles Link is as cost effective as stated. FN18 In its draft report, SoCalGas must provide additional estimates of the storage capacities of California's depleted oil and gas fields for potential use as underground storage, so that stakeholders can properly assess the cost-effectiveness of the Angeles Link compared to other hydrogen delivery alternatives.

FN 13 – Angeles Link High-Level Economic Analysis and Cost Effectiveness Preliminary Findings (Cost Findings), at 8.
FN 14 – Cost Findings, at 8, shows an estimated storage cost of $0.28/kg of H2 for underground storage vs. $1.65/kg of H2 for Liquid Hydrogen Shipping, the nearest cost competitor. Storage savings are even stronger for other alternatives analyzed as their assumed levelized cost was $2.31/kg of H2.
FN 15 – Cost Findings, at 8, shows an estimated storage cost of $0.28/kg of H2 for underground storage vs. $2.31/kg of H2 for the storage cost of non-Angeles Link alternatives. Stakeholders are left to assume that aboveground storage costs for the Angeles Link pipeline solution would be comparable to these alternatives and that the difference in levelized storage cost is due to this aboveground/underground cost assumption.
FN 16 – At page 9 of Findings document, Scenarios 2, 3, and 5 are all examples of production without SJV site, and therefore without access to local underground storage.
FN 17 – Cost Findings, at 5.
FN 18 – Cost Findings, at 8.

SOCALGAS RESPONSE TO COMMENT 7-7

Based on the draft Production Study (see Section 10), production location resources available (land and solar) have been identified that could potentially produce hydrogen volumes that could be transported via Angeles Link to serve end-user hydrogen demand. Third-party production area proximity to third-party storage locations would impact the Levelized Cost of Hydrogen (LCOH).

SoCalGas also agrees that more broadly, research into the feasibility of underground hydrogen storage should be completed and looks forward to a decision on the California Energy Commission's Feasibility of Underground Storage grant funding opportunity (GFO-23-503).[19]

With respect to quantifying the suitability and storage capacity of depleted oil and gas fields for third-party underground storage, the Production Study (Section 8.1 and Appendix B) includes an evaluation of the geologic potential of underground hydrogen storage but did not estimate the capacity for individual salt basins or depleted oil and gas fields. The third-party storage evaluation identified underground storage site candidates that can potentially, either individually or in aggregate, provide sufficient storage volume over time to support potential supply and demand in Central and Southern California. As Angeles Link is further designed, and in alignment with the development of system requirements, the role of storage to support regional hydrogen producers and end users would be further considered.

[19] Award will be published in Q3 2024 https://www.energy.ca.gov/sites/default/files/2024-04/GFO-23-503_Pre-Application_Workshop_Presentation_ada.pdf and https://www.energy.ca.gov/solicitations/2024-04/gfo-23-503-feasibility-underground-hydrogen-storage-california]

CAL ADVOCATES COMMENT 7-8

SoCalGas Must Cite Research of Safely Storing Hydrogen at Depleted Oil and Gas Fields – Separate from the issue of siting primary production near underground storage, there remains several unanswered safety questions raised specifically by utilizing depleted oil and gas fields for hydrogen storage. The California Public Utilities Commission, as part of its process to design safety thresholds for injecting hydrogen into the natural gas pipeline system in the Biomethane Rulemaking (R.13-02-008), commissioned the University of California Riverside (UCR) to perform a literature review of the issues associated with hydrogen blends. Although focused on blends specifically, the resulting research paper – the UCR Study – also assessed safety issues with the injection of hydrogen into depleted oil and gas reservoirs for long-term storage. FN19 Among the concerns raised were twenty major issues involved with storing hydrogen inside of depleted oil and gas fields. FN20 The UCR study later concluded that additional effort should be undertaken to "Conduct experimental and modeling work and analysis to develop strategies to mitigate or avoid known hydrogen impacts including underground storage facilities other than salt caverns…" FN21 The Design Findings document does not address these risks, nor does it present new information which may have clarified these safety concerns. Cal Advocates recommends that SoCalGas include in its draft report all the information on the mitigation strategies for these known safety issues that SoCalGas intends to implement so that hydrogen storage at these depleted oil and gas field locations will be safe.

FN 19 – UCR Study, at 15-16.
FN 20 – "Hydrogen is known to have serious detrimental effects on underground porous reservoirs. Twenty different hydrogen related phenomena have been observed that have negative effects on porous reservoirs' performance as storage facilities for methane-hydrogen gas blends. The most serious of these is bacterial growth and activity, resulting in loss of gas volume, potential for H2S production and damage to reservoir itself [44]." UCR Study, at 15.
FN 21 – UCR Study, at 114.

SOCALGAS RESPONSE TO COMMENT 7-8

In accordance with the Phase 1 Decision[20] the Safety Study evaluates safety concerns involved in pipeline transmission, storage, and transportation as applicable to Angeles Link and demonstrates that Angeles Link can be safely designed, constructed, operated, and maintained in accordance with existing regulations and industry standards and best practices pertaining to hydrogen; adapting corollary safety regulations and industry standards and best practices to suit the specific properties and characteristics of hydrogen; and developing new standards and practices specific to the transport of hydrogen. Through ongoing industry research, safety risks and mitigation information will be monitored for underground hydrogen storage in depleted oil and gas fields.

[20] D.22-12-055, OP 6(f).

CAL ADVOCATES COMMENT 7-9

Conclusion – In summary, underground storage will be essential to influence the locations that can be developed for hydrogen production. Understanding and analysis of the viability of underground storage will determine whether a pipeline solution is safe and the most cost-effective solution for delivering hydrogen to demand in-basin. As such, the draft Pipeline Sizing and Design Criteria study should clearly answer the following questions:

- What are the specific materials for pipeline, fittings, and differences in operational equipment SoCalGas identifies for its pipeline?
- How is SoCalGas finding its deliverability to end users constrained by either production outside of the basin or design considerations in-basin?
- How is the use of depleted oil and gas fields as underground storage for hydrogen feasible from a safety mitigation and storage capacity perspective?

SOCALGAS RESPONSE TO COMMENT 7-9

Please refer to Response to Comment 7-2.

Based on the draft Production Study (see Section 10), production location resources available (land and solar) have been identified that could potentially produce hydrogen volumes that could be transported via Angeles Link to serve end-user hydrogen demand. The hydrogen throughput scenarios considered for Angeles Link included 0.5, 1.0, and 1.5 MMTPY of hydrogen.

Please refer to response to Comment 7-7 and Comment 7-8.

2.8 Comment Letter 8 – Communities for Better Environment

Comment Letter 8

COMMUNITIES
FOR A BETTER
ENVIRONMENT
established 1978

June 4, 2024

Southern California Gas Company
555 West Fifth Street,
Los Angeles, CA 90013

Submitted via email to ALP1_Study_PAG_Feedback@insigniaenv.com.

Feedback for Southern California Gas Company on Preliminary Findings Presentations Provided on May 21, 2024

Communities for a Better Environment (CBE) submits this letter of feedback to Southern California Gas Company (SoCalGas) on the following materials:

I. Proposed Timelines
II. Project Options and Alternatives: Preliminary Data and Findings
III. Pipeline Sizing and Design Criteria: Preliminary Data and Findings
IV. High-Level Economic Analysis and Cost Effectiveness: Preliminary Data and Findings

These comments specifically pertain only to the preliminary findings presented in the abbreviated presentations provided on May 21, 2024. Per SoCalGas's representations at the April 23, 2024 joint PAG and CBOSG meeting, CBE expects that a separate, complete draft of the data, analysis, and findings will be released at an unknown later date. These preliminary presentations lack basic data, let alone the analysis parties need to provide feedback, and these comments cannot and do not comprise the entire scope of feedback from CBE on any of the topics presented. Failing to provide data does not comply with part seven of the CPUC Decision D.22-12-055 (hereinafter "CPUC Decision"), which requires SoCalGas to "make the data, findings, and results of Phase One feasibility studies…available to the public and not redacted unless SoCalGas is granted confidentiality of data."[1] **Comment 08-01**

As previously raised in CBE's May 3, 2024 feedback letter, it is deeply concerning that these presentations are labeled "data and findings." The presentations contain no data or related analysis to support any findings they may be summarizing. Overall, the presentations are more like public relations materials, which the PUC prohibited SoCalGas from promulgating in this

[1] CPUC Decision, Order No. 7 pg. 77.

process, than feasibility studies.[2] The CPUC Decision emphasized the importance of stakeholder engagement to identify potential impacts of the project on disadvantaged and environmental justice communities.[3] Meaningful engagement is impossible without the facts on which findings or conclusions are based.

I. Concerns Regarding Proposed Timelines

CBE is troubled by the shortened timeline for feedback for this set of materials specifically and all materials in general. These materials were provided after 5:00 pm on May 21, 2024, with a feedback submission deadline of June 4, 2024, at 5:00 pm. Accounting for the federally observed holiday of Memorial Day, that is nine business days. This timeline was further strained when SoCalGas released a 60-page Hydrogen Leakage Assessment Draft Report for feedback on May 29, 2024. Under the California Environmental Quality Act (CEQA), the required public comment period for Environmental Impact Reports is at a minimum 30 days and more than 60 days in exceptional circumstances.[4] Even a negative declaration is open for public review for 20 days at the very least, and local authorities provide for public review of notices of exemption, which can be challenged within 35 days.[5] CEQA is California's iconic public engagement statute, and its timeline provides a useful comparison for the pace at which SoCalGas demands feedback.

Of even greater concern, the timelines provided in the Project Options and Alternatives, and High-Level Economics Analysis and Cost Effectiveness presentations suggest that the complete studies, which presumably will include all the data and information that is lacking from the presentations, will be released in June 2024 and comments will be "incorporated" in June/July 2024. This timeline is incredibly concerning because these draft studies require considerable time to review in order to provide meaningful feedback. Community groups and other stakeholders have repeatedly requested longer feedback periods for these technical reports. CBE echoes these requests, in asking that SoCalGas adjust these timelines to provide appropriate periods for feedback.

Comment 08-01

II. Project Options and Alternatives: Preliminary Data and Findings

The Project Options and Alternatives: Preliminary Data and Findings Presentation ("Alternatives Presentation") is rooted in a set of criteria established by SoCalGas for the purpose of evaluating options and alternatives to the Angeles Link project. The Alternatives Presentation does not provide any substantive basis for establishing these criteria as a valid means of comparing and "carrying through" project options or alternatives. The Angeles Link project as it has been proposed is a significant investment of public funds, for new hydrogen

Comment 08-02

[2] CPUC Decision D.22-12-055 (hereinafter CPUC Decision), pg. 38.
[3] CPUC Decision, pg. 80. See also pg. 58 "Stakeholder engagement, including those from CBOs, ESJ groups, and disadvantaged communities (DAC) groups, are important to the planning process."
[4] Cal. Pub. Resources Code §21091; Cal. Code Regs. Tit. 14 §15105.
[5] Cal. Pub. Resources Code §21091; Cal. Code Regs. Tit. 14 §15062.

infrastructure that covers vast swaths of Southern California with substantial impact and risks to communities along the pipeline. Accurately and transparently weighing alternatives such as electrification at this early juncture in decision making is important to obtaining meaningful community consent and feedback. The Alternatives Presentation fails to do so.

Comment 08-02

In the Alternatives Presentation it is unclear what the complete set of criteria even are. Nine distinct criteria are named throughout the presentation, but only five of these criteria are defined. On slide three SoCalGas states that "alternatives that meet the criteria established in the study will be carried forward to the environmental and environmental social justice analysis." However, confusingly, slide 11 indicates that environmental impacts are a criterion of comparison based on the category's inclusion in a comparative heat map. Failing to provide a complete set of criteria and definitions precludes community members from providing feedback on the comparative process which is essential to establishing the viability of alternatives. Further, the Alternatives Presentation provides conflicting information about how undefined criteria are established within this study and in relation to others. For example, while CBE strongly supports screening alternatives based on "Alignment with California's Environmental Law and Public Policies", SoCalGas identifies only three applicable laws and policies - the 2022 Scoping Plan, the Advanced Clean Fleets regulation and the Executive Order (N-79-202) on zero-emissions vehicles.[6] Is this the invitation from SoCalGas for feedback on the laws and policies it should include in the screening criteria? If so, CBE requests confirmation and an opportunity to provide additional briefing, as we have extensive experience explaining to decisionmakers such as the PUC and local decisionmakers what environmental laws and policies apply to projects like Angeles Link, but it is not at all clear from the slide deck whether the listed laws/policies are illustrative or comprehensive. This lack of clarity calls into question the reliability of the findings presented in the Alternatives Presentation. CBE requests that SoCalGas clearly define each criterion and establish a separate criterion of evaluation for environmental justice concerns.

Comment 08-03

It is unclear how the criteria are applied and what exactly the four-part color-coded scale used in comparative heat maps represents. In the study approach slide[7], step two states that SoCalGas will "evaluate potential alternatives against identified criteria" but does not elaborate, and no further clarity is provided in the presentation. When examining the multiple heat map charts using the same four-part color scale which ranks criteria from highest to lowest score, Angeles Link is rated differently throughout. Because no background is provided on how or what kind of evaluation criteria are used, it is impossible to discern what a high or low score indicates. For example, on slide six, Angeles Link does not satisfy the technological maturity criteria, however later in the presentation on slide 13, in the same category as applied to distinct subsectors Angeles Link was rated in the middle of the high to low scale. Further, slide 13 asserts that "molecules are easier to store than electrons, supporting system reliability", but provides no evidence for this statement that is heavily contested. These and other inconsistencies and questionable assertions throughout the Alternatives Presentation raise significant questions as to the legitimacy of SoCalGas' findings. These inconsistencies seem to indicate a troubling bias

Comment 08-04

[6] Project Options and Alternatives, Slide 7.
[7] Project Options and Alternatives, Slide 4.

towards development of the Angeles Link project over alternatives. This lack of transparency regarding alternative comparison and the overall criteria application process precludes meaningful community feedback on the important matter of alternatives comparison. Comment 08-04

Further, an array of non-hydrogen alternatives are dismissed without providing information on the application of the stated criteria. For the sake of transparency and equitable analysis, CBE requests that SoCalGas provide the analysis related to the following dismissed alternatives: Energy Efficiency, Hydro, Geothermal, and Plug-in Hybrid. Comment 08-05

Although the presentation slide deck does not show how SoCalGas arrived at its methodology, CEQA requires alternatives consideration, and the CEQA guidelines may be instructive. These require consideration of a "no project" alternative and alternatives that are feasible and meet some of the project's high-level goals, which cannot be framed in terms so narrow that only the project could meet them.[8] Comment 08-06

SoCalGas concludes the slide deck by summarizing stakeholder feedback. While it identifies parties, including CBE, who have submitted feedback, it is impossible to discern from the summary slide what feedback is attributable to any particular group. This gives the classic "hearsay" problem, by making sweeping statements that are unreliable and untraceable. To the extent SoCalGas intends to summarize participant comments, it should identify who said what, so CBE can understand SoCalGas's responses to its comments. Comment 08-07

III. High-Level Economic Analysis and Cost Effectiveness: Preliminary Data and Findings

The High-Level Economic Analysis and Cost Effectiveness: Preliminary Data and Findings presentation ("Economic Presentation") provides no data or explanation of the methods of analysis, and troublingly only compares the estimated cost of Angeles Link to selected alternatives. At this early stage, the projected costs for the Angeles Link project already amount to billions of dollars. SoCalGas clearly intends to rate-base this costly infrastructure, which will particularly harm ratepayers in low income communities of color who already carry a disproportionate burden of utility debt and are more susceptible to shut off.[9] Particularly with respect to the use of hydrogen in electricity production, low-income ratepayers could be bearing higher costs both for the infrastructure (Angeles Link) and in their electric bills, whether through LADWP or Southern California Edison. The Economic Presentation is entirely silent about ratepayer impacts. Comment 08-08

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[8] Cal. Code Regs. Tit. 14 §15126.6; *see also* Cal. Pub. Resources Code Section 21083; 21002, 21002.1, 21003, and 21100; *Citizens of Goleta Valley v. Board of Supervisors*, (1990) 52 Cal.3d 553; *Laurel Heights Improvement Association v. Regents of the University of California*, (1988) 47 Cal.3d 376; *Gentry v. City of Murrieta* (1995) 36 Cal.App.4th 1359; and *Laurel Heights Improvement Association v. Regents of the University of California* (1993) 6 Cal.4th 1112.

[9] Paul M. Ong et al., *Keeping the Stove On: COVID-19 and Utility Debt, UCLA Luskin Center for Innovation*, (2021). "Gas bill debt disproportionately impacts low-income neighborhoods.

The Economic Presentation only examines production, storage, transmission, regasification, liquification, and distribution once the Angeles Link pipeline is in place. The Economic Presentation fails to account for the significant economic cost of building out pipeline infrastructure. In fact, the presentation does not provide any estimates regarding the cost of the project or potential funding in support of the project. Information regarding the complete estimated cost of the project must be made available before any further action on the Project can be taken. Comment 08-09

Slide nine of the Economic Presentation borrows the comparative heat map, four color scale diagram provided in the Alternatives Presentation to provide a comparative evaluation of the cost effectiveness of electrification and hydrogen. In the Economic Presentation, the environmental category has been redacted. Whereas in the Alternatives Presentation, this column is noted as "pending environmental study impact results." This seems to indicate that the criteria analysis in the Alternative Presentation draws from the body of the other studies. It is troubling then that SoCalGas has elected to not provide any further details for the economic analysis for electrification than what has already been filtered into Alternatives Presentation. This again raises questions regarding the validity and transparency with which SoCalGas is performing these preliminary studies. CBE requests that the full and complete economic analysis for electrification be released. Comment 08-10

IV. Pipeline Sizing and Design Criteria: Preliminary Data and Findings

The Pipeline Sizing and Design Criteria: Preliminary Data and Findings Presentation ("Design Presentation"), like other presentations provided by SoCalGas provides no data, references or analysis for the findings presented within. Which is particularly concerning because the "pipeline system" shown on slide nine provides an array of not previously identified pipeline routing scenarios that could connect the San Joaquin Valley, Blythe, and Lancaster with 578 miles of pipeline. Further concerning, slide eleven identifies significant storage areas in Utah, Nevada, New Mexico, and Arizona, and despite slide ten stating that "Angeles Link is proposed to be an intrastate system… within Central and Southern California" it goes on to state that these areas were evaluated for "potential future market conditions." CBE strongly believes that in order to avoid perpetuating the impacts of gas infrastructure on environmental justice communities and limit the impacts of infrastructure development, operations and decommissioning, any form of the Angeles Link Project must be limited in size and scope.[10] The Design Presentations conflicting statements regarding the scope of the Angeles Link project raises significant concern regarding the intended scale of the project, and the transparency with which SoCalGas is discussing their intent to expand the project beyond what has been examined in the CPUC Decision. Comment 08-11

Further concerning, Footnote 2 on slide 9 states that "Blythe scenarios were not carried through for detailed modeling." Despite Blythe having been named in the Preliminary Comment 08-12

[10] *See* CBE et al., Environmental Justice Position on Green Hydrogen in California, *Equity Principles for Hydrogen*, at 28 (2023).

Routing/Configuration Analysis, Including Right-of-way and Franchise: Preliminary Data and Findings Presentation released on April 14, 2024. CBE requests that SoCalGas clarify why the Lancaster and San Joaquin Valley routes were carried through and the Blythe scenarios were not. **Comment 08-12**

The Design Presentation states that depleted oil and gas fields are promising candidates for local underground hydrogen storage. The use of existing gas infrastructure is deeply concerning to CBE because it poses particular risk to fence line environmental justice communities. CBE firmly believes that hydrogen should not be transported, stored, or blended into existing gas pipelines or storage containers. The Design Presentation makes no indication that the concerns of environmental justice communities near these depleted oil and gas fields have been consulted or considered in the Design study underlying the presentation or elsewhere. It is essential that SoCalGas avoid perpetuating the impacts of gas infrastructure on environmental justice communities. SoCalGas cannot begin to do so until they begin to address how they are considering historic harms of gas infrastructure in project communities and obtain meaningful consent with fence line, impacted communities.

Further, the Design Presentation states that SoCalGas facilities are not currently being considered as storage options for Angeles Link because "they are located within the study area." It is unclear what this means, CBE requests that SoCalGas state clearly what the study indicated concerning SoCalGas facilities based on the confidence in geologic elements adequacy scale used throughout the Design Presentation. Further, CBE requests that more localized maps of the Los Angeles basin be provided. The sole map provided in the Design Presentation shows a geographic area that includes almost the entire length of California, and well into Utah, and Arizona making it difficult to examine the proposed storage options in Southern California where SoCalGas has highlighted potential pipeline routes. **Comment 08-13**

Concerningly, the Design Presentation indicates that "'safety considerations, pressures, and maintenance operations associated with design' are addressed in the Plan for Applicable Safety Requirements." However, the Preliminary Data and Findings: Plan for Applicable Safety Requirements Presentation provided on April 14, 2024 did not indicate any kind of risk analysis, or mention the major safety considerations of leakage, exposure, flammability, explosion, and end-use related health risks.[11] In fact, the Plan for Applicable Safety Requirements Presentation did not mention storage, pipeline sizing, or pipeline siting at all. **Comment 08-14**

As reiterated throughout this letter, and in CBOSG meetings, these presentations and SoCalGas's stakeholder engagement methodologies have raised serious concerns regarding transparency. The vague language regarding stakeholder engagement and actions taken on slide three of the Design Presentation does not address the serious concerns regarding data transparency, and community engagement that have been repeatedly raised by CBE and other community groups. **Comment 08-15**

[11] *See* CBE Letter Re*: Feedback for Southern California Gas Company on Preliminary Findings Presentations* dated May 3, 2024.

Conclusion

CBE appreciates the opportunity to provide feedback on these matters. However, neither the format nor minimal substantive information allows CBE, or other interested stakeholders, to understand the many necessary studies SoCalGas must undertake if it intends to move forward the Angeles Link project.

Comment 08-15

Respectfully Submitted.

Lauren Gallagher
Communities for a Better Environment

CC:
Emily Grant, SoCalGas
Chester Britt, Arellano Associates
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Angeles Link PAG Service List

COMMUNITIES FOR BETTER ENVIRONMENT COMMENT 8-1

These comments specifically pertain only to the preliminary findings presented in the abbreviated presentations provided on May 21, 2024. Per SoCalGas's representations at the April 23, 2024 joint PAG and CBOSG meeting, CBE expects that a separate, complete draft of the data, analysis, and findings will be released at an unknown later date. These preliminary presentations lack basic data, let alone the analysis parties need to provide feedback, and these comments cannot and do not comprise the entire scope of feedback from CBE on any of the topics presented. Failing to provide data does not comply with part seven of the CPUC Decision D.22-12-055 (hereinafter "CPUC Decision"), which requires SoCalGas to "make the data, findings, and results of Phase One feasibility studies…available to the public and not redacted unless SoCalGas is granted confidentiality of data." FN1

As previously raised in CBE's May 3, 2024 feedback letter, it is deeply concerning that these presentations are labeled "data and findings." The presentations contain no data or related analysis to support any findings they may be summarizing. Overall, the presentations are more like public relations materials, which the PUC prohibited SoCalGas from promulgating in this process, than feasibility studies. FN2 CPUC Decision emphasized the importance of stakeholder engagement to identify potential impacts of the project on disadvantaged and environmental justice communities. FN3 Meaningful engagement is impossible without facts on which findings or conclusions are based.

I. Concerns Regarding Proposed Timelines - CBE is troubled by the shortened timeline for feedback for this set of materials specifically and all materials in general. These materials were provided after 5:00 pm on May 21, 2024, with a feedback submission deadline of June 4, 2024, at 5:00 pm. Accounting for the federally observed holiday of Memorial Day, that is nine business days. This timeline was further strained when SoCalGas released a 60-page Hydrogen Leakage Assessment Draft Report for feedback on May 29, 2024. Under the California Environmental Quality Act (CEQA), the required public comment period for Environmental Impact Reports is at a minimum 30 days and more than 60 days in exceptional circumstances. FN4 Even a negative declaration is open for public review for 20 days at the very least, and local authorities provide for public review of notices of exemption, which can be challenged within 35 days. FN5 CEQA is California's iconic public engagement statute, and its timeline provides a useful comparison for the pace at which SoCalGas demands feedback.

Of even greater concern, the timelines provided in the Project Options and Alternatives, and High-Level Economics Analysis and Cost Effectiveness presentations suggest that the complete studies, which presumably will include all the data and information that is lacking from the presentations, will be released in June 2024 and comments will be "incorporated" in June/July 2024. This timeline is incredibly concerning because these draft studies require considerable time to review in order to provide meaningful feedback. Community groups and other stakeholders have repeatedly requested longer feedback periods for these technical reports. CBE echoes these requests, in asking that SoCalGas adjust these timelines to provide appropriate periods for feedback.

FN 1 – CPUC Decision, Order No. 7 pg. 77.
FN 2 – CPUC Decision D.22-12-055 (hereinafter CPUC Decision), pg. 38.
FN 3 – CPUC Decision, pg. 80. See also pg. 58 "Stakeholder engagement, including those from CBOs, ESJ groups, and disadvantaged communities (DAC) groups, are important to the planning process."
FN 4 & 5 – Cal. Pub. Resources Code §21091; Cal. Code Regs. Tit. 14 §15105 and Tit. 14 §15062.

SOCALGAS RESPONSE TO COMMENT 8-1

In response to this comment concerning timelines to provide feedback, please refer to Global Response 1.

COMMUNITIES FOR BETTER ENVIRONMENT COMMENT 8-2

II. Project Options and Alternatives: Preliminary Data and Findings – The Project Options and Alternatives: Preliminary Data and Findings Presentation ("Alternatives Presentation") is rooted in a set of criteria established by SoCalGas for the purpose of evaluating options and alternatives to the Angeles Link project. The Alternatives Presentation does not provide any substantive basis for establishing these criteria as a valid means of comparing and "carrying through" project options or alternatives. The Angeles Link project as it has been proposed is a significant investment of public funds, for new hydrogen infrastructure that covers vast swaths of Southern California with substantial impact and risks to communities along the pipeline. Accurately and transparently weighing alternatives such as electrification at this early juncture in decision making is important to obtaining meaningful community consent and feedback. The Alternatives Presentation fails to do so.

SOCALGAS RESPONSE TO COMMENT 8-2

SoCalGas understands this comment concerning the information presented in the preliminary findings. Please also refer to Global Response 1. The preliminary findings were intended to present information in a summary format with the understanding that more detailed analysis and assumptions would be provided in the full draft reports when they were available. SoCalGas agrees evaluating potential alternatives is an important part of assessing Angeles Link. The draft Alternatives Study, Section 4 - Framework for Evaluation of Project Alternatives provides additional information on the criteria used to evaluate potential options and alternatives to Angeles Link. Please refer to the Alternatives Study, which was provided to the PAG and CBOSG on July 26 for review and feedback.

COMMUNITIES FOR BETTER ENVIRONMENT COMMENT 8-3

In the Alternatives Presentation it is unclear what the complete set of criteria even are. Nine distinct criteria are named throughout the presentation, but only five of these criteria are defined. On slide three SoCalGas states that "alternatives that meet the criteria established in the study will be carried forward to the environmental and environmental social justice analysis." However, confusingly, slide 11 indicates that environmental impacts are a criterion of comparison based on the category's inclusion in a comparative heat map. Failing to provide a complete set of criteria and definitions precludes community members from providing feedback on the comparative process which is essential to establishing the viability of alternatives. Further, the Alternatives Presentation provides conflicting information about how undefined criteria are established within this study and in relation to others. For example, while CBE strongly supports screening alternatives based on "Alignment with California's Environmental Law and Public Policies", SoCalGas identifies only three applicable laws and policies - the 2022 Scoping Plan, the Advanced Clean Fleets regulation and the Executive Order (N-79-202) on zero-emissions vehicles. FN6 Is this the invitation from SoCalGas for feedback on the laws and policies it should include in the screening criteria? If so, CBE requests confirmation and an opportunity to provide additional briefing, as we have extensive experience explaining to decisionmakers such as the PUC and local decisionmakers what environmental laws and policies apply to projects like Angeles Link, but it is not at all clear from the slide deck whether the listed laws/policies are illustrative or comprehensive. This lack of clarity calls into question the reliability of the findings presented in the Alternatives Presentation. CBE requests that SoCalGas clearly define each criterion and establish a separate criterion of evaluation for environmental justice concerns.

FN 6 – Project Options and Alternatives, Slide 7.

SOCALGAS RESPONSE TO COMMENT 8-3

SoCalGas understands this comment concerning the information presented in the preliminary findings. The preliminary findings were intended to present information in a summary format with the understanding that more detailed analysis and assumptions would be provided in the full draft reports when they were available. Please also refer to Global Response 1. The draft Alternatives Study, Section 4- Framework for Evaluation of Project Alternatives provides additional information on the criteria used to evaluate the potential alternatives, including the applicable laws and policies evaluated as part of the analysis. Please refer to the Alternatives Study, which was provided to the PAG and CBOSG on July 26, 2024, for a four-week comment window to provide additional feedback on the analysis in the study.

COMMUNITIES FOR BETTER ENVIRONMENT COMMENT 8-4

It is unclear how the criteria are applied and what exactly the four-part color-coded scale used in comparative heat maps represents. In the study approach slide FN7, step two states that SoCalGas will "evaluate potential alternatives against identified criteria" but does not elaborate, and no further clarity is provided in the presentation. When examining the multiple heat map charts using the same four-part color scale which ranks criteria from highest to lowest score, Angeles Link is rated differently throughout. Because no background is provided on how or what kind of evaluation criteria are used, it is impossible to discern what a high or low score indicates. For example, on slide six, Angeles Link does not satisfy the technological maturity criteria, however later in the presentation on slide 13, in the same category as applied to distinct subsectors Angeles Link was rated in the middle of the high to low scale. Further, slide 13 asserts that "molecules are easier to store than electrons, supporting system reliability", but provides no evidence for this statement that is heavily contested. These and other inconsistencies and questionable assertions throughout the Alternatives Presentation raise significant questions as to the legitimacy of SoCalGas' findings. These inconsistencies seem to indicate a troubling bias towards development of the Angeles Link project over alternatives. This lack of transparency regarding alternative comparison and the overall criteria application process precludes meaningful community feedback on the important matter of alternatives comparison.

FN 7 – Project Options and Alternatives, Slide 4.

SOCALGAS RESPONSE TO COMMENT 8-4

SoCalGas understands this comment concerning the information presented in the preliminary findings. The preliminary findings were intended to present information in a summary format with the understanding that more detailed analysis and assumptions would be provided in the full draft reports when they were available. Please also refer to Global Response 1. The draft Alternatives Study provides additional information on how the criteria were applied to evaluate the potential identified alternatives and the assumptions supporting the analysis in that study. Please refer to the Alternatives Study, which was provided to the PAG and CBOSG on July 26, 2024, for a four-week comment window to provide additional feedback on the analysis in the study.

COMMUNITIES FOR BETTER ENVIRONMENT COMMENT 8-5

Further, an array of non-hydrogen alternatives are dismissed without providing information on the application of the stated criteria. For the sake of transparency and equitable analysis, CBE requests that SoCalGas provide the analysis related to the following dismissed alternatives: Energy Efficiency, Hydro, Geothermal, and Plug-in Hybrid.

SOCALGAS RESPONSE TO COMMENT 8-5

SoCalGas understands this comment concerning the information presented in the preliminary findings. The preliminary findings were intended to present information in a summary format with the understanding that more detailed analysis and assumptions would be provided in the full draft reports when they were available. Please refer to Global Response 1. The Alternatives Study (Section 4 - Framework for Evaluation of Project Alternatives) provides additional details on the analysis of the potential alternatives that were initially identified but not carried forward for further analysis in the separate draft Cost Effectiveness Study or draft Environmental Analysis. Please refer to the Alternatives Study, which was provided to the PAG and CBOSG on July 26, 2024, for a four-week comment window to provide additional feedback on the analysis in the study.

COMMUNITIES FOR BETTER ENVIRONMENT COMMENT 8-6

Although the presentation slide deck does not show how SoCalGas arrived at its methodology, CEQA requires alternatives consideration, and the CEQA guidelines may be instructive. These require consideration of a “no project” alternative and alternatives that are feasible and meet some of the project’s high-level goals, which cannot be framed in terms so narrow that only the project could meet them. FN8

FN 8 – Cal. Code Regs. Tit. 14 §15126.6; see also Cal. Pub. Resources Code Section 21083; 21002, 21002.1, 21003, and 21100; Citizens of Goleta Valley v. Board of Supervisors, (1990) 52 Cal.3d 553; Laurel Heights Improvement Association v. Regents of the University of California, (1988) 47 Cal.3d 376; Gentry v. City of Murrieta (1995) 36 Cal.App.4th 1359; and Laurel Heights Improvement Association v. Regents of the University of California (1993) 6 Cal.4th 1112.

SOCALGAS RESPONSE TO COMMENT 8-6

SoCalGas understands this comment concerning the information presented in the preliminary findings. The preliminary findings were intended to present information in a summary format with the understanding that more detailed analysis and assumptions would be provided in the full draft reports when they were available. Please refer to Global Response 1. While the CEQA guidelines may be instructive, the development of Angeles Link is still in the feasibility stage of development and therefore a full CEQA analysis, was not prepared at this phase. A complete environmental review of Angeles Link would be conducted in future phases pursuant to CEQA by the public agency(ies) considering applications for discretionary approvals for Angeles Link. SoCalGas expects that environmental review would include an evaluation of alternatives to the proposed project, including a “no project” alternative, consistent with CEQA’s applicable requirements. For additional information on the methodology used to identify and evaluate alternatives for the feasibility analysis in Phase 1, please refer to the Alternatives Study, Section 4 (Framework for Evaluation of Project Alternatives).

COMMUNITIES FOR BETTER ENVIRONMENT COMMENT 8-7

SoCalGas concludes the slide deck by summarizing stakeholder feedback. While it identifies parties, including CBE, who have submitted feedback, it is impossible to discern from the summary slide what feedback is attributable to any particular group. This gives the classic "hearsay" problem, by making sweeping statements that are unreliable and untraceable. To the extent SoCalGas intends to summarize participant comments, it should identify who said what, so CBE can understand SoCalGas's responses to its comments.

SOCALGAS RESPONSE TO COMMENT 8-7

SoCalGas has included each written comment received on all milestones in Phase 1 to date, along with SoCalGas's responses to each comment received, in the Quarterly Reports available to PAG and CBOSG members through the Living Library and posted online to the public through the SoCalGas Angeles Link website. In addition, the draft studies have all been released as of the date of this submittal and the draft reports include a section discussing how stakeholder feedback was incorporated into the study. SoCalGas will continue to respond to and incorporate additional feedback on the draft studies as appropriate and will document those responses in the final draft reports and Q3 2024 Quarterly Report to be submitted later this year.

For additional information on the stakeholder engagement process, please refer to Global Response 1. Also,

COMMUNITIES FOR BETTER ENVIRONMENT COMMENT 8-8

III. High-Level Economic Analysis and Cost Effectiveness: Preliminary Data and Findings – The High-Level Economic Analysis and Cost Effectiveness: Preliminary Data and Findings presentation ("Economic Presentation") provides no data or explanation of the methods of analysis, and troublingly only compares the estimated cost of Angeles Link to selected alternatives. At this early stage, the projected costs for the Angeles Link project already amount to billions of dollars. SoCalGas clearly intends to rate-base this costly infrastructure, which will particularly harm ratepayers in low income communities of color who already carry a disproportionate burden of utility debt and are more susceptible to shut off. FN9 Particularly with respect to the use of hydrogen in electricity production, low-income ratepayers could be bearing higher costs both for the infrastructure (Angeles Link) and in their electric bills, whether through LADWP or Southern California Edison. The Economic Presentation is entirely silent about ratepayer impacts. FN 9 – Paul M. Ong et al., Keeping the Stove On: COVID-19 and Utility Debt, UCLA Luskin Center for Innovation, (2021). "Gas bill debt disproportionately impacts low-income neighborhoods.

SOCALGAS RESPONSE TO COMMENT 8-8

The draft Cost Effectiveness Study (which is conducted in the feasibility phase) used the LCOH to compare Angeles Link to hydrogen delivery alternatives, and the Levelized Cost of Electricity (LCOE), Total Cost of Ownership (TCO), and LCOE/LOCH to compare Angeles Link to the non-hydrogen delivery alternatives (i.e. electrification and Carbon Capture and Sequestration (CCS)) in the Power, Mobility and Industrial sectors, respectively. LCOH and LCOE are common metrics to benchmark cost competitiveness and take into account the cost to produce and deliver hydrogen (LCOH) or electricity (LCOE) to the end-user. TCO is a common metric used to benchmark cost competitiveness when comparing different fuels in the mobility sector. TCO takes into account the vehicle's cost, operation and maintenance. The draft Cost Effectiveness Study finds that hydrogen delivered via the proposed Angeles Link pipeline system would be a competitive energy source with alternatives (including other hydrogen delivery alternatives, as well as non-hydrogen alternatives such as electrification and CCS) for certain end uses, and in line with state policy objectives in addition to being mature, scalable and capable of providing reliability and resiliency. As discussed in the draft Cost Effectiveness Study, delivering hydrogen by pipeline is a cost-effective method of decarbonizing hard-to-electrify end users compared to the other alternatives studied in SoCalGas's Alternatives Study.

Ratemaking for utility infrastructure begins with a determination of the costs of the investment, and then considers how those costs should be allocated among ratepayers and customers. This process will require information that is not available at the necessary level of detail in Phase 1 because a preferred route has not yet been selected. For this reason, the potential rate impacts to customers are not addressed in this Phase 1 study and will be addressed in a later phase once a preferred route is selected and more refined cost estimates are performed. With respect to the commentor's concern about impacts on low-income ratepayers, SoCalGas and the electric utilities have a variety of customer assistance programs, including the CARE Program; Arrearage Management Plans, the Energy Services Assistance Program (ESAP), and Percent of Income Payment Plans (PIPP), which are approved by the CPUC. SoCalGas looks forward to continuing to work with stakeholders and the CPUC to meet the State's aggressive decarbonization goals, including net-zero carbon emissions by 2045, in a manner that is most equitable and affordable. Based on the Phase 1 studies, as well as other third-party research, SoCalGas believes that clean firm power, which could be provided via clean renewable hydrogen, is essential to meet those goals in a reliable, resilient, and affordable manner.

COMMUNITIES FOR BETTER ENVIRONMENT COMMENT 8-9

The Economic Presentation only examines production, storage, transmission, regasification, liquification, and distribution once the Angeles Link pipeline is in place. The Economic Presentation fails to account for the significant economic cost of building out pipeline infrastructure. In fact, the presentation does not provide any estimates regarding the cost of the project or potential funding in support of the project. Information regarding the complete estimated cost of the project must be made available before any further action on the Project can be taken.

SOCALGAS RESPONSE TO COMMENT 8-9

Please refer to Section 6 (Cost Estimates) of the Design Study, which includes a high-level cost estimate for constructing potential conceptual Angeles Link configurations. A more detailed estimate of Angeles Link costs would be performed in future phases as a preferred route is selected and refined.

COMMUNITIES FOR BETTER ENVIRONMENT COMMENT 8-10

Slide nine of the Economic Presentation borrows the comparative heat map, four color scale diagram provided in the Alternatives Presentation to provide a comparative evaluation of the cost effectiveness of electrification and hydrogen. In the Economic Presentation, the environmental category has been redacted. Whereas in the Alternatives Presentation, this column is noted as “pending environmental study impact results.” This seems to indicate that the criteria analysis in the Alternative Presentation draws from the body of the other studies. It is troubling then that SoCalGas has elected to not provide any further details for the economic analysis for electrification than what has already been filtered into Alternatives Presentation. This again raises questions regarding the validity and transparency with which SoCalGas is performing these preliminary studies. CBE requests that the full and complete economic analysis for electrification be released.

SOCALGAS RESPONSE TO COMMENT 8-10

SoCalGas understands this comment concerns the information presented in the preliminary findings. The preliminary findings were intended to present information in a summary format with the understanding that more detailed analysis and assumptions would be provided in the full draft reports when they were available. Please also refer to Global Response 1. Full details and assumptions supporting the alternatives analysis, including the analysis of the electrification alternative, are provided in the draft Alternatives Study and the Cost Effectiveness Study. For additional information, please refer to those draft studies, which were provided to the PAG and CBOSG on July 26, 2024, for review and feedback.

COMMUNITIES FOR BETTER ENVIRONMENT COMMENT 8-11

IV. Pipeline Sizing and Design Criteria: Preliminary Data and Findings – The Pipeline Sizing and Design Criteria: Preliminary Data and Findings Presentation ("Design Presentation"), like other presentations provided by SoCalGas provides no data, references or analysis for the findings presented within. Which is particularly concerning because the "pipeline system" shown on slide nine provides an array of not previously identified pipeline routing scenarios that could connect the San Joaquin Valley, Blythe, and Lancaster with 578 miles of pipeline. Further concerning, slide eleven identifies significant storage areas in Utah, Nevada, New Mexico, and Arizona, and despite slide ten stating that "Angeles Link is proposed to be an intrastate system… within Central and Southern California" it goes on to state that these areas were evaluated for "potential future market conditions." CBE strongly believes that in order to avoid perpetuating the impacts of gas infrastructure on environmental justice communities and limit the impacts of infrastructure development, operations and decommissioning, any form of the Angeles Link Project must be limited in size and scope. FN10 The Design Presentations conflicting statements regarding the scope of the Angeles Link project raises significant concern regarding the intended scale of the project, and the transparency with which SoCalGas is discussing their intent to expand the project beyond what has been examined in the CPUC Decision.

FN 10 – See CBE et al., Environmental Justice Position on Green Hydrogen in California, Equity Principles for Hydrogen, at 28 (2023).

SOCALGAS RESPONSE TO COMMENT 8-11

SoCalGas understands this comment concerning the information presented in the preliminary findings for the Design Study. The preliminary findings were intended to present information in a summary format with the understanding that more detailed analysis and assumptions would be provided in the full draft reports when they were available. Please also refer to Global Response 1. As of the date of this submittal, the draft Design Study has been provided to the PAG and CBOSG for review and feedback. Please refer to the draft report for additional details and assumptions supporting the sizing and design analysis that has been completed at this feasibility stage.

In response to the comment concerning the locations of potential storage areas, please refer to Response to Comment 7-6.

In response to the comment concerning environmental justice communities, SoCalGas has prepared an ESJ Plan and ESJ Screening. The ESJ Plan provides a framework for engaging ESJ communities during Phase 2 of Angeles Link to learn about those communities' most pressing concerns, mitigate potential negative impacts, and maximize benefits to the community. It also includes a response to the Environmental Justice Position on Green Hydrogen in California, Equity Principles for Hydrogen. The draft ESJ Plan and ESJ Screening were released to the PAG and CBOSG for review and feedback on July 19, 2024.

COMMUNITIES FOR BETTER ENVIRONMENT COMMENT 8-12

Further concerning, Footnote 2 on slide 9 states that “Blythe scenarios were not carried through for detailed modeling.” Despite Blythe having been named in the Preliminary Routing/Configuration Analysis, Including Right-of-way and Franchise: Preliminary Data and Findings Presentation released on April 14, 2024. CBE requests that SoCalGas clarify why the Lancaster and San Joaquin Valley routes were carried through and the Blythe scenarios were not.

SOCALGAS RESPONSE TO COMMENT 8-12

The initial route evaluation included Blythe as a primary regional third-party production area. As the evaluation progressively narrowed and the objectives for preferred routing were developed, it was identified that possible preferred routes would connect SoCalGas’s ARCHES projects, Segments B and C, which are located near Lancaster and San Joaquin Valley respectively. Thereafter, Blythe was not pursued further as the additional mileage and land disturbance were not necessary to meet the objectives of a preferred route at this time. Please refer to Section 3.3 of the draft Routing Analysis for additional details on the route analysis.

COMMUNITIES FOR BETTER ENVIRONMENT COMMENT 8-13

The Design Presentation states that depleted oil and gas fields are promising candidates for local underground hydrogen storage. The use of existing gas infrastructure is deeply concerning to CBE because it poses particular risk to fence line environmental justice communities. CBE firmly believes that hydrogen should not be transported, stored, or blended into existing gas pipelines or storage containers. The Design Presentation makes no indication that the concerns of environmental justice communities near these depleted oil and gas fields have been consulted or considered in the Design study underlying the presentation or elsewhere. It is essential that SoCalGas avoid perpetuating the impacts of gas infrastructure on environmental justice communities. SoCalGas cannot begin to do so until they begin to address how they are considering historic harms of gas infrastructure in project communities and obtain meaningful consent with fence line, impacted communities.

Further, the Design Presentation states that SoCalGas facilities are not currently being considered as storage options for Angeles Link because “they are located within the study area.” It is unclear what this means, CBE requests that SoCalGas state clearly what the study indicated concerning SoCalGas facilities based on the confidence in geologic elements adequacy scale used throughout the Design Presentation. Further, CBE requests that more localized maps of the Los Angeles basin be provided. The sole map provided in the Design Presentation shows a geographic area that includes almost the entire length of California, and well into Utah, and Arizona making it difficult to examine the proposed storage options in Southern California where SoCalGas has highlighted potential pipeline routes.

SOCALGAS RESPONSE TO COMMENT 8-13

In response to the comment concerning additional information related to potential storage locations, please refer to Response to Comment 7-6 and Comment 7-7. The draft Production Study Appendix B contains maps depicting potential third-party underground hydrogen storage fields that were evaluated for geologic feasibility.

In response to the comment concerning potential impacts on environmental justice communities, please refer to Response to Comment 8-11 for more information on the analysis related to potential impacts of Angeles Link preferred routes.

COMMUNITIES FOR BETTER ENVIRONMENT COMMENT 8-14

Concerningly, the Design Presentation indicates that "'safety considerations, pressures, and maintenance operations associated with design' are addressed in the Plan for Applicable Safety Requirements." However, the Preliminary Data and Findings: Plan for Applicable Safety Requirements Presentation provided on April 14, 2024 did not indicate any kind of risk analysis, or mention the major safety considerations of leakage, exposure, flammability, explosion, and end-use related health risks. FN11 In fact, the Plan for Applicable Safety Requirements Presentation did not mention storage, pipeline sizing, or pipeline siting at all.

FN 11 – See CBE Letter Re: Feedback for Southern California Gas Company on Preliminary Findings Presentations dated May 3, 2024.

SOCALGAS RESPONSE TO COMMENT 8-14

SoCalGas understands this comment concerning the information presented in the preliminary findings. The preliminary findings were intended to present information in a summary format with the understanding that more detailed analysis and assumptions would be provided in the full draft reports when they were available. Please also refer to Global Response 1. As of the date of this submittal, the full draft report of the draft Safety Study has been released to the PAG and CBOSG for review and feedback. For additional information, please see section 6.0 Risk Management and section 4.0 Safety Management System in the draft Safety Study. Further evaluation of SoCalGas' risk management approach that incorporates and addresses hydrogen infrastructure including conducting hazard analyses will be conducted in subsequent phases as more detailed project information is available.

COMMUNITIES FOR BETTER ENVIRONMENT COMMENT 8-15

As reiterated throughout this letter, and in CBOSG meetings, these presentations and SoCalGas's stakeholder engagement methodologies have raised serious concerns regarding transparency. The vague language regarding stakeholder engagement and actions taken on slide three of the Design Presentation does not address the serious concerns regarding data transparency, and community engagement that have been repeatedly raised by CBE and other community groups.

Conclusion – CBE appreciates the opportunity to provide feedback on these matters. However, neither the format nor minimal substantive information allows CBE, or other interested stakeholders, to understand the many necessary studies SoCalGas must undertake if it intends to move forward the Angeles Link project.

SOCALGAS RESPONSE TO COMMENT 8-15

Please refer to Global Response 1.

2.9 Comment Letter 9 – Food and Water Watch

Comment Letter 9

From: Andrea Vega
Sent: Tuesday, June 4, 2024 3:18 PM
To: ALP1 Study CBO Feedback
Cc: Emily Grant; Alma Marquez
Subject: Feedback on Angeles Link Project Preliminary Data and Findings - Food & Water Watch

Follow Up Flag: Follow up
Flag Status: Flagged

You don't often get email from avega@fwwatch.org. Learn why this is important

Hello,

The following is feedback on the preliminary data and findings on project options and alternatives, pipeline sizing and design criteria, and high-level economic analysis and cost effectiveness:

As members of the Community Based Stakeholders Group, we need full, detailed preliminary data and findings reports rather than slidedecks. We look forward to providing feedback on project options and alternatives, pipeline sizing and design criteria, and high-level economic analysis and cost effectiveness once those full reports are available in the Angeles Link Project's Living Library.

Comment 09-01

Thank you,
Andrea Vega

Andrea Vega
Southern California Senior Organizer
Food & Water Watch and Food & Water Action

Fight like you live here.

FOOD AND WATER WATCH COMMENT 9-1

The following is feedback on the preliminary data and findings on project options and alternatives, pipeline sizing and design criteria, and high-level economic analysis and cost effectiveness:

As members of the Community Based Stakeholders Group, we need full, detailed preliminary data and findings reports rather than slide decks. We look forward to providing feedback on project options and alternatives, pipeline sizing and design criteria, and high-level economic analysis and cost effectiveness once those full reports are available in the Angeles Link Project's Living Library.

SOCALGAS RESPONSE TO COMMENT 9-1

SoCalGas understands this comment concerns the information presented in the preliminary findings. The preliminary findings were intended to present information in a summary format with the understanding that more detailed analysis and assumptions would be provided in the full draft reports when they were available. As of the date of this submittal, all of the draft studies with additional detail have been submitted for PAG and CBOSG review. For additional information on the stakeholder engagement process, please also refer to Global Response 1.

2.10 Comment Letter 10 – Protect Playa Now

Comment Letter 10

June 4, 2024
California Public Utilities Commission (CPUC)
505 Van Ness
Avenue San Francisco, CA 94102

RE: Protect Playa Now Feedback for Angeles Link and CBO Stakeholder Group

To the California Public Utilities Commission (CPUC),

Feedback on Preliminary Findings Presentations

I am providing concise feedback on SoCalGas's preliminary presentations for the Angeles Link project. The presentations lack the detailed data and analysis necessary for stakeholders to give meaningful input. It is quite frankly unprofessional in addition to being irresponsible. This brevity prevents a full understanding of project impacts, especially on disadvantaged communities. **Comment 10-01**

Timeline Concerns: The feedback period is too short, especially with overlapping reports. Please extend deadlines and align with CEQA standards for public comment.

Alternatives: The criteria for evaluating alternatives are not fully disclosed, undermining the legitimacy of the findings. It's crucial to clearly define all criteria to aspire to include environmental justice in the evaluations. **Comment 10-02**

Economic Analysis: The economic impacts, especially on low-income communities, are not addressed. A more thorough analysis comparing all alternatives, including non-hydrogen options, is necessary. **Comment 10-03**

Pipeline Design and Sizing: There's a lack of transparency in the selection and evaluation of pipeline routes and storage. Ensure local community concerns are considered in planning and design to avoid perpetuating past harms.

General needs for overall process: **Comment 10-04**

- This process is still failing to include robust engagement with local tribal leaders which directly conflict with the CPUC's emphasis on inclusive stakeholder engagement and the need for consent from tribal communities for projects of this nature.
- Require detailed, independent studies on all aspects of the project.
- Schedule meetings at least 3 months in advance (6 months would be more appropriate) Avoid repetitive opening remarks and public service announcements on unrelated topics to maximize discussion time.
- Survey stakeholders for suitable meeting times to enhance participation.

These steps are crucial for ensuring a transparent, inclusive process that addresses the needs and concerns of all stakeholders. **Comment 10-04**

Sincerely,
Faith Myhra (she/they)
Member
Protect Playa Now
protectplayanow@gmail.com
Writing from the traditional, ancestral, and unceded territory of the Tongva, Kizh, and Chumash People.

PROTECT PLAYA NOW COMMENT 10-1

Feedback on Preliminary Findings Presentations I am providing concise feedback on SoCalGas's preliminary presentations for the Angeles Link project. The presentations lack the detailed data and analysis necessary for stakeholders to give meaningful input. It is quite frankly unprofessional in addition to being irresponsible. This brevity prevents a full understanding of project impacts, especially on disadvantaged communities.

Timeline Concerns: The feedback period is too short, especially with overlapping reports. Please extend deadlines and align with CEQA standards for public comment.

SOCALGAS RESPONSE TO COMMENT 10-1

SoCalGas understands this comment concerns the information presented in the preliminary findings. The preliminary findings were intended to present information in a summary format with the understanding that more detailed analysis and assumptions would be provided in the full draft reports when they were available. As of the date of this submittal, all of the draft studies with additional detail have been submitted for PAG and CBOSG review for a four-week comment period. For additional information on the stakeholder engagement process, please refer to Global Response 1.

PROTECT PLAYA NOW COMMENT 10-2

Alternatives: The criteria for evaluating alternatives are not fully disclosed, undermining the legitimacy of the findings. It's crucial to clearly define all criteria to aspire to include environmental justice in the evaluations.

SOCALGAS RESPONSE TO COMMENT 10-2

SoCalGas understands this comment concerning the information presented in the preliminary findings. The preliminary findings were intended to present information in a summary format with the understanding that more detailed analysis and assumptions would be provided in the full draft reports when they were available. Please also refer to Global Response 1. The draft Alternatives Study was provided to the PAG and CBOSG on July 26, 2024, for a four-week comment period. Please refer to the draft Alternatives Study, Section 4 - Framework for Evaluation of Project Alternatives, for additional information concerning the assumptions and supporting analysis for the criteria used to evaluate the alternatives.

For additional information related to environmental justice analysis of potential impacts related to Angeles Link, please refer to Response to Comment 8-11.

PROTECT PLAYA NOW COMMENT 10-3

Economic Analysis: The economic impacts, especially on low-income communities, are not addressed. A more thorough analysis comparing all alternatives, including non-hydrogen options, is necessary.

SOCALGAS RESPONSE TO COMMENT 10-3

In response to the comment concerning an analysis comparing the alternatives, the draft Alternatives Study provided to the PAG and CBOSG on July 26, 2024, provides detailed analysis comparing Angeles Link to identified hydrogen-delivery alternatives and non-hydrogen alternatives (including electrification). In addition, the draft Cost Effectiveness Study, provided to the PAG and CBOSG on July 26, 2024, includes the methodology and analysis to measure the cost effectiveness of Angeles Link and the identified alternatives. As described by the draft Cost Effectiveness Study, delivering hydrogen by pipeline is a cost-effective method of decarbonizing hard-to-electrify end users compared to the other alternatives studied in SoCalGas's Alternatives Study. Please refer to Section 4 (Key Findings) in the High-Level Economics and Cost Effectives draft report for additional information.

In response to the comment concerning potential economic impacts on low-income communities, please refer to response to comment 8-8.

An employment impact analysis was also conducted to estimate the number of potential jobs that could be created directly and indirectly by Angeles Link, as well as the associated regional economic output. Please see Section 2.0 (Employment Impact Analysis) in the draft Workforce Study.

Please also refer to the ESJ Plan which provides a framework for engaging ESJ communities during Phase 2 of Angeles Link to learn about those communities' most pressing concerns, mitigate potential negative impacts, and maximize benefits to the community.

PROTECT PLAYA NOW COMMENT 10-4

Pipeline Design and Sizing: There's a lack of transparency in the selection and evaluation of pipeline routes and storage. Ensure local community concerns are considered in planning and design to avoid perpetuating past harms.

General needs for overall process: This process is still failing to include robust engagement with local tribal leaders which directly conflict with the CPUC's emphasis on inclusive stakeholder engagement and the need for consent from tribal communities for projects of this nature.

- Require detailed, independent studies on all aspects of the project.
- Schedule meetings at least 3 months in advance (6 months would be more appropriate) Avoid repetitive opening remarks and public service announcements on unrelated topics to maximize discussion time.
- Survey stakeholders for suitable meeting times to enhance participation.
- These steps are crucial for ensuring a transparent, inclusive process that addresses the needs and concerns of all stakeholders.

SOCALGAS RESPONSE TO COMMENT 10-4

In response to the comment concerning transparency in the pipeline routes, the draft Routing Analysis was provided to the PAG and CBOSG for a four-week comment period on July 19, 2024. The draft Routing Analysis includes more detailed information on the assumptions and methodology supporting how preferred routes for Angeles Link were identified during this feasibility stage.

In response to the comment concerning the general stakeholder engagement process, please refer to Global Response 1.

In response to the comment concerning engagement with tribal communities, please refer to and Response to Comment 4-3.

2.11 Comment Letter 11 – Communities for a Better Environment

Comment Letter 11

COMMUNITIES FOR A BETTER ENVIRONMENT
established 1978

June 25, 2024

Southern California Gas
Company 555 West Fifth Street,
Los Angeles, CA 90013

Submitted via email to ALP1_Study_PAG_Feedback@insigniaenv.com.

Feedback for Southern California Gas Company on Environmental & Environmental Social Justice Analysis Provided on June 11, 2024

Communities for a Better Environment (CBE) submits this letter of feedback to Southern California Gas Company (SoCalGas) on the Environmental & Environmental Social Justice Analysis: Preliminary Data and Findings presentation (Environmental Presentation).

Comment 11-01

These comments specifically pertain only to the preliminary findings presented in the abbreviated presentation provided on June 11, 2024. Per SoCalGas's representations at the April 23, 2024 joint PAG and CBOSG meeting, CBE expects that a separate, complete draft of the data, analysis, and findings will be released. This preliminary presentation lacks basic data, let alone the analysis parties need to provide feedback, and these comments cannot and do not comprise the entire scope of feedback from CBE on any of the topics presented. Failing to provide data does not comply with part seven of the CPUC Decision 22-12-055, which requires SoCalGas to "make the data, findings, and results of Phase One feasibility studies…available to the public and not redacted unless SoCalGas is granted confidentiality of data."[1] The CPUC Decision emphasized the importance of stakeholder engagement to identify potential impacts of the project on disadvantaged and environmental justice communities.[2] Meaningful engagement is impossible without the facts on which findings or conclusions are based. To foster meaningful community feedback at the upcoming environmental justice focused July workshops, CBE requests that the Environmental Draft Report, the Environmental Social Justice Plan, and related materials are released at least a week in advance of the July workshop meetings in order to provide sufficient time for review.

As previously raised in CBE's May 3, 2024, and May 21, 2024 feedback letters, in one-on-one meetings with SoCalGas staff, and in stakeholder meetings it is deeply concerning that these preliminary presentations are labeled "data and findings." All the presentations provided thus far contain no data or related analysis to support any findings they may be summarizing. Overall, the presentations are more like public relations materials, which the PUC prohibited SoCalGas from promulgating in this process, than feasibility studies.[3]

[1] CPUC Decision, Order No. 7 pg. 77.
[2] CPUC Decision, pg. 80. See also pg. 58 "Stakeholder engagement, including those from CBOs, ESJ groups, and disadvantaged communities (DAC) groups, are important to the planning process."
[3] CPUC Decision D.22-12-055 (hereinafter CPUC Decision), pg. 38.

1

CBE also reiterates concerns regarding the timeline for feedback demanded by SoCalGas. During the 9- day feedback period for the Environmental Presentation (accounting for Juneteenth, a federal holiday) there were two concurrent feedback periods for the lengthy Hydrogen Leakage Assessment Draft Report, and Plan for Applicable Safety Requirements Draft Report. This is deeply concerning because these reports require substantial time and effort to review and respond to.

Comment 11-01

I. Environmental Review Concerns

The lack of data and analysis in the Environmental Presentation precludes us from providing substantive feedback. CBE appreciates that a more substantive CEQA and NEPA environmental review process is planned for later in phase 2 but questions whether this pared down analysis is sufficient to provide a basis for determining if the project should continue.

Comment 11-02

Further, CBE questions the blanket application of the geographic barrier of one hundred feet on either side of the corridor for all the analyzed topic areas. In particular, the 200-foot corridor is not likely to provide an adequate basis for analysis in the noted topic areas of air quality, greenhouse gas emissions, hydrology, and water quality.

II. Environmental Social Justice

CBE requests that SoCalGas promptly post higher quality, individual PDF files of the ESJ maps provided in the Environmental Presentation. Further, to facilitate meaningful discussion at the July workshops, CBE requests that SoCalGas publish maps that break up the larger map of Southern California into more distinct regions, so that impacted communities along the proposed pipeline can be better identified.

The lack of data and analysis provided to support the purported findings in the Environmental Presentation is unacceptable. For example, slide 22 of the Environmental Presentation, titled "Preliminary Findings Routing and ESJ," states as a finding that "Angeles Link has the potential to reduce greenhouse gas emissions, improve air quality, create union jobs, grow small and diverse businesses, and generate millions of dollars in community benefits." No support has been provided for the five distinct and significant findings lauded in this bullet point, and it is concerning that these statements seem to be drawn directly from SoCalGas' Angeles Link project (ALP) promotional materials. As discussed by CBE and several other parties, any impacts of the ALP in these areas depend heavily on project design, and, in many cases, significant negative impacts are expected. While the ALP has the potential to impact the abovementioned areas, listing potential benefits in a vacuum, without both balancing perspectives and supporting these conclusions with definite evidence is unproductive at best.

Comment 11-03

III. Commitment to Green Hydrogen

An essential assumption missing from the Environmental Presentation's environmental and environmental social justice assumptions and introductory analysis is whether and how SoCalGas has committed to supplying green hydrogen.

SoCalGas's own promotional materials for the project state that the pipeline will exclusively supply green hydrogen to hard-to-electrify sources.[4] However, when pushed to define the extent of SoCalGas's commitment to transporting only green hydrogen, SoCalGas has outright refused to commit even to compliance

Comment 11-04

[4] *See* How does it work? Tab on SoCalGas, Angeles Link homepage at https://www.socalgas.com/sustainability/hydrogen/angeles-link

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with the "three pillars of hydrogen."[5] In SoCalGas's May 6, 2024 letter to Environmental Justice Partners, SoCalGas states only that "SoCalGas supports clean renewable hydrogen production from non-fossil feedstocks" in compliance with the PUC's memorandum authorization requiring that SoCalGas analyze only the feasibility of hydrogen transport that does not use fossil fuels in its production process. [6] This statement and others made by SoCalGas neither defines, nor commits to limiting transported hydrogen to green hydrogen that is produced by means of electrolysis using surplus water and additional renewable electricity.

Comment 11-04

As a hydrogen transportation pipeline in this early phase in development of a hydrogen market, the ALP is likely to have a relational impact on production sources, siting, and development. If SoCalGas is truly committed to their vision of green hydrogen and decarbonization in line with the Equity Principles for Hydrogen, SoCalGas must commit to a definition of green hydrogen that constitutes truly green hydrogen. Doing so is an essential part of providing robust and complete feasibility studies. Committing to the role of transportation only does not absolve SoCalGas of the responsibility of clearly rejecting production of hydrogen that contributes to worsening air quality or climate pollution and damages the supply of scarce water resources in already water strapped communities.

IV. Conclusion

CBE appreciates the opportunity to provide feedback on these matters. However, as emphasized in our prior feedback, neither the format nor minimal substantive information provided in the preliminary findings Environmental Presentation allows CBE, or other interested stakeholders, to understand the many necessary studies SoCalGas must undertake if it intends to move the ALP forward.

Comment 11-05

Respectfully Submitted.

Lauren
Gallagher
Theo Caretto
Communities for a Better Environment

CC:
Emily Grant, SoCalGas
Chester Britt, Arellano Associates
Alma Marquez, Lee Andrews
Group Angeles Link PAG
Service List

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[5] *See* Rachel Fakhry, New Analysis: The 3 Pillars Will Support Large Hydrogen Deployment, June 20, 2023, NRDC, https://www.nrdc.org/bio/rachel-fakhry/new-analysis-3-pillars-will-support-large-hydrogen-deployment.
[6] Q4 2023 Quarterly Report Appendices, released May 15, 2024, p. 208.

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COMMUNITIES FOR BETTER ENVIRONMENT COMMENT 11-1

These comments specifically pertain only to the preliminary findings presented in the abbreviated presentation provided on June 11, 2024. Per SoCalGas's representations at the April 23, 2024 joint PAG and CBOSG meeting, CBE expects that a separate, complete draft of the data, analysis, and findings will be released. This preliminary presentation lacks basic data, let alone the analysis parties need to provide feedback, and these comments cannot and do not comprise the entire scope of feedback from CBE on any of the topics presented. Failing to provide data does not comply with part seven of the CPUC Decision 22-12-055, which requires SoCalGas to "make the data, findings, and results of Phase One feasibility studies…available to the public and not redacted unless SoCalGas is granted confidentiality of data." FN1 The CPUC Decision emphasized the importance of stakeholder engagement to identify potential impacts of the project on disadvantaged and environmental justice communities. FN2 Meaningful engagement is impossible without the facts on which findings or conclusions are based. To foster meaningful community feedback at the upcoming environmental justice focused July workshops, CBE requests that the Environmental Draft Report, the Environmental Social Justice Plan, and related materials are released at least a week in advance of the July workshop meetings in order to provide sufficient time for review.

As previously raised in CBE's May 3, 2024, and May 21, 2024 feedback letters, in one-on-one meetings with SoCalGas staff, and in stakeholder meetings it is deeply concerning that these preliminary presentations are labeled "data and findings." All the presentations provided thus far contain no data or related analysis to support any findings they may be summarizing. Overall, the presentations are more like public relations materials, which the PUC prohibited SoCalGas from promulgating in this process, than feasibility studies. FN3

CBE also reiterates concerns regarding the timeline for feedback demanded by SoCalGas. During the 9-day feedback period for the Environmental Presentation (accounting for Juneteenth, a federal holiday) there were two concurrent feedback periods for the lengthy Hydrogen Leakage Assessment Draft Report, and Plan for Applicable Safety Requirements Draft Report. This is deeply concerning because these reports require substantial time and effort to review and respond to.

FN1 – CPUC Decision, Order No. 7 pg. 77.
FN2 – CPUC Decision, pg. 80. See also pg. 58 "Stakeholder engagement, including those from CBOs, ESJ groups, and disadvantaged communities (DAC) groups, are important to the planning process.
FN3 – CPUC Decision D.22-12-055 (hereinafter CPUC Decision), pg. 38.

SOCALGAS RESPONSE TO COMMENT 11-1

SoCalGas understands this comment concerning the information presented in the preliminary findings. The preliminary findings were intended to present information in a summary format with the understanding that more detailed analysis and assumptions would be provided in the full draft reports when they were available. As of the date of this submission, all draft studies have been released to the PAG and CBOSG for review and feedback. Supporting detail, including data and appendixes, is provided in the draft reports, including the draft Environmental Analysis.

SoCalGas understands it has shared a lot of information with its PAG and CBOSG members and understands that some may feel the process is moving quickly. SoCalGas stated in its Angeles Link application that its Phase 1 process would be completed in 12-18 months and is working diligently to provide its deliverables on time and within budget. SoCalGas has met with its PAG and CBOSG once a quarter and added supplemental workshops in response to PAG and CBOSG feedback. SoCalGas will continue to work with its PAG and CBOSG to determine the appropriate meeting cadence and identify the best ways for members to provide feedback on studies and process. For additional information regarding the review and engagement process, please refer to Global Response 1.

COMMUNITIES FOR BETTER ENVIRONMENT COMMENT 11-2

The lack of data and analysis in the Environmental Presentation precludes us from providing substantive feedback. CBE appreciates that a more substantive CEQA and NEPA environmental review process is planned for later in phase 2 but questions whether this pared down analysis is sufficient to provide a basis for determining if the project should continue.

Further, CBE questions the blanket application of the geographic barrier of one hundred feet on either side of the corridor for all the analyzed topic areas. In particular, the 200-foot corridor is not likely to provide an adequate basis for analysis in the noted topic areas of air quality, greenhouse gas emissions, hydrology, and water quality.

SOCALGAS RESPONSE TO COMMENT 11-2

SoCalGas understands this comment concerning the information presented in the preliminary findings. The preliminary findings were intended to present information in a summary format with the understanding that more detailed analysis and assumptions would be provided in the full draft reports when they were available. The draft Environmental Analysis was provided to the PAG and CBOSG stakeholders for a four-week review and comment period on July 26, 2024. As this comment highlights, the draf Environmental Analysis uses the CEQA Guidelines Appendix G checklist as a framework to evaluate the potential for environmental impacts at this feasibility stage. This methodology provides for an analysis of how the planning process may consider the environmental impacts of Angeles Link and the identified alternatives at this feasibility stage, consistent with the Phase 1 Decision[21]. The analysis at this stage was not intended to provide a full review pursuant to CEQA and/or NEPA's requirements. As this comment further highlights, it is anticipated full environmental review under CEQA and/or NEPA, as applicable, would be conducted by the appropriate lead agencies once more details about Angeles Link are refined in future phases.

In response to the comment concerning the corridor that was evaluated, the draft Environmental Analysis evaluated a corridor for different environmental topics based on certain parameters of those topic areas in order to provide the analysis necessary to identify potential environmental impacts associated with Angeles Link. The analysis at this stage was not intended to provide a full environmental review of all potential environmental impacts as would be completed during a CEQA and/or NEPA review. Please refer to Chapters 2 and 3 of the draft Environmental Analysis for additional information on the methodology supporting the Environmental Analysis.

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[21] D. 22-12-055, OP 5 (5).

COMMUNITIES FOR BETTER ENVIRONMENT COMMENT 11-3

CBE requests that SoCalGas promptly post higher quality, individual PDF files of the ESJ maps provided in the Environmental Presentation. Further, to facilitate meaningful discussion at the July workshops, CBE requests that SoCalGas publish maps that break up the larger map of Southern California into more distinct regions, so that impacted communities along the proposed pipeline can be better identified.

The lack of data and analysis provided to support the purported findings in the Environmental Presentation is unacceptable. For example, slide 22 of the Environmental Presentation, titled “Preliminary Findings Routing and ESJ,” states as a finding that “Angeles Link has the potential to reduce greenhouse gas emissions, improve air quality, create union jobs, grow small and diverse businesses, and generate millions of dollars in community benefits.” No support has been provided for the five distinct and significant findings lauded in this bullet point, and it is concerning that these statements seem to be drawn directly from SoCalGas’ Angeles Link project (ALP) promotional materials. As discussed by CBE and several other parties, any impacts of the ALP in these areas depend heavily on project design, and, in many cases, significant negative impacts are expected. While the ALP has the potential to impact the abovementioned areas, listing potential benefits in a vacuum, without both balancing perspectives and supporting these conclusions with definite evidence is unproductive at best.

SOCALGAS RESPONSE TO COMMENT 11-3

SoCalGas understands this comment concerning the information presented in the preliminary findings. SoCalGas also acknowledges that the finding on Slide 22 of the Environmental Presentation at the June 21, 2024 PAG meeting, required additional supporting detail to draw such conclusions. The preliminary findings were intended to present information in a summary format with the understanding that more detailed analysis and assumptions would be provided in the full draft reports when they were available. For additional information on the stakeholder process, please refer to Global Response 1.

For additional information related to maps of ESJ communities along the potential pipeline routes, please refer to response to Comment 5-2.

COMMUNITIES FOR BETTER ENVIRONMENT COMMENT 11-4

An essential assumption missing from the Environmental Presentation's environmental and environmental social justice assumptions and introductory analysis is whether and how SoCalGas has committed to supplying green hydrogen.

SoCalGas's own promotional materials for the project state that the pipeline will exclusively supply green hydrogen to hard-to-electrify sources. FN4 However, when pushed to define the extent of SoCalGas's commitment to transporting only green hydrogen, SoCalGas has outright refused to commit even to compliance with the "three pillars of hydrogen." FN5 In SoCalGas's May 6, 2024 letter to Environmental Justice Partners, SoCalGas states only that "SoCalGas supports clean renewable hydrogen production from non-fossil feedstocks" in compliance with the PUC's memorandum authorization requiring that SoCalGas analyze only the feasibility of hydrogen transport that does not use fossil fuels in its production process. FN6 This statement and others made by SoCalGas neither defines, nor commits to limiting transported hydrogen to green hydrogen that is produced by means of electrolysis using surplus water and additional renewable electricity.

As a hydrogen transportation pipeline in this early phase in development of a hydrogen market, the ALP is likely to have a relational impact on production sources, siting, and development. If SoCalGas is truly committed to their vision of green hydrogen and decarbonization in line with the Equity Principles for Hydrogen, SoCalGas must commit to a definition of green hydrogen that constitutes truly green hydrogen. Doing so is an essential part of providing robust and complete feasibility studies. Committing to the role of transportation only does not absolve SoCalGas of the responsibility of clearly rejecting production of hydrogen that contributes to worsening air quality or climate pollution and damages the supply of scarce water resources in already water strapped communities.

FN4 – See How does it work? Tab on SoCalGas, Angeles Link homepage at https://www.socalgas.com/sustainability/hydrogen/angeles-link
FN5 – See Rachel Fakhry, New Analysis: The 3 Pillars Will Support Large Hydrogen Deployment, June 20, 2023, NRDC, https://www.nrdc.org/bio/rachel-fakhry/new-analysis-3-pillars-will-support-large-hydrogen-deployment.
FN6 – Q4 2023 Quarterly Report Appendices, released May 15, 2024, p. 208.

SOCALGAS RESPONSE TO COMMENT 11-4

SoCalGas is required by the CPUC decision authorizing Angeles Link to transport clean renewable hydrogen as defined in the decision.[22] Please refer to the draft Production Study, Section 2.5, Plans to Confirm Adherence to Clean Renewable Hydrogen Standards: Clean Renewable Hydrogen Certification and Other Measures, for additional information on the potential measures SoCalGas could take to confirm that hydrogen transported by Angeles Link meets the applicable clean renewable hydrogen standards.

In addition, SoCalGas has reviewed the Equity Principles for Hydrogen (Equity Principles) document and believes it is a foundational document that can help guide the company as we proceed with Angeles Link to foster meaningful conversation between environmental justice advocates and SoCalGas. While SoCalGas does not plan to produce hydrogen as part of the Angeles Link, SoCalGas supports sustainable

[22] Per D.22-12-055, clean renewable hydrogen" is defined as hydrogen produced with a carbon intensity equal to or less than four kilograms of carbon dioxide-equivalent produced on a lifecycle basis per kilogram and does not use any fossil fuel in its production process.

upstream production pathways. SoCalGas's response to the Equity Principles document is included as an appendix in its Q4 2023 Quarterly Report.

COMMUNITIES FOR BETTER ENVIRONMENT COMMENT 11-5

CBE appreciates the opportunity to provide feedback on these matters. However, as emphasized in our prior feedback, neither the format nor minimal substantive information provided in the preliminary findings Environmental Presentation allows CBE, or other interested stakeholders, to understand the many necessary studies SoCalGas must undertake if it intends to move the ALP forward.

SOCALGAS RESPONSE TO COMMENT 11-5

SoCalGas understands this comment concerning the information presented in the preliminary findings. The preliminary findings were intended to present information in a summary format with the understanding that more detailed analysis and assumptions would be provided in the full draft reports when they were available. As of the date of this submittal, all the draft reports with additional detail have been shared with PAG and CBOSG for review and comment. For additional information on the stakeholder engagement process and feedback process, please refer to Global Response 1 and Response to Comment 11–1.

2.12 Comment Letter 12 – Environmental Defense Fund and Natural Resources Defense Council

Comment Letter 12

June 26, 2024

Chester Britt
Planning Advisory Group Facilitator

Emily Grant
Angeles Link Senior Public Affairs Representative
Southern California Gas Company

Alisa Lykens
Director
Insignia Environmental

Subject: Environmental Defense Fund and Natural Resources Defense Council Comments on Hydrogen Leakage Assessment Draft Report

Environmental Defense Fund (EDF) and the Natural Resources Defense Council (NRDC) share the following comments to the hydrogen leakage assessment draft report shared by the Southern California Gas Company (SoCalGas) and the Angeles Link Planning Advisory Group Facilitator team.

EDF and NRDC (hereafter, the commenters) note and appreciate SoCalGas' efforts to directly address stakeholder comments and input in the draft report, including those provided by the comments. Leakage risks and impacts will be an important part of assessing the efficacy and appropriateness of the proposed Angeles Link project as a potential decarbonization tool for California. The commenters look forward to providing continued feedback on the issue; and reviewing updates to the greenhouse gas (GHG) studies that account for hydrogen leakage impacts.[1]

Comment 12-01

Additionally, the commenters highlight that currently there is no discussion of last-mile leakage risks in either the hydrogen leakage draft report or other parallel studies conducted as a part of Angeles Link Project Phase 1. Through SoCalGas representative comments in Planning Advisory Group (PAG) sessions and preliminary study results shared with the PAG members, it

[1] Hydrogen Leakage Assessment Draft Report at 8.

has become clear that SoCalGas expects a significant portion of any hydrogen throughput supplied through a potential Angeles Link pipeline to serve the mobility sector—and heavy-duty vehicle traffic associated with the Ports of Los Angeles and Long Beach in particular. SoCalGas has also acknowledged that meeting such demand will require last-mile delivery of hydrogen beyond the Angeles Link Project, potentially in the form of hydrogen liquefaction and delivery to refueling stations.[2] Each additional step in the hydrogen value chain increases possible points of leakage; particularly, both liquefaction of hydrogen supplied through Angeles Link and the transfer of liquified hydrogen to end users carry significant risks of leakage.[3] SoCalGas states that leakage impacts associated with end users—which would include last-mile delivery—was not incorporated into the draft report because "specific details…was not available" and "end users were considered out of scope".[4] The commenters find this argument inadequate and unconvincing. The end-uses of hydrogen supplied by a potential Angeles Link pipeline provide the justification and need for such a pipeline to be constructed in the first place; they have been described extensively and incorporated into demand studies provided by SoCalGas. End uses of hydrogen cannot be suddenly dismissed as "out-of-scope" when their impacts would raise concerns on the feasibility of a potential Angeles Link pipeline. Comment 12-01

EDF's comments on March 28, 2024, highlighted how the lack of consensus figures and details on leakage should not be an excuse for the lack of leakage estimates.[5] In response to such stakeholder comments, SoCalGas has provided high-level preliminary leakage estimates in the draft report.[6] Furthermore, SoCalGas has also provided various other concrete figures related to the potential Angeles Link pipeline such as expected throughput and costs, which have served as the basis for PAG discussions. Therefore, **EDF and NRDC strongly recommend SoCalGas to conduct similar high-level assessments of leakage impacts associated with end-use of hydrogen supplied through a potential Angeles Link pipeline**, including impacts of last-mile delivery for mobility sector use. Comment 12-02

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[2] Angeles Link PAG Meeting, June 21, 2024.
[3] Esquivel-Elizondo, Sofia, Alejandra Hormaza Mejia, Tianyi Sun, Eriko Shrestha, Steven P. Hamburg and Ilissa B. Ocko, 2023, Wide Range in Estimates of Hydrogen Emissions from Infrastructure, Frontiers in Energy Research Vol. 11: 1207208, https://www.frontiersin.org/articles/10.3389/fenrg.2023.1207208/full.
[4] Hydrogen Leakage Assessment Draft Report at 52.
[5] EDF Comments on GHG Emissions and Leakage Preliminary Reports at 2.
[6] Hydrogen Leakage Assessment Draft Report at 40.

Respectfully,

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ENVIRONMENTAL DEFENSE FUND AND NATURAL RESOURCES DEFENSE COUNCIL COMMENT 12-1

EDF and NRDC (hereafter, the commenters) note and appreciate SoCalGas' efforts to directly address stakeholder comments and input in the draft report, including those provided by the comments. Leakage risks and impacts will be an important part of assessing the efficacy and appropriateness of the proposed Angeles Link project as a potential decarbonization tool for California. The commenters look forward to providing continued feedback on the issue; and reviewing updates to the greenhouse gas (GHG) studies that account for hydrogen leakage impacts. FN1

Additionally, the commenters highlight that currently there is no discussion of last-mile leakage risks in either the hydrogen leakage draft report or other parallel studies conducted as a part of Angeles Link Project Phase 1. Through SoCalGas representative comments in Planning Advisory Group (PAG) sessions and preliminary study results shared with the PAG members, it has become clear that SoCalGas expects a significant portion of any hydrogen throughput supplied through a potential Angeles Link pipeline to serve the mobility sector—and heavy-duty vehicle traffic associated with the Ports of Los Angeles and Long Beach in particular. SoCalGas has also acknowledged that meeting such demand will require last-mile delivery of hydrogen beyond the Angeles Link Project, potentially in the form of hydrogen liquefaction and delivery to refueling stations.FN2 Each additional step in the hydrogen value chain increases possible points of leakage; particularly, both liquefaction of hydrogen supplied through Angeles Link and the transfer of liquified hydrogen to end users carry significant risks of leakage.FN3 SoCalGas states that leakage impacts associated with end users—which would include last-mile delivery—was not incorporated into the draft report because "specific details…was not available" and "end users were considered out of scope".FN4 The commenters find this argument inadequate and unconvincing. The end-uses of hydrogen supplied by a potential Angeles Link pipeline provide the justification and need for such a pipeline to be constructed in the first place; they have been described extensively and incorporated into demand studies provided by SoCalGas. End uses of hydrogen cannot be suddenly dismissed as "out-of-scope" when their impacts would raise concerns on the feasibility of a potential Angeles Link pipeline.

FN1 – Hydrogen Leakage Assessment Draft Report at 8.
FN2 – Angeles Link PAG Meeting, June 21, 2024.
FN3 – Esquivel-Elizondo, Sofia, Alejandra Hormaza Mejia, Tianyi Sun, Eriko Shrestha, Steven P. Hamburg and Ilissa B. Ocko, 2023, Wide Range in Estimates of Hydrogen Emissions from Infrastructure, Frontiers in Energy Research Vol. 11: 1207208,
https://www.frontiersin.org/articles/10.3389/fenrg.2023.1207208/full.
FN4 – Hydrogen Leakage Assessment Draft Report at 52.

SOCALGAS RESPONSE TO COMMENT 12-1

Please refer to Global Response 2 for leakage information related to last mile delivery and end users.

ENVIRONMENTAL DEFENSE FUND AND NATURAL RESOURCES DEFENSE COUNCIL COMMENT 12-2

EDF's comments on March 28, 2024, highlighted how the lack of consensus figures and details on leakage should not be an excuse for the lack of leakage estimates. FN5 In response to such stakeholder comments, SoCalGas has provided high-level preliminary leakage estimates in the draft report. FN6 Furthermore, SoCalGas has also provided various other concrete figures related to the potential Angeles Link pipeline such as expected throughput and costs, which have served as the basis for PAG discussions. Therefore, EDF and NRDC strongly recommend SoCalGas to conduct similar high-level assessments of leakage impacts associated with end-use of hydrogen supplied through a potential Angeles Link pipeline, including impacts of last-mile delivery for mobility sector use.

FN5 – EDF Comments on GHG Emissions and Leakage Preliminary Reports at 2.
FN6 – Hydrogen Leakage Assessment Draft Report at 40.

SOCALGAS RESPONSE TO COMMENT 12-2

In response to the comment concerning leakage related to last mile delivery and end users please refer to Global Response 2.

2.13 Comment Letter 13 – Communities for a Better Environment

Comment Letter 13

COMMUNITIES FOR A BETTER ENVIRONMENT
established 1978

June 26, 2024

Southern California Gas Company
555 West Fifth Street,
Los Angeles, CA 90013

Submitted via email to ALP1_Study_PAG_Feedback@insigniaenv.com

Feedback for Southern California Gas Company on Hydrogen Leakage Assessment Draft Report

Communities for a Better Environment (CBE) submits this letter of feedback to Southern California Gas Company (SoCalGas) on the Hydrogen Leakage Assessment Draft Report (the "Report") provided on May 29, 2024. This letter discusses serious oversights and omissions which distort the Report's conclusions and corrode its value as a feasibility assessment document. CPUC Decision 22-12-055 emphasizes the importance of stakeholder engagement. Meaningful engagement is impossible where key data, studies, and environmental risk are not included in project study documents and information is presented in a misleading manner. Particularly, the Report: Comment 13-01

I. Improperly Excludes Leakage from Delivery, End-uses, and Large Leakage Events
II. Draws Unsubstantiated and Misleading Improper Assumptions and Conclusions
III. Draws Unreasonably Favorable Conclusions in the Absence of Adequate Data

I. The Report Improperly Excludes Leakage from Delivery, End-uses, and Large Leakage Events

Comment 13-02

The study of hydrogen leakage is critical to understanding climate and environmental impacts of the Angeles Link Project (ALP), one of the core requirements of D.22-12-055. Hydrogen is an indirect greenhouse gas; its presence in the atmosphere increases the concentration of climate warming air pollution such as methane and stratospheric water vapor. Several studies, including some cited in the Report explain that quantifying total, "well-to-gate" hydrogen leakage is a prerequisite of understanding hydrogen's climate impacts. At present, the draft Report omits or appears to omit several sources of hydrogen leakage, artificially driving down leakage estimates and undermining the reliability of its results. CBE understands that ALP Phase 1 reports are preliminary in nature, however that does not excuse the lack of data and analysis SoCalGas can and should include. Critically, the Report does not examine leakage from end-uses, fails to clearly examine leakage from delivery or supply of hydrogen (i.e. connection

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> Regulations can impact the potential for leakage via design requirements and mitigation measures. The inclusion of hydrogen pipelines within PHMSA's proposed LDAR regulation may increase the speed at which leaks are detected and repaired, and minimize the total volume of gas leaked, by requiring regular leak detection monitoring and by providing structured requirements around how quickly repairs are required.

While regulations are critical to setting legal minimum safety standards, which can impact leakage, nobody other than SoCalGas is in a better position to undertake safety and leak preventions measures. It is entirely the gas company's responsibility to determine what measures, beyond the legal minimum, are necessary and the negative impacts which stem from lack of action fall on SoCalGas' shoulders.

Comment 13-06

Ensuring environmental justice involves safeguarding everyone's right to have and access a clean, healthy, and safe environment by taking affirmative steps beyond the bare minimum. Should SoCalGas wish to take environmental justice seriously, it should consider how the toxic legacy of the fossil fuel industry which has and does disproportionately impacted poor communities and communities of color, Los Angeles' history of redlining, and the fossil fuel industry's history of exploiting tribal lands, in addition to public health and safety risks posed by gas infrastructure leakage.

Comment 13-07

III. The Report Draws Unreasonably Favorable Conclusions in the Absence of Adequate Data

There is no commercially accessible technology for measuring and mitigating hydrogen leakage for many links in the "hydrogen value chain" according to research cited in the Report.[2] This unacknowledged shortcoming leads to a critical lack of direct hydrogen leakage data. The Report's failure to discuss pipeline conditions, leakage data, or lessons learned from the 1600 miles of existing hydrogen pipeline within the country further emphasizes its glaring lack of data. Concerningly, the Report instead relies substantially on non-hydrogen leakage and emissions data and ignores research showing that hydrogen has the potential to leak 1.3-4.6 times more than methane.[3]

Comment 13-08

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[2] National Petroleum Council, April 2024, "Harnessing Hydrogen: A Key Element of the U.S. Energy Future, Report Summary", https://harnessinghydrogen.npc.org/downloads.php; M. Penchev et al.

[3] Makhijani, Arjun & Hersbach Thom, "Hydrogen: What Good is it? A technical exploration of the potential of hydrogen to contribute to a decarbonized energy system" Institute for Energy and Environmental Research, January 2024, https://ieer.org/wp/wp-content/uploads/2024/06/What-Good-Is-Hydrogen-IEER-report-for-Just-Solutions-January-2024.pdf; National Petroleum Council, April 2024, "Harnessing Hydrogen: A Key Element of the U.S. Energy Future, Chapter 1: Role of Low Carbon Intensity Hydrogen in the United States"; "Hydrogen Blending Impacts Study Final Report", California Public Utilities Commission, Agreement Number 19NS1662, 2022, https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M493/K760/493760600.PDF.

The absence of adequate existing leakage measurement and mitigation technology also throws into doubt the Report's wildly speculative leakage reduction potential figures. These figures, which rely on natural gas as a proxy, do not account for the difference in leakage potential between hydrogen and methane. Further, the analysis does not discuss leakage mitigation cost, availability, or even feasibility of hydrogen specific mitigation technology. The U.S. EPA's new methane leakage rule aims to reduce methane emissions by 30% by 2030 and will cost several billion dollars. Diminishing returns mean that as reductions approach 100% every incremental gain will be costlier and more difficult. In light of this and the Report's lack of supportive data and analysis, it is entirely unclear how SoCalGas came to their conclusions regarding leakage reduction. While it would be reassuring to believe the Report's optimistic outlook for leakage reductions, the figures presented are unsubstantiated, and extraordinarily misleading.

Comment 13-09

Sincerely,

Theo Caretto
Lauren Gallagher

Communities for a Better Environment

CC:
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Chester Britt, Arellano Associates
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Angeles Link service list

COMMUNITIES FOR A BETTER ENVIRONMENT COMMENT 13-1

Communities for a Better Environment (CBE) submits this letter of feedback to Southern California Gas Company (SoCalGas) on the Hydrogen Leakage Assessment Draft Report (the "Report") provided on May 29, 2024. This letter discusses serious oversights and omissions which distort the Report's conclusions and corrode its value as a feasibility assessment document. CPUC Decision 22-12-055 emphasizes the importance of stakeholder engagement. Meaningful engagement is impossible where key data, studies, and environmental risk are not included in project study documents and information is presented in a misleading manner.

Particularly, the Report:

I. Improperly Excludes Leakage from Delivery, End-uses, and Large Leakage Events
II. Draws Unsubstantiated and Misleading Improper Assumptions and Conclusions
III. Draws Unreasonably Favorable Conclusions in the Absence of Adequate Data

SOCALGAS RESPONSE TO COMMENT 13-1

Please refer to Global Response 1 and Global Response 2. Additional information is provided in responses to Comments 13-3 and 13-5.

COMMUNITIES FOR A BETTER ENVIRONMENT COMMENT 13-2

I. The Report Improperly Excludes Leakage from Delivery, End-uses, and Large Leakage Events

The study of hydrogen leakage is critical to understanding climate and environmental impacts of the Angeles Link Project (ALP), one of the core requirements of D.22-12-055. Hydrogen is an indirect greenhouse gas; its presence in the atmosphere increases the concentration of climate warming air pollution such as methane and stratospheric water vapor. Several studies, including some cited in the Report explain that quantifying total, "well-to-gate" hydrogen leakage is a prerequisite of understanding hydrogen's climate impacts. At present, the draft Report omits or appears to omit several sources of hydrogen leakage, artificially driving down leakage estimates and undermining the reliability of its results. CBE understands that ALP Phase 1 reports are preliminary in nature, however that does not excuse the lack of data and analysis SoCalGas can and should include. Critically, the Report does not examine leakage from end-uses, fails to clearly examine leakage from delivery or supply of hydrogen (i.e. connection between the ALP terminus and the end-user), and completely excludes large scale leakage events.

SOCALGAS RESPONSE TO COMMENT 13-2

In response to this comment concerning leakage from delivery, end uses, and large leakage events, please refer to Global Response 2.

COMMUNITIES FOR A BETTER ENVIRONMENT COMMENT 13-3

The Report's failure to examine hydrogen emissions from delivery and end-use is not excusable. Not only do studies on hydrogen end-use leakage rates exist, but several are cited in the Report. Both Cooper Jasmin, Luke Dubey, Semra Bakkaloglu, Adam Hawkes, as well as Esquivel-Elizondo, Sofia, et al., examine end-uses. In fact, SoCalGas itself is, concurrently with the ALP, studying hydrogen end-uses at California ratepayer expense in the hydrogen blending proceeding (Application 22-09-006). Not only does SoCalGas have data available to examine these emissions, but their existing demand study also cited in the Report breaks down estimated hydrogen demand of the ALP by end-use. Despite this, the Report confusingly states that end-use is "out of scope for this assessment."

SOCALGAS RESPONSE TO COMMENT 13-3

In response to the comment concerning an evaluation of potential leakage related to end uses, please refer to Global Response 2.

In response to the comment citing one of the articles referenced in the draft Leakage Study, the article "Hydrogen emissions from the hydrogen value chain-emissions profile and impact to global warming"[23] reviewed as part of the draft Leakage Study does not appear to contain leakage estimates for end users. A potential statement with respect to potential end users referenced in the article is as follows: "Derwent at al., 2020,[24] also estimated the impacts of H_2 leaks in a system where H_2 replaces fossil fuels and found that H_2 is a good alternative fuel, provided H_2 leaks are curtailed."

The other article provided by stakeholders and also evaluated for the draft Leakage Study, "Wide Range in Estimates of Hydrogen Emissions from Infrastructure,"[25] indicates that anticipated ranges of the potential for leakage from hydrogen liquefaction and refueling stations, are approximately 0.15% to 10% and 2% to 15%, respectively. Regarding the power generation end use sector, the same article indicates that anticipated range of the potential for leakage from power generation is 0.01% to 3%. Further investigation would be needed to evaluate whether any of these estimated values amongst these wide ranges would be appropriate predictors for Angeles Link end users.

Additionally, the hydrogen blending application[26] referenced in this comment, which is pending approval before the CPUC will be examining hydrogen/natural gas blended fuels and will not evaluate pure hydrogen in combustion equipment. The leakage evaluation as part of the blending application is for hydrogen/natural gas blended fuels rather than for pure hydrogen/dedicated hydrogen pipelines. Results for hydrogen/natural gas blends are not representative of pure clean renewable hydrogen, which is the focus of Angeles Link. End-user equipment evaluated in SoCalGas's portion of the blending application only includes residential and commercial heating equipment such as boilers and water

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23 Cooper, Jasmin, Luke Dubey, Semra Bakkaloglu, Adam Hawkes, 2022, Hydrogen Emissions from the Hydrogen Value Chain - Emissions Profile and Impact to Global Warming, Science of the Total Environment Vol. 380: 154624, July 15, https://www.sciencedirect.com/science/article/pii/S004896972201717X#s0070

24 Derwent, R.G., et. al., 2020, Global modelling studies of hydrogen and its isotopomers using STOCHEM-CRI: likely radiative forcing consequences of a future hydrogen economy, https://www.sciencedirect.com/science/article/abs/pii/S0360319920302779

25 Esquivel-Elizondo, Sofia, Alejandra Hormaza Mejia, Tianyi Sun, Eriko Shrestha, Steven P. Hamburg and Ilissa B. Ocko, 2023, Wide Range in Estimates of Hydrogen Emissions from Infrastructure, Frontiers in Energy Research Vol. 11: 1207208, https://www.frontiersin.org/articles/10.3389/fenrg.2023.1207208/full

26 Application (A.) 22-09-006.

heaters. In comparison, in Phase 1 of Angeles Link, the draft GHG and draft NOx Studies evaluated the mobility, power generation, and hard-to-electrify industrial end users and did not focus on residential or commercial equipment. For these reasons, the information collected as part of the hydrogen blending application will not be applicable or informative to the Angeles Link draft Leakage Study.

COMMUNITIES FOR A BETTER ENVIRONMENT COMMENT 13-4

The Report also does not address, or even mention, large-scale leakage, such as leakage from catastrophic events or undetected equipment failures. While such events can be difficult to quantify, their public health, and climate impacts cannot be ignored. The Report must, at minimum, look at this risk, identify risk factors and where they fall across a hydrogen infrastructure network.

SOCALGAS RESPONSE TO COMMENT 13-4

In response to this comment concerning large-scale leakage events, please refer to Global Response 2.

COMMUNITIES FOR A BETTER ENVIRONMENT COMMENT 13-5

When examining feasibility, it is critical that all parties can examine the data available. Unfortunately, on page 16 the Report, SoCalGas paraphrases another study, which cites a U.S. gas infrastructure methane leakage rate of 2%, rather than the true number in the cited study which is 2.3%.FN1 With a range of even higher U.S. estimates, it is misleading to include only a lowest estimate that explicitly omits some sources of leakage.

FN1 – Alvarez, et al., Science (2018); https://doi.org/10.1126/science.aar7204.

SOCALGAS RESPONSE TO COMMENT 13-5

In SoCalGas's review of existing literature regarding leakage, the general range of values are relatively consistent. The draft Leakage Study states that the EPA estimates the nationwide average leak rate as approximately 2% of natural gas produced, whereas other studies estimate a weighted average of 2.95% across several basins and global regions.[27] The data referenced cites the National Petroleum Council, April 2024, "Harnessing Hydrogen: A Key Element of the U.S. Energy Future."

The article referenced by the stakeholder, Alvarez, et al., (2018) states: "When scaled up nationally, our facility-based estimate of 2015 supply chain emissions is 13 ± 2 teragrams per year, equivalent to 2.3% of gross U.S. gas production."

Additionally, based on a review of information publicly available, the following statement is also cited frequently: "EPA estimates current leak rates across the natural gas supply chain to be 2 to 3%." Thus, there seems to be general consensus on this range of values which are consistent with both the estimates included in the draft Leakage Study and with the article referenced in this stakeholder comment.

[27] National Petroleum Council, April 2024, "Harnessing Hydrogen: A Key Element of the U.S. Energy Future https://harnessinghydrogen.npc.org/downloads.php

COMMUNITIES FOR A BETTER ENVIRONMENT COMMENT 13-6

The Report also severely mischaracterizes the relationship between regulators and SoCalGas.

Regulations can impact the potential for leakage via design requirements and mitigation measures. The inclusion of hydrogen pipelines within PHMSA's proposed LDAR regulation may increase the speed at which leaks are detected and repaired, and minimize the total volume of gas leaked, by requiring regular leak detection monitoring and by providing structured requirements around how quickly repairs are required.

While regulations are critical to setting legal minimum safety standards, which can impact leakage, nobody other than SoCalGas is in a better position to undertake safety and leak preventions measures. It is entirely the gas company's responsibility to determine what measures, beyond the legal minimum, are necessary and the negative impacts which stem from lack of action fall on SoCalGas' shoulders.

SOCALGAS RESPONSE TO COMMENT 13-6

SoCalGas acknowledges regulations are critical to setting legal minimum safety standards and currently has policies and procedures in place to meet environmental and safety regulations implemented by various state and federal agencies, including, but not limited to, the federal Environmental Protection Agency (EPA) and Pipeline and Hazardous Materials Safety Administration (PHMSA), California's Department of Conservation's Geological Energy Management Division (CalGEM), Occupational Safety and Health Administration (OSHA), CARB, and local air pollution control districts. SoCalGas also performs leak prevention measures as exemplified by SoCalGas's Natural Gas Leak Abatement Program in accordance with Senate Bill (SB) 1371 requirements.

The draft Leakage Study includes a section on the regulatory requirements related to leakage (see Section 3.3) and states that regulations can impact the potential for leakage via design requirements and mitigation. The draft Leakage Study also provides a summary of mitigation opportunities, including available sensors and emerging leak detection methodologies (see Section 4.0).

COMMUNITIES FOR A BETTER ENVIRONMENT COMMENT 13-7

Ensuring environmental justice involves safeguarding everyone's right to have and access a clean, healthy, and safe environment by taking affirmative steps beyond the bare minimum. Should SoCalGas wish to take environmental justice seriously, it should consider how the toxic legacy of the fossil fuel industry which has and does disproportionately impacted poor communities and communities of color, Los Angeles' history of redlining, and the fossil fuel industry's history of exploiting tribal lands, in addition to public health and safety risks posed by gas infrastructure leakage.

SOCALGAS RESPONSE TO COMMENT 13-7

SoCalGas acknowledges it is crucial to address environmental justice issues comprehensively and consider historical inequities in project planning. SoCalGas is developing an draft ESJ Community Engagement Plan in Phase 1, with plans for implementation in Phase 2 (subject to CPUC approval). The draft ESJ Plan provides a framework for engaging ESJ communities and is designed to provide low-income communities, communities of color, and other stakeholders that have been historically overlooked in a typical project development process. SoCalGas is actively seeking feedback on the draft ESJ Plan and looks forward to learning from stakeholders how best to engage disadvantaged communities in the Angeles Link planning process.

COMMUNITIES FOR A BETTER ENVIRONMENT COMMENT 13-8

There is no commercially accessible technology for measuring and mitigating hydrogen leakage for many links in the "hydrogen value chain" according to research cited in the Report.FN2 This unacknowledged shortcoming leads to a critical lack of direct hydrogen leakage data. The Report's failure to discuss pipeline conditions, leakage data, or lessons learned from the 1600 miles of existing hydrogen pipeline within the country further emphasizes its glaring lack of data. Concerningly, the Report instead relies substantially on non-hydrogen leakage and emissions data and ignores research showing that hydrogen has the potential to leak 1.3-4.6 times more than methane.FN3

FN2 – National Petroleum Council, April 2024, "Harnessing Hydrogen: A Key Element of the U.S. Energy Future, Report Summary", https://harnessinghydrogen.npc.org/downloads.php; M. Penchev et al.

FN3 – Makhijani, Arjun & Hersbach Thom, "Hydrogen: What Good is it? A technical exploration of the potential of hydrogen to contribute to a decarbonized energy system" Institute for Energy and Environmental Research, January 2024, https://ieer.org/wp/wp-content/uploads/2024/06/What-Good-Is-Hydrogen-IEER-report-for-Just-SolutionsJanuary-2024.pdf; National Petroleum Council, April 2024, "Harnessing Hydrogen: A Key Element of the U.S. Energy Future, Chapter 1: Role of Low Carbon Intensity Hydrogen in the United States"; "Hydrogen Blending Impacts Study Final Report", California Public Utilities Commission, Agreement Number 19NS1662, 2022, https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M493/K760/493760600.PDF.

SOCALGAS RESPONSE TO COMMENT 13-8

In response to the general comments concerning data included in the draft Leakage Study, please refer to Global Response 2. In further response to the comment concerning lessons learned from the 1,600 miles of existing hydrogen pipeline within the country, please refer to Lessons Learned section in the draft Safety Study (Section 11), which includes a summary of incidents involving various hydrogen infrastructure. While these incidents did not involve SoCalGas, the lessons learned from those incidents will be valuable for SoCalGas's continued hydrogen safety planning

COMMUNITIES FOR A BETTER ENVIRONMENT COMMENT 13-9

The absence of adequate existing leakage measurement and mitigation technology also throws into doubt the Report's wildly speculative leakage reduction potential figures. These figures, which rely on natural gas as a proxy, do not account for the difference in leakage potential between hydrogen and methane. Further, the analysis does not discuss leakage mitigation cost, availability, or even feasibility of hydrogen specific mitigation technology. The U.S. EPA's new methane leakage rule aims to reduce methane emissions by 30% by 2030 and will cost several billion dollars. Diminishing returns mean that as reductions approach 100% every incremental gain will be costlier and more difficult. In light of this and the Report's lack of supportive data and analysis, it is entirely unclear how SoCalGas came to their conclusions regarding leakage reduction. While it would be reassuring to believe the Report's optimistic outlook for leakage reductions, the figures presented are unsubstantiated, and extraordinarily misleading.

SOCALGAS RESPONSE TO COMMENT 13-9

Please refer to Global Response 2.

The potential for hydrogen leakage in the draft Leakage Study is estimated based on the range of values provided in the available literature, which are currently based on a variety of methodologies, including calculations via proxies such as natural gas, laboratory experiments, and theory-based models or simulations, due to the lack of empirical data available. Regarding comments related to opportunities to minimize leakage, the draft Leakage Study includes discussion regarding opportunities to mitigate and minimize leakage in Section 4.4 with a summary in Table 3, details with respect to opportunities during design and engineering in Section 4.4.1, options during operations in Section 4.4.2, and discussion related to maintenance and repair in Section 4.4.3. The draft Leakage Study includes discussion regarding available hydrogen detection sensors and direct measurement tools in Section 4.2.1. Additionally, please refer to the draft Safety Study for further information regarding the availability of leak detection equipment.

2.14 Comment Letter 14 – Food and Water Watch

Comment Letter 14

June 26, 2024

Submitted via email to ALP1_Study_PAG_Feedback@insigniaenv.com.

RE: Feedback on Hydrogen Leakage Assessment Draft Report

Food & Water Watch, as part of the Community Based Organization Stakeholder Group (CBOSG), submits this letter of feedback regarding the Hydrogen Leakage Assessment Draft Report for the Angeles Link Project by the Southern California Gas Company (SoCalGas). Concerns relating to the Hydrogen Leakage Assessment Draft Report are as follows:

Comment 14-01

The Hydrogen Leakage Assessment Draft Report fails to examine leakage from delivery, end-uses, and large leakage events. The report also fails to address safety and leak prevention measures that SoCalGas plans to implement, instead shifting responsibility onto regulators. The report also fails to consider the current lack of accessible technology for measuring and mitigating hydrogen leakage.

Due to these critical factors being omitted in the report, it is questionable as to how SoCalGas came to the conclusions that it did in this report.

Sincerely,

Andrea Vega
Southern California Senior Organizer
Food & Water Watch

FOOD AND WATER WATCH COMMENT 14-1

The Hydrogen Leakage Assessment Draft Report fails to examine leakage from delivery, end-uses, and large leakage events. The report also fails to address safety and leak prevention measures that SoCalGas plans to implement, instead shifting responsibility onto regulators. The report also fails to consider the current lack of accessible technology for measuring and mitigating hydrogen leakage.

Due to these critical factors being omitted in the report, it is questionable as to how SoCalGas came to the conclusions that it did in this report.

SOCALGAS RESPONSE TO COMMENT 14-1

In response to the comment concerning evaluating potential leakage from delivery, end users, and large leakage events, please refer to Global Response 2. Additionally, please refer to the draft Safety Study for further information regarding hydrogen safety and leak prevention measures.

The draft Leakage Study includes discussion regarding opportunities to mitigate and minimize leakage in Section 4.4 with a summary in Table 3, details with respect to opportunities during design and engineering in Section 4.4.1, options during operations in Section 4.4.2, and discussion related to maintenance and repair in Section 4.4.3. Finally, discussion regarding available hydrogen detection sensors and direct measurement tools is provided in Section 4.2.1 of the draft Leakage Study.

Appendix 4 – Attendee List for PAG and CBOSG Meetings and Workshop

(including those invited)

CBOSG April Invitee List		
Organization	First Name	Last Name
Protect Playa Now	Faith	Myhra
Protect Playa Now	Kevin	Weir
Ballona Wetland Institute	Marcia	Hanscom
Ballona Wetland Institute	Marcia	Hanscom
California Greenworks	Mike	Meador
California Greenworks	Jessy	Shelton
California Greenworks	Michael	Berns
Communities for a Better Environment	Theo	Caretto
Communities for a Better Environment	Roberto	Cabrales
Communities for a Better Environment	Ambar	Rivera
Communities for a Better Environment	Roselyn	Tovar
Communities for a Better Environment	Jay	Parepally
Communities for a Better Environment	Lauren	Gallagher
Breathe Southern California	Marc	Carrel
Breathe Southern California	Tigran	Agdaian
Nature for All	Belen	Bernal
Nature for All	Steven	Ochoa
Climate Action Campaign	Ayn	Craciun
Climate Action Campaign	Lexi	Hernandez
Vote Solar	Andrea	Leon-Grossmann
Food and Water Watch	Andrea	Vega
Food and Water Watch	Chirag	Bhakta
Defend Ballona Wetlands	Robert Roy	van de Hoek
Defend Ballona Wetlands	Jackson	Garland
Physicians for Social Responsibility - Los Angeles	Alex	Jasset
Go Green Initiative	Jill	Buck
Chinatown Service Center	Daisy	Ma
Chinatown Service Center	Kerry	Situ
Soledad Enrichment Action	Enrique	Aranda
Soledad Enrichment Action	Nathan	Aranda
Communities for Responsible Community Development	Ricardo	Mendoza
Communities for Responsible Community Development	Kenta	Estrada-Darley
Watts/Century Latino Organization	Autumn	Ybarra
Little Tokyo Community Council	Kristin	Fukushima
Little Tokyo Community Council	Chris	Fukushima
Reimagine LA Foundation	Rashad	Trapp
Reimagine LA Foundation	Shawna	Andrews
Reimagine LA Foundation	Raul	Claros
Mexican American Opportunity Foundation	Ciriaco "Cid"	Pinedo
Watts Labor Community Action Committee	Timothy	Watkins
Watts Labor Community Action Committee	Thelmy	Alvarez
LA Black Workers Center/Care at Work, UCLA Labor Center	Andrea	Slater
LA Black Workers Center/Care at Work, UCLA Labor Center	Deja	Thomas
LA Black Workers Center/Care at Work, UCLA Labor Center	Andrea	Slater
Alma Family Services	Lourdes	Caracoza
Alma Family Services	Aida	Vega
Alma Family Services	Diego	Rodriguez
Southside Coalition of Community Health Centers	Andrea	Williams
Southside Coalition of Community Health Centers	Lucy	Castro
Greater Zion Church Family	Michael	Fisher
Greater Zion Church Family	Danny	Harrison
Greater Zion Church Family	Aquyla	Walker
Faith and Community Empowerment (FACE)	Hyepin	Im
YMCA of Greater Los Angeles	Gerry	Salcedo
Parents, Educators/Teachers, and Students in Action (PESA)	Seymour	Amster
Parents, Educators/Teachers, and Students in Action (PESA)	Ella	Cavlan
Parents, Educators/Teachers, and Students in Action (PESA)	Olivia	Fike
Parents, Educators/Teachers, and Students in Action (PESA)	Araksya	Nordikyan
Los Angeles Indigenous People's Alliance	Luis R.	Pena

CBOSG April Invitee List		
Organization	**First Name**	**Last Name**
Los Angeles Indigenous People's Alliance	Jamie	Patino
California Native Vote Project	Rene	Williams
Comunidades Indigenas en Liderazgo (CIELO)	Odilia	Romero

4/23/24 CBOSG Angeles Link Joint Update Attendees

CBOSG			
Organization	**First Name**	**Last Name**	**Zoom**
Alma Family Services	Lourdes	Caracoza	X
Ballona Wetlands Institute	Marcia	Hanscom	X
Breathe Southern California	Marc	Carrel	X
California Greenworks	Michael	Berns	X
Coalition for Responsible Community Development	Ricardo	Mendoza	X
Coalition for Responsible Community Development	Kenta	Estrada-Darley	X
Communities for a Better Environment	Jay	Parepally	X
Communities for a Better Environment	Lauren	Gallagher	X
Defend Ballona Wetlands	Roy	van de Hoek	X
Food and Water Watch	Andrea	Vega	X
Go Green Initiative	Jill	Buck	X
Greater Zion Church Family	Michael	Fisher	X
Little Tokyo Community Council	Kisa	Ito	X
Physicians for Social Responsibility-LA	Alex	Jasset	X
Reimagine LA	Rashad	Rucker-Trapp	X
Soledad Enrichment Action	Enrique	Aranda	X
Southeast Rio Vista YMCA	Gerry	Salcedo	X
Southside Coalition of Community Health Centers	Andrea	Williams	X
Watts/Century Latino Organization	Autumn	Ybarra	X
Non CBOSG			
California Public Utilities Commission	Sasha	Cole	X
California Public Utilities Commission	Christopher	Arroyo	X
TOTAL CBOs			**17**

PAG April Invitee List

Organization	First name	Last name
Agricultural Energy Consumers Association	Michael	Boccadoro
Air Products	JP	Gunn
Air Products	Lorraine	Paskett
Air Products	Seth	Hilton
Air Products	Miles	Heller
Air Products	Vince	Wiraatmadja
ARCHES	Angelina	Galiteva
ARCHES	Tyson	Eckerle
Bizfed	Sarah	Wiltfong
Bloom Energy	Christina	Tan
California Air Resources Board	Steve	Cliff
California Energy Commission	Rizaldo	Aldas
California Hydrogen Business Council	Katrina	Fritz
California Manufacturers and Technology Association	Lance	Hastings
California Manufacturers and Technology Association	Robert	Spiegel
California Public Utilities Commission	Arthur (Iain)	Fisher
California Public Utilities Commission	Christopher	Arroyo
California Public Utilities Commission	Christopher	Myers
California Public Utilities Commission	Matthew	Taul
California Public Utilities Commission	Jack	Chang
California Public Utilities Commission	Sasha	Cole
California Public Utilities Commission	Nick	Zanjani
California Public Utilities Commission	Nathaniel	Skinner
California Public Utilities Commission	Kaj	Peterson
California Public Utilities Commission	Benjamin	Tang
California Water Data Consortium	Deven	Upadhay
CIty of Burbank	Anthony	D'aquila
City of Long Beach - Long Beach Water	Diana	Tang
City of Long Beach - Utilities	Tony	Foster
City of Long Beach - Utilities	Dennis	Burke
City of Long Beach - Utilities	Heather	Hamilton
City of Long Beach*	Mario	Cordero
Clean Energy	Nora	Sheriff
Clean Energy Strategies representing the Utility Consumers' Acti	Tyson	Siegele
Communities for a Better Environment	Theo	Caretto
Communities for a Better Environment	Shara	Burwell
Communities for a Better Environment	Roberto	Cabrales
Communities for a Better Environment	Jay	Parepally
Communities for a Better Environment	Lauren	Gallagher
Earth Justice	Sara	Gersen
Energy Independence Now	Brian	Goldstein
Environmental Defense Fund	Joon Hun	Seong
Environmental Defense Fund	Michael	Colvin
Environmental Justice League	Russell	Lowery

GoBiz	Deedee	Myers
Green Hydrogen Coalition	Nick	Connell
Green Hydrogen Coalition	Hope	Fasching
Green Hygroden Coalition	Sergio	Dueñas
Green Hygroden Coalition	Janice	Lin
Harbor Trucking Association	Karla	Sanchez
Harbor Trucking Association	Matthew	Schrap
Independent Energy Producers Association*	Jan	Smutny Jones
Independent Energy Producers Association*	Sara	Fitzsimon
International Longshore and Warehouse Union Local 13	Sal	DiConstanzo
International Longshore and Warehouse Union Local 13	Mark	Jurisic
International Longshore and Warehouse Union Local 13	Sophia	Dubrovich
Local Union 250	Nathaniel	Williams
Local Union 250	Hector	Carbajal
Los Angeles Department of Water and Power	Aaron	Guthrey
Los Angeles Department of Water and Power	Marty	Adams
Los Angeles Department of Water and Power	Paul	Habib
Los Angeles Department of Water and Power	Nermina	Rucic
Los Angeles Department of Water and Power	Jesse	Vismonte
Los Angeles Department of Water and Power	Xinhe	Le
Los Angeles Department of Water and Power	Eric	Hill
Metropolitan Water District	Deven	Upadhyay
Natural Resources Defense Council	Pete	Budden
Pasadena Water & Power	Erik	Johnson
Port of Los Angeles	Mike	Galvin
Port of Los Angeles	Tim	DeMoss
Protect our Communities Foundation	Malinda	Dickenson
Reimagine LA	Rashad	Rucker-Trapp
Reimagine LA	Raul	Claros
Sierra Club	Monica	Embrey
Sierra Club	Julia	Dowell
Sierra Club	Teresa	Cheng
South Coast AQMD	Maryam	Hajbabaei
South Coast AQMD	Sam	Cao
South Coast AQMD	Aaron	Katzenstein
South Coast AQMD	Vasileios	Papapostolou
Southern CA Water Coalition	Charley	Wilson
Southern California Association of Governments	Kome	Ajise
Southern California Generation Coalition	Norman	Pedersen
Southern California Leadership Council	Richard	Lambros
Southern California Pipe Trades	Rodney	Cobos
Southern California Public Power Authority	Charles	Guss
The United Association	Aaron	Stockwell
UC Davis Insitutue of Transportation Studies	Lukas	Wernert
UC Davis Sustainable Transportation Energy Pathways	Lew	Fulton
UCI Advanced Power and Energy Program	Jack	Brouwer
University of CA Riverside	Arun	Raju

Utility Reform Network (TURN)	Marcel	Hawiger
Utility Reform Network (TURN)	Marna	Paintsil Anning
Utility Workers Union of America 483	Ernest	Shaw
Utility Workers Union of America 483	Robin	Downs
Utility Workers Union of America 483	Anthony	Flores
Utility Workers Union of America Local 132	Joe	Moreno
Utility Workers Union of America Local 132	Mike	Cormode

PAG/CBOSG Joint Update - April 23, 2024

PAG		
Organization	**First name**	**Last name**
Air Products	JP	Gunn
Bizfed	Sarah	Wiltfong
California Energy Commission	Rizaldo	Aldas
California Hydrogen Business Council	Katrina	Fritz
California Public Utilities Commission	Arthur (Iain)	Fisher
California Public Utilities Commission	Christopher	Arroyo
California Public Utilities Commission	Sasha	Cole
CIty of Burbank	Anthony	D'aquila
City of Long Beach - Utilities	Tony	Foster
City of Long Beach - Utilities	Dennis	Burke
City of Long Beach - Utilities	Heather	Hamilton
Clean Energy Strategies representing the Utility Consumers' Action Netwo	Tyson	Siegele
Communities for a Better Environment	Jay	Parepally
Communities for a Better Environment	Lauren	Gallagher
Environmental Defense Fund	Joon Hun	Seong
Green Hygroden Coalition	Janice	Lin
Harbor Trucking Association	Karla	Sanchez
Los Angeles Department of Water and Power	Aaron	Guthrey
Los Angeles Department of Water and Power	Jesse	Vismonte
Los Angeles Department of Water and Power	Xinhe	Le
Metropolitan Water District	Deven	Upadhyay
Natural Resources Defense Council	Pete	Budden
Pasadena Water & Power	Erik	Johnson
Port of Los Angeles	Mike	Galvin
Reimagine LA	Rashad	Rucker-Trapp
Sierra Club	Julia	Dowell
Sierra Club	Teresa	Cheng
South Coast AQMD	Maryam	Hajbabaei
South Coast AQMD	Sam	Cao
Southern California Generation Coalition	Norman	Pedersen
Non PAG		
Arellano Associates	Chester	Britt
Arellano Associates	Stevie	Espinoza
Arellano Associates	Keven	Michele
Insignia Environmental	Armen	Keochekian
Insignia Environmental	Anniken	Lydon
Insignia Environmental	Julie	Roshala
Lee Andrews Group	Alma	Marquez
Lee Andrews Group	Antonia	Issaevitch
Lee Andrews Group	Alyssa	Martinez
SoCalGas	Emily	Grant
SoCalGas	Andy	Carrasco

SoCalGas	Frank	Lopez
SoCalGas	Amy	Kitson
SoCalGas	Jessica	Foley
SoCalGas	Shirley	Arazi
SoCalGas	Colby	Wells

CBOSG June 18th Q2 Invitee List		
Organization	**First Name**	**Last Name**
Protect Playa Now	Faith	Myhra
Protect Playa Now	Kevin	Weir
Ballona Wetland Institute	Marcia	Hanscom
Ballona Wetland Institute	Marcia	Hanscom
California Greenworks	Mike	Meador
California Greenworks	Jessy	Shelton
California Greenworks	Michael	Berns
Communities for a Better Environment	Theo	Caretto
Communities for a Better Environment	Roberto	Cabrales
Communities for a Better Environment	Ambar	Rivera
Communities for a Better Environment	Roselyn	Tovar
Communities for a Better Environment	Jay	Parepally
Communities for a Better Environment	Lauren	Gallagher
Breathe Southern California	Marc	Carrel
Breathe Southern California	Tigran	Agdaian
Nature for All	Belen	Bernal
Nature for All	Steven	Ochoa
Climate Action Campaign	Ayn	Craciun
Climate Action Campaign	Lexi	Hernandez
Vote Solar	Andrea	Leon-Grossmann
Food and Water Watch	Andrea	Vega
Food and Water Watch	Chirag	Bhakta
Defend Ballona Wetlands	Robert Roy	van de Hoek
Defend Ballona Wetlands	Jackson	Garland
Physicians for Social Responsibility - Los Angeles	Alex	Jasset
Go Green Initiative	Jill	Buck
Chinatown Service Center	Daisy	Ma
Chinatown Service Center	Kerry	Situ
Soledad Enrichment Action	Enrique	Aranda
Soledad Enrichment Action	Nathan	Aranda
Communities for Responsible Community Development	Ricardo	Mendoza
Communities for Responsible Community Development	Kenta	Estrada-Darley
Watts/Century Latino Organization	Autumn	Ybarra
Little Tokyo Community Council	Kristin	Fukushima
Little Tokyo Community Council	Chris	Fukushima
Reimagine LA Foundation	Rashad	Trapp
Reimagine LA Foundation	Shawna	Andrews
Reimagine LA Foundation	Raul	Claros
Mexican American Opportunity Foundation	Ciriaco "Cid"	Pinedo
Watts Labor Community Action Committee	Timothy	Watkins
Watts Labor Community Action Committee	Thelmy	Alvarez
LA Black Workers Center/Care at Work, UCLA Labor Center	Andrea	Slater
LA Black Workers Center/Care at Work, UCLA Labor Center	Deja	Thomas
LA Black Workers Center/Care at Work, UCLA Labor Center	Andrea	Slater
Alma Family Services	Lourdes	Caracoza
Alma Family Services	Aida	Vega
Alma Family Services	Diego	Rodriguez
Southside Coalition of Community Health Centers	Andrea	Williams
Southside Coalition of Community Health Centers	Lucy	Castro
Greater Zion Church Family	Michael	Fisher
Greater Zion Church Family	Danny	Harrison
Greater Zion Church Family	Aquyla	Walker
Faith and Community Empowerment (FACE)	Hyepin	Im
YMCA of Greater Los Angeles	Gerry	Salcedo
Parents, Educators/Teachers, and Students in Action (PESA)	Seymour	Amster
Parents, Educators/Teachers, and Students in Action (PESA)	Ella	Cavlan
Parents, Educators/Teachers, and Students in Action (PESA)	Olivia	Fike
Parents, Educators/Teachers, and Students in Action (PESA)	Araksya	Nordikyan
Los Angeles Indigenous People's Alliance	Luis R.	Pena

CBOSG June 18th Q2 Invitee List		
Organization	**First Name**	**Last Name**
Los Angeles Indigenous People's Alliance	Jamie	Patino
California Native Vote Project	Rene	Williams
Comunidades Indigenas en Liderazgo (CIELO)	Odilia	Romero

CBOSG June Q2 Meeting Attendees

CBOSG				
Organization	**First Name**	**Last Name**	**In Person**	**Zoom**
Ballona Wetlands Institute	Marcia	Hanscom	X	
California Greenworks	Michael	Berns	X	
Coalition for Responsible Community Development	Ricardo	Mendoza		X
Coalition for Responsible Community Development	Kenta	Estrada-Darley	X	
Defend Ballona Wetlands	Roy	van de Hoek	X	
Faith and Community Empowerment (FACE)	Hyepin	Im		X
Food and Water Watch	Andrea	Vega	X	
Go Green Initiative	Jill	Buck		X
Little Tokyo Community Council	Kristin	Fukushima		X
Watts Labor Community Action Committee	Ava	Post		X
Reimagine LA	Rashad	Rucker-Trapp	X	
Soledad Enrichment Action	Enrique	Aranda		X
Southeast Rio Vista YMCA	Gerry	Salcedo		X
Southside Coalition of Community Health Centers	Andrea	Williams		X
Watts Labor Community Action Committee	Thelmy	Alvarez		X
Protect Playa Now	Faith	Myhra	X	
Communities for Better Environment	Jay	Parpelly		X
Communities for Better Environment	Roslyn	Tovar		X
Communities for Better Environment	Lauren	Gallagher		X
Breathe Southern Caliifornia	Tigran	Agdaian		X
Alma Family Services	Lourdes	Caracoza		X
LA Black Workers Center/Care at Work, UCLA Labor Center	Andrea	Slater		X
Non CBOSG				
California Public Utilities Commission	Christopher	Arroyo		X
Insignia Environmental	Armen	Keochekian	X	
Insignia Environmental	Julie	Roshala	X	
Insignia Environmental	Anniken	Lydon		X
ARCHES	Joy	Langford	X	
New Ways to Work	Robert	Sainz	X	
Los Angeles World Airports Capital Improvement Program	Veronica	Soto	X	
TOTAL CBOs			**18**	

PAG June Invitee List

Organization	First name	Last name
Agricultural Energy Consumers Association	Michael	Boccadoro
Air Products	JP	Gunn
Air Products	Lorraine	Paskett
Air Products	Seth	Hilton
Air Products	Miles	Heller
Air Products	Vince	Wiraatmadja
ARCHES	Angelina	Galiteva
ARCHES	Tyson	Eckerle
Bizfed	Sarah	Wiltfong
Bloom Energy	Christina	Tan
California Air Resources Board	Steve	Cliff
California Energy Commission	Rizaldo	Aldas
California Hydrogen Business Council	Katrina	Fritz
California Manufacturers and Technology Association	Lance	Hastings
California Manufacturers and Technology Association	Robert	Spiegel
California Public Utilities Commission	Arthur (Iain)	Fisher
California Public Utilities Commission	Christopher	Arroyo
California Public Utilities Commission	Christopher	Myers
California Public Utilities Commission	Matthew	Taul
California Public Utilities Commission	Jack	Chang
California Public Utilities Commission	Sasha	Cole
California Public Utilities Commission	Nick	Zanjani
California Public Utilities Commission	Nathaniel	Skinner
California Public Utilities Commission	Kaj	Peterson
California Public Utilities Commission	Benjamin	Tang
California Water Data Consortium	Deven	Upadhay
City of Burbank	Anthony	D'aquila
City of Long Beach - Long Beach Water	Diana	Tang
City of Long Beach - Utilities	Tony	Foster
City of Long Beach - Utilities	Dennis	Burke
City of Long Beach - Utilities	Heather	Hamilton
City of Long Beach*	Mario	Cordero
Clean Energy	Nora	Sheriff
Clean Energy Strategies representing the Utility Consumers' Acti	Tyson	Siegele
Communities for a Better Environment	Theo	Caretto
Communities for a Better Environment	Shara	Burwell
Communities for a Better Environment	Roberto	Cabrales
Communities for a Better Environment	Jay	Parepally
Communities for a Better Environment	Lauren	Gallagher
Earth Justice	Sara	Gersen
Energy Independence Now	Brian	Goldstein
Environmental Defense Fund	Joon Hun	Seong
Environmental Defense Fund	Michael	Colvin
Environmental Justice League	Russell	Lowery

Fernandeno Tataviam Band of Mission Indians	Ray	Salas
GoBiz	Deedee	Myers
Green Hydrogen Coalition	Hope	Fasching
Green Hygroden Coalition	Sergio	Dueñas
Green Hydrogen Coalition	Janice	Lin
Harbor Trucking Association	Karla	Sanchez
Harbor Trucking Association	Matthew	Schrap
Independent Energy Producers Association*	Jan	Smutny Jones
Independent Energy Producers Association*	Sara	Fitzsimon
International Longshore and Warehouse Union Local 13	Sal	DiConstanzo
International Longshore and Warehouse Union Local 13	Mark	Jurisic
International Longshore and Warehouse Union Local 13	Sophia	Dubrovich
LAWDP	Joseph	Ortiz
Local Union 250	Nathaniel	Williams
Local Union 250	Hector	Carbajal
Los Angeles Department of Water and Power	Aaron	Guthrey
Los Angeles Department of Water and Power	Marty	Adams
Los Angeles Department of Water and Power	Paul	Habib
Los Angeles Department of Water and Power	Nermina	Rucic
Los Angeles Department of Water and Power	Jesse	Vismonte
Los Angeles Department of Water and Power	Xinhe	Le
Los Angeles Department of Water and Power	Eric	Hill
Metropolitan Water District	Deven	Upadhyay
Natural Resources Defense Council	Pete	Budden
Pasadena Water & Power	Erik	Johnson
Port of Los Angeles	Mike	Galvin
Port of Los Angeles	Tim	DeMoss
Protect our Communities Foundation	Malinda	Dickenson
Reimagine LA	Rashad	Rucker-Trapp
Reimagine LA	Raul	Claros
Sierra Club	Monica	Embrey
Sierra Club	Julia	Dowell
Sierra Club	Teresa	Cheng
South Coast AQMD	Maryam	Hajbabaei
South Coast AQMD	Sam	Cao
South Coast AQMD	Aaron	Katzenstein
South Coast AQMD	Vasileios	Papapostolou
Southern CA Water Coalition	Charley	Wilson
Southern California Association of Governments	Kome	Ajise
Southern California Generation Coalition	Norman	Pedersen
Southern California Leadership Council	Richard	Lambros
Southern California Pipe Trades	Rodney	Cobos
Southern California Public Power Authority	Charles	Guss
The United Association	Aaron	Stockwell
UC Davis Insitute of Transportation Studies	Lukas	Wernert
UC Davis Sustainable Transportation Energy Pathways	Lew	Fulton
UCI Advanced Power and Energy Program	Jack	Brouwer

University of CA Riverside	Arun	Raju
UC Davis Sustainable Transportation Energy Pathways	Stefania	Mitova
Utility Reform Network (TURN)	Marcel	Hawiger
Utility Reform Network (TURN)	Marna	Paintsil Anning
Utility Workers Union of America 483	Ernest	Shaw
Utility Workers Union of America 483	Robin	Downs
Utility Workers Union of America 483	Anthony	Flores
Utility Workers Union of America Local 132	Joe	Moreno

PAG Q2 Meeting - June 21, 2024

PAG		
Organization	**First name**	**Last name**
Air Products	JP	Gunn
Air Products	Miles	Heller
Bizfed	Sarah	Wiltfong
California Energy Commission	Rizaldo	Aldas
California Hydrogen Business Council	Katrina	Fritz
California Public Utilities Commission	Arthur (Iain)	Fisher
California Public Utilities Commission	Christopher	Arroyo
California Public Utilities Commission	Matthew	Taul
California Public Utilities Commission	Benjamin	Tang
City of Burbank	Anthony	D'aquila
City of Long Beach - Utilities	Heather	Hamilton
Clean Energy Strategies representing the Utility Consumers' Action Netwo	Tyson	Siegele
Communities for a Better Environment	Theo	Caretto
Communities for a Better Environment	Jay	Parepally
Communities for a Better Environment	Lauren	Gallagher
Environmental Defense Fund	Joon Hun	Seong
Green Hydrogen Coalition	Janice	Lin
International Longshore and Warehouse Union Local 13	Sophia	Dubrovich
LAWDP	Joseph	Ortiz
Los Angeles Department of Water and Power	Aaron	Guthrey
Los Angeles Department of Water and Power	Jesse	Vismonte
Natural Resources Defense Council	Pete	Budden
Port of Los Angeles	Mike	Galvin
Sierra Club	Julia	Dowell
South Coast AQMD	Sam	Cao
Southern California Generation Coalition	Norman	Pedersen
UCI Advanced Power and Energy Program	Jack	Brouwer
UC Davis Sustainable Transportation Energy Pathways	Stefania	Mitova
Utility Workers Union of America 483	Ernest	Shaw
Non PAG		
Arellano Associates*	Chester	Britt
Arellano Associates*	Stevie	Espinoza
Arellano Associates*	Keven	Michele
Insignia Environmental	Armen	Keochekian
Insignia Environmental	Anniken	Lydon
Insignia Environmental	Julie	Roshala
Lee Andrews Group*	Alma	Marquez
Lee Andrews Group*	Keshanna	Wiley
SoCalGas*	Emily	Grant
SoCalGas	Andy	Carrasco
SoCalGas*	Frank	Lopez
SoCalGas*	Amy	Kitson

SoCalGas*	Jessica	Foley
SoCalGas*	Shirley	Arazi
SoCalGas*	Yuri	Freedman
SoCalGas*	Neil	Navin
SoCalGas*	Chanice	Allen

Appendix 5 – Meeting Transcripts

HEARD BEFORE SOCALGAS

ANGELES LINK TEAM

In the matter of the Meeting re:)

ANGELES LINK COMMUNITY BASED ORGANIZATION SHAREHOLDER GROUP.)

CERTIFIED COPY

TRANSCRIPT OF PROCEEDING

VIRTUAL STAKEHOLDER MEETING

Tuesday, April 23, 2024

Reported by:

DALAUNA CARDOZA
Hearing Reporter

Job No.:
47951LEE

HEARD BEFORE SOCALGAS

ANGELES LINK TEAM

In the matter of the Meeting re:)
)
ANGELES LINK COMMUNITY BASED)
ORGANIZATION SHAREHOLDER GROUP.)
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TRANSCRIPT OF PROCEEDINGS,

taken via Zoom, commencing at 10:03 a.m. on Tuesday, April 23, 2024, heard before ANGELES LINK TEAM, reported by Dalauna Cardoza, a Shorthand Reporter in and for the State of California.

VIRTUAL PROCEEDINGS, TUESDAY, APRIL 23, 2024

10:03 A.M.

CHESTER BRITT: Thank you, all, for joining us this morning for a joint meeting of the Planning Advisory Group and the Community-Based Organization, Stakeholder Group for Angeles Link.

I want to welcome everyone. Again, thank you for taking your time. And let's just jump into the presentation today. We have a couple of housekeeping slides that I wanted to just go through to make sure you guys all know the process that we're going to go through as a virtual meeting.

But before I do that, let me just introduce myself. Most of you should know me already, but I'm Chester Britt, the Executive Vice President with Arellano Associates. I serve as the facilitator for the PAG and also assist on facilitating the CBOSG.

I also have with me today, Alma Marquez, who is the Vice president of Government Relations with Lee Andrews Group, and she is the CBOSG lead, and you'll be hearing from her today later in the presentation.

So, with that, I'm going to go ahead and just go over a couple of the rules that you should be familiar with.

This meeting is being recorded, both the video and audio component. There is a court reporter that will be transcribing the meeting so, please, announce yourself before you speak.

I just want to make sure that you guys all remember to do that. When it's your turn to speak, just say your name and your organization just for the record so we know who's speaking.

The Zoom microphones are muted by us to eliminate background noise. You will need to unmute your microphone when we -- you are called on to speak. We will unmute you on our side, and then you'll have to unmute yourself on your side.

We do encourage you to turn your cameras on, so we can better engage with you. We'd like to see your bright and shiny faces. So, if you could do that, it just makes the meeting feel like we're all together. So that would be tremendous.

Please feel free to use the Zoom chat throughout the meeting to provide input and ask questions throughout the meeting. That should also be familiar to you. But again, if you don't get a chance to speak or if you think of something and you don't want to verbally speak, you are free to type in something in the chat. We are documenting all of that and keeping track of that.

If you would like to speak, please raise your hand. And then we'll be able to see the people that have raised their hands, and then we'll call on you, and you'll be able to unmute yourself.

Today we're -- instead of doing rollcall, because this is a joint meeting and we have upwards of 60 people on the call, we're going to not do a formal rollcall. That would probably take most of our time.

Instead, we would encourage you to announce yourself in the chat, add your organization and/or your Zoom name. Just welcome everybody and so everyone can see through the chat who is participating today.

As all of our meetings, this is being recorded. We will post it and make it available, so if anyone would like to see who participated, we can, also, provide that as well going forward.

Next slide.

So, today's agenda is a brief agenda. This is a -- a small briefing between our quarterly meetings. It is the first time that the PAG and the CBOSG has done a joint meeting, which I'll mention in a second.

We're going to have SoCalGas do some opening remarks. We're going to have a briefing on the Phase One studies and the review and commenting process. And we'll have a member discussion about that. We'll also talk about the stakeholder calendar for Phase One, and we'll also give you an update on the CBOSG Compensation Plan.

Nothing has changed for the intervening PAG members that are getting compensated through the CQC, but there is an update on the CBOSG compensation plan that Alma will give.

And then we'll do Next Steps, and we'll talk about our upcoming Quarterly 2 meeting in June.

So, I want to just welcome everyone. You know, for the last year or so, the PAG and the CBOSG have been meeting separately as part of the Phase One activities, which you are all familiar with.

We've mentioned the potential for us having a joint meeting, and today is an opportunity for us to convene both groups together between our Q1 and Q2 meetings.

And this is really just a quick briefing. We want to talk about a few items that we think would be beneficial for both the PAG and the CBOSG to hear together. So, we decided to have a joint meeting today.

So far, we've hosted over 20 meetings to discuss the 16 work studies that are being undertaken by SoCalGas and their consultants. And after reviewing the scopes and the technical approach, which we've done with you guys individually, we've looked at the preliminary findings now for a select few, and we're on the homeward stretch to releasing the draft reports at the end of Phase One as we look towards that, potentially, in probably the fall of this year.

And in our discussions with many of you and together in one-on-one meetings we've had, we felt it would be a good idea to have a joint meeting to discuss how we plan to release our findings and the draft reports over the next few months as we close in on the end of Phase One.

Again, there's 16 of these work studies, so we want to make sure we are efficiently going through that process with you. And as I mentioned earlier, we would, also, like to discuss the updates to the Compensation Plan for the CBOSG while nothing has changed for PAG and the intervening compensation through the CPC.

So with that, I'm going to turn it over to Frank. If we could go to on the next slide?

Frank Lopez is the Director of Regional Public Affairs, and he is going to do our welcome today.

So, Frank, please go ahead.

FRANK LOPEZ: Thank you, Chester. Good morning, everyone. Thank you for joining us today. As Chester mentioned, I'm Frank Lopez, director of Regional Public

Affairs for SoCalGas.

For those of you who missed our March meetings, I took over stakeholder engagement responsibilities for Angeles Link earlier this year, including management of the PAG and CBOSG.

As Chester mentioned, the purpose of this meeting is to share information with you about a few changes we're making to improve our PAG and CBOSG process.

The first process improvement you'll hear about is a change to the way we share preliminary findings with you. Jessica Foley led this effort for us, and we will provide the update after my remarks.

You will then hear from Emily Grant who will share a proposed PAG and CBOSG meeting calendar for the remainder of Phase One, so you can plan for the year.

We'll then close the meeting today with Alma Marquez who will share a proposed update to our CBOSG Compensation Plan.

All of these changes were made in response to feedback we received from you. Our intent in making these changes is to make it more convenient for all members to provide us with feedback to make sure we're adequately compensating eligible organizations for their participation and to help you plan for meetings further in advance so you can attend as many meetings as possible.

We thought it would be more efficient to share this information with you in a quick virtual meeting instead of sending an email or waiting until our next quarterly meeting in June.

I, also, want to start off every meeting moving forward by summarizing what's happened since our last meeting. I know everyone is unable to attend every meeting. And while I think we do a good job of sending out email updates, following up with individuals one-on-one, and posting materials to our Living Library, it's possible some members may miss an update here and there.

So, for those of you who were unable to attend our last quarterly meeting in March, we presented new information on our routing, workforce, and safety studies. Preliminary findings for those studies have been released in our new format and are open for comment until Friday, May 3rd.

If you didn't receive that information and would like to review those materials, you can find them on our Living Library, or you can contact us via email, and we'll provide you with a link to the materials.

Since our least meeting, we also received three comment letters on our Draft Demand Study and seven letters on our preliminary findings for our water resources evaluation, NOx and other emissions assessment, hydrogen leakage assessment, and greenhouse gas emissions evaluation.

We're still reviewing and discussing those comments and we're planning to respond to those comments in our upcoming 4th quarterly report which we would like to release in May.

As mentioned in a previous meeting, quarterly reports will include all comment letters received in their entirety so you can see what other members said in their own words.

We, also, released five preliminary findings under our new format on April 10th. Those preliminary findings are also available on Our Living Library, and we are providing three weeks for comments. Jessica will cover this in more detail during her presentation.

Finally, in our March meetings, we heard from some of our members that they wanted us to engage communities along potential hydrogen corridors based on our routing presentation.

I'm happy to share that we've met with several organizations along those corridors, and we plan to continue doing additional outreach throughout the next several months.

I want to thank you again for all of your feedback. We continue to learn from you on how to make this process better so we can make Angeles Link better.

And with that, I'll turn it back to Chester.

Chester, I think you're on mute.

CHESTER BRITT: I know. I should know better. I protect myself, and then I forget. Thank you, Frank.

And now we're going to move to Jessica who is going to make a presentation on the process improvements that Frank mentioned.

Jessica Foley is the Regulatory Strategy and Financial Controls Manager for Angeles Link. And we want to welcome her to the PAG and the CBOSG meeting today. I think this is the first time you've heard from Jessica, so I'll let her introduce herself and make the presentation.

Go ahead, Jessica.

JESSICA FOLEY: Thank you, Chester. Good morning, everybody. Thank you so much for your time today. We really appreciate you being here.

As Chester and Frank both mentioned, my name is Jessica Kinnahan (phonetic) Foley. I -- just to give you a quick background about myself, I have about 25 years of experience mostly within the energy industry. I've worked on solar, wind, better energy storage, natural gas, and now hydrogen.

I have been with SoCalGas for about eight years and have been supporting the Angeles Link project now for about two months.

As Frank and Chester had mentioned, I'm here to talk about some of our process improvements that we are moving forward with based on stakeholder input to help improve efficiency and to streamline our process.

If I could have the next slide, please?

So, as Frank had mentioned, we had posted some of our findings from our prior studies related to our water and our -- primarily air studies as well. And as many of you, if you have seen those, they are fairly dense, and they are fairly lengthy as well. In fact, our greenhouse gas emissions evaluation was more than 50 pages for the draft findings.

So, what we found is that it can be difficult to take the key findings and the takeaways that we'd like you to be able to understand. It can be a little difficult to discern.

We've, also, heard that stakeholders would like to see participant comments earlier on in the process. As Frank had mentioned, we are including all of our comment letters in our quarterly reports, but our quarterly reports can trail our comment windows by some time. And so, our feedback that we've heard is that we'd like to have participant comment letters seen more visibly and sooner along in the process.

Next slide.

So, the proposed process improvements that we'd like to present today, as you'd heard, we're looking to simplify our preliminary findings format to make it a little bit easier and more digestible.

So, it is being presented now in a PowerPoint-based slide-deck format instead of a Word document format. And what we've found is that instead of being a 50-plus pages of detailed Word documents, you are looking at more, like, five to seven slides, potentially as many as 10 to 15 slides. But it's a lot easier to review and understand what the key takeaways and findings are.

We're going to be providing two weeks to comment. And as Frank mentioned, we do have our five studies that are available currently in the Living Library and the close of comment is on the 3rd of May. And I will walk through an example here in just a moment.

Of course, for those of you who would like the comprehensive detailed information, that will all be made available in our draft studies, which we'll -- we'll be releasing over the next few months as you'll see when we get to our schedule.

Those studies will also include a detailed executive summary. So, for those of you who would like to see the findings but also see the executive summary and maybe not have to dig into all the details, you'll be able to do that. And for those of you who really want to see the meat of the document, that will also be available.

We will be talking about -- at future stakeholders' meetings -- how we've heard your feedback and how we're able to incorporate it, if possible, into our studies.

Additionally, another change we're making is to post the living -- to Our Living Library our comments letters that we received during a particular comment period at the close of that period.

So, instead of seeing it at the quarterly report stage, which you will continue to do that, you'll also have the opportunity to see comment letters that we received upon the close of the comment period in the Living Library.

And as -- of course, we will continue to provide a full summary of our response to your comments and our quarterly reports, and those will be made available on our regulatory website. As you can see, the link is on the page, or you can also use the QR code to take a look at those comments as well.

Next slide, please.

So, this is just a sample and I'll walk through this pretty quickly because this is available on Our Living Library now, and we'd love to hear your comments so, please, do take advantage of the opportunity to email us through our portal.

But this is our preliminary data and findings for our Workforce Planning and Training Evaluation. If we could just walk through these fairly quickly. So, this is our first slide. The next slide will show you the basis of the regulatory drivers behind the findings.

So, next slide, please.

Perfect. So, this will walk you through the decision itself. We can go to the next slide.

This is to give you an overview of the considerations for what went into the workforce study. And you can see -- and this may look very familiar to many of you who were able to participate in our March PAG meeting, and we were able to walk through the workforce study. You'll recall Chenise Allen (phonetic) was able to present the conclusions of that study at that time.

Next slide, please.

And this is an overview of our study and approach. You can go to the next slide.

Here's our overview of our methodology and forecasting. Go ahead to the next one.

Here's our preliminary findings that, again, all of this is available on Our Living Library. And next slide.

And through here is our schedule. And this as you can see as -- we've got a lot going on, and we're really grateful, again, for all of your participation from the beginning of Q1 2023 when we first started walking through our scope and our technical approach. We're now at our draft findings. And then we're going to be releasing several of our draft studies here in the next few months.

As you can see across the top of the slide, there are those orange boxes. Those are representative of our quarterly report meetings that we anticipate hosting through the rest of the 2024. Of course, as needed, if we see that there is interest from our participants to have a workshop or other type of meeting, we'd be happy to do that.

And if -- through this feedback today, if there is any time where you're looking at one of our studies or our findings and have any additional questions or would like to meet with us directly to talk through some questions you may have, please, reach out to us, and we'd be happy to get something set up so that we can have these one-on-one conversations with you.

As Frank had mentioned, we've been doing that throughout our process and really, really appreciate the opportunity to talk with you all directly.

So, with that, I'll wrap up, and I'll hand it back over to Chester. Thank you so much.

CHESTER BRITT: Thank you, Jessica. If we could go to the next slide? I think we're at the member discussion now. For today's discussion about Jessica's presentation and what you heard from Frank, we also have Shirley Arazi, who is the Director of Regulatory and Policy with Angeles Link.

I'm going to let her introduce herself. You might have remembered that at the last meeting I think that we had, we mentioned that Jill Tracy was leaving Angeles Link and Shirley is replacing her, and so I wanted to give her an opportunity to introduce herself.

And then you, also, know Frank and Amy from today's presentation, and then Amy's been part of all of our meetings or most of them going back the past year.

So go ahead, Shirley, and introduce yourself.

SHIRLEY ARAZI: Thanks so much, Chester. This is Shirley Arazi with SoCalGas. In March of this year, I started my current role as Director of Angeles Link Regulatory and Policy. It oversees all the various regulatory deliverables and project management office, specifically also to help wrap up Phase One work streams.

I've been with the Sempra family of companies, SoCalGas, but starting at SDG&E since June 2006. Over the past 17 or so years, I've worked in various areas of the company including regulatory, finance, sustainability.

And while I'm new to this role, I've been tracking the PAG and CBO process, and I've attended the last couple of meetings, learned a lot about the great work you are all doing, and look forward to working with you more directly. Thanks, Chester.

CHESTER BRITT: You're welcome. Thank you. All right. So, if you have any questions or any comments, please, raise your hand. While you're doing that, I'm going to go to the chat. There was a few people that have already chatted something in during the presentation, which I can start off by reading.

So, I think, Lauren Gallagher, you typed in "When the studies including data are released, will there be opportunities for feedback?" So, I think, Jessica, you might be the one to answer that question.

JESSICA FOLEY: Yeah, thank you, Chester. That's a great question. Absolutely. And we really welcome the opportunity for feedback.

So, I think Frank had mentioned, for our current batch of findings that we have available, the close of the comment window is May 3rd, so you are able to submit those comments through our written portal.

If I could ask one of my team members to, please, drop that portal information in the chat, so people have immediate access to it, I would be grateful for that. So, you are able to submit comments through that, and then as studies become available, they will be posted to the Living Library, and you'll also have the opportunity to comment on the studies directly as well.

CHESTER BRITT: Great. I think this next question, Frank, goes to you.

In your presentation, there was some questions in the chat about, "If you could share which communities specifically around the proposed corridors that you've reached out to and what did that outreach look like?"

FRANK LOPEZ: Yeah, thanks, Andrea Robert (phonetic). Good question.

So, there are actually several communities. I'm not going to name them all, but if -- for those of you who attended the March quarterly meeting, you recall that Katrina had shared a presentation on routing and showed multiple hydrogen corridors that were under consideration, and those are the corridors that we actually used for the basis of our outreach.

So, we looked at what community-based

organizations, environmental justice organizations, service provider, tribal organizations and tribes, and public officials, cities and counties along those corridors, and we've started to reach out to -- to several of those organizations along those corridors.

So, if you want, I can follow-up after this meeting and give you, kind of, a more-detailed list of who we've already met with. And if there are certain organizations that you think we should be reaching out to, you have recommendations, we're happy to reach out to them as well too.

CHESTER BRITT: All right. Thanks, Frank. Jay, it looks like, Parepally, I believe. I don't want to butcher your name, but I think that's how you say it.

JAY PAREPALLY: Yeah. Butchered, but it's Jay Parepally. I'm a legal --

CHESTER BRITT: Parepally, I'm sorry.

JAY PAREPALLY: That's okay. No one gets it right in this half of the world, so that's okay.

My feedback is, like, I'm a little new to the process because I'm covering for -- along with my colleague, Lauren, we're covering for the normal person here, Theo. So we're a little new -- newer to the process.

But it sounds like people give feedback that the preliminary findings used to be too dense. My critique now is that they are really conclusory, and there's really no analysis, and they're just to -- kind of, like -- kind of a bunch of buzzwords and images of, like, the ARCHES' logo and -- and maps without any labels of cities so -- like, so I can include that as feedback by May 3rd.

But my question is, why now -- like, this is going to add extra homework of, like, a feedback process on these very bare bones slide decks, and then a feedback process on presumably full-detailed reports with actual numbers and with things beyond one word, like, environmental being a factor or demand being a factor and if you could address that in this process change?

To me, it sounds like we've -- we -- we're adding work and that this stage is, kind of, excessive and a little bit unnecessary and unhelpful with these slide decks. Thanks.

CHESTER BRITT: Yeah, so I'm going to turn that back to Jessica, but before I do, just -- I think in her presentation, one of the things she communicated was that we're going to be doing three different things with the study. So, you are going to get opportunities to have the entire full study. There will be an executive summary that you can also use if that's better for you.

And then, there's also this preliminary findings slide deck which is also more abbreviated as you mentioned. So, there's the opportunity, depending on who you are and how much information you want, to look at the studies in three different ways. So, you will have full access to the full studies if that's what you would like, and so that won't change.

But go ahead, Jessica.

JESSICA FOLEY: Yeah, thank you. And thanks, Jay, for your question. And -- and I can understand the concern about multiple-review processes.

Angeles Link has been an iterative process from the beginning. That's been a commitment that I think we have taken to heart, so as we have had opportunities to take in stakeholder feedback, we have tried to adopt the process, so I think that has been a vital tool that we have taken and really appreciate everyone's input along the way.

From the beginning of our process, we did reach out to our stakeholders to -- and review our scopes of work with them and as well as our technical approaches. So, there's been a couple of benchmarks along the way to get to where we are today.

Preliminary findings were also a commitment that we had made to our stakeholders both with our PAG and CBOSG, so we see this as a continuum of our ongoing stakeholder engagement process, and we'll also have the opportunity to provide the detailed reports as well. So, for those of you who would like to look at all the detail, those will be made available in the reports themselves.

So, I understand that it's -- it's a lot of information to digest and to comment on and -- and, also, that is part of the reason why we're trying to streamline this and make it more efficient so that each stakeholder has the ability to look at and take the level of detail that they want from the information presented.

So, if there's anything more as far as a particular study that has questions or -- or detail that people would like shared, we'd be happy to meet with you directly about that.

CHESTER BRITT: All right. Thank you, Jessica. The next person I see that raised their hand is Ricardo Mendoza. Go ahead and unmute yourself.

RICARDO MENDOZA: Thank you. I just want to echo kind of some of the --

CHESTER BRITT: If you could -- I'm sorry -- could you just introduce yourself for the court reporter just to make sure?

RICARDO MENDOZA: Certainly. Good morning, everyone. Ricardo Mendoza with Coalition for Responsible Community Development, CRCD. I just want to thank the team at The Gas Company and Angeles Link for putting the information the way that you have in the presentation in the executive summary format.

I think, oftentimes, when we go through these regulatory processes, we do have the dense information that is still available. But it's not always readily accessible in the language that is readable by most.

So, at least for our team and for several members that have been reviewing this information that are not experts in hydrogen or a lot of the technical elements that are incorporated within the study, I really appreciate you taking the time to go and take this additional step, allowing us to further comment and understand the process.

CHESTER BRITT: All right. Thank you, Ricardo. I'm going to switch back to the chat. There was a chat from Marcia Hanscom.

"Can someone, please, say, again, what is expected in terms of a May 3rd deadline for comments? I was never informed that written comments were expected as part of participation in this process. Only that we would be attending these meetings and learning things in these meetings.

"The time commitment is already significant without additional homework which we are not being compensated for." So, I am going to turn that to Jessica to start, and maybe Frank, you might be able to weigh in as well.

JESSICA FOLEY: Yeah, that -- that's a great question, great point. I think the -- raising concerns and comments based on what you are seeing today, this is really helpful. I think that the meetings that we have been hosting have been transcribed and recorded and are being made available through the Living Library so your comments are definitely being captured and heard, and to the extent that we can incorporate the feedback, we are.

So absolutely agree, I think the written communication is an opportunity to take it to a point where we have a written record that can also be shared in addition to the transcripts and the recordings with the CPUC as part of our response to comments.

So, I -- I do sympathize with the fact that you need to do -- if you'd like to submit the comments, you can do that through that written portal. But it also gives us a chance to take a look at and share with our -- our whole PAG and CBOSG those written comments as well. I don't know if anybody else, as part of the panel, would like to -- to comment.

FRANK LOPEZ: Yeah, I would like to just, kind of, clarify, too, that no one is required to provide us with comments; right? Obviously, we want your feedback. That's the whole point of this process. And I think one of the things that we're trying to do is provide multiple opportunities to provide feedback and different ways of providing feedback; right?

So, one of the ways we do it is we do a presentation, and you can provide verbal feedback in the meetings and have an opportunity to ask questions and make comments to our subject-matter experts. You can do so in writing when we print out materials; right? And we're going to do it in multiple segments; right?

So, we've -- we've released materials on -- on scope and methodology. We're doing it on preliminary findings, and then we'll release more -- the full-detailed draft reports in the future. So, there are multiple opportunities and different ways to provide feedback. It doesn't have to be in writing.

CHESTER BRITT: All right. Thank you, Frank. Now I'm going to go to another person who has raised their hand, Tyson Siegele. Tyson, if you could unmute yourself and introduce yourself, please?

TYSON SIEGELE: Hello. My name is Tyson Siegele. I am with Clean Energy Strategies, and today I am representing the Utility Consumers' Action Network.

I wanted to echo Jay's point which is that, you know, the -- the preliminary findings that -- that -- that the new format, it really looks like just promotional material. It's not information that is going to allow us to make a -- complete a proper evaluation of these -- of these studies.

One of the things that we -- we've also asked for is -- is more-detailed information than what has been provided thus far. For instance, in the demand study, one of the -- the requests that was made by the PAG, as -- the Detailed and Consumers' Action Network specifically, is the -- the actual calculations, the actual spreadsheets that were used to come up with the -- the findings that SoCalGas released.

One of the -- the main concerns that the Utility Consumers' Action Network has is that the demand study does not align with any of the California Government Agency findings on demand or hydrogen in the future.

When we submitted our -- our comments on the demand study, what we pointed out was that the CEC, the -- the commission itself, the California Air Resources Board, they have all found that within the power sector specifically, there won't be great hydrogen use by 2045. There's simply won't be any.

And when -- when I pointed that out, I was -- I was hoping to see a -- a revision to the demand study, something that acknowledged, yes, you know, all of these government agencies have come up with very different conclusions than what SoCalGas has -- has released.

And so, when I see these preliminary findings promotional materials that are being released now, it is -- it's very concerning. Because, you know, really what is -- is being done is we don't have any of the data we need to evaluate what's going on. And what's more, we haven't seen revisions based on very detailed analysis that the Planning Advisory Group has provided to SoCalGas.

And so, it's -- it's something that I think we're actually heading in the wrong direction, in -- in the opposite direction of where we need to go in order to end up with something that is going to be beneficial to -- to California rate bearers, to customers of SoCalGas.

I can't -- I can't see how promotional materials are going to benefit the overall process. One of the -- the pieces for the preliminary findings and the reports that have been released so far, that is -- is beneficial is that it does allow SoCalGas to take back the feedback and be able to -- to revise. Again, so far, we haven't seen that.

So, I guess in -- in closing my comments on -- on this portion, what I'd like to do is to reiterate what I've requested in -- in previous PAG meetings, which is that we -- we really need the -- the modeling that has been done for the demand study, the -- the analysis that Utility Consumers' Action Network has completed has found that SoCalGas is overestimating demand for green hydrogen by at least a factor of ten.

That is -- that's something that, you know, if -- if the modeling is -- is showing something different that SoCalGas has done, great. Please release that modeling so that we can take a look at it, and we can say either yes we agree with it or -- or no we don't.

It -- and it -- it's really important for us to be able to see how SoCalGas has come up with such a different conclusion from the California Resources Board, the California Energy Commission, and the California Public Utilities Commission.

CHESTER BRITT: All right. Thank you, Tyson.

Frank or Jessica or Shirley, did any of you want to comment on any of the comments that Tyson made?

FRANK LOPEZ: Yeah, I'm happy to respond. I mean, I can't respond to his comments on demand, obviously, you know, Yuri's leading that effort, and he's not here. I know we're in receipt of -- of Tyson's comments, and I know we've had several conversations about that.

I will -- you know, just to clarify on the process, you know, and -- our intention in doing this isn't to make this a promotional item; right? So this is not an additional step. And we -- just to echo what -- what -- what Jessica presented is that previously, we were putting out these lengthy technical documents and asking for folks to -- to provide feedback.

We heard that that material was too dense, and it was too long. And so, what we thought we would do is we would make it easier for folks to comment by synthesizing this information and still putting out the key findings, the main takeaways from the actual studies themselves and actually pointing to areas, too, where we would like feedback; right? -- on certain areas and, kind of, pointing and directing folks as opposed to just putting out a bunch of material and then letting folks comment.

Now, obviously, we're not -- members are not limited to providing feedback on just those areas. They can comment on anything that they want.

And just to clarify, we're still going to put out the full-detailed study in draft form with all of the underlying data, all of the methodology, all of the findings, and we do plan to respond to all of the comments that we have received, will be reflected in those final studies.

So, we're still going to be doing all of that information. We just didn't want to wait and delay until we have those -- information to put out some draft, you know, preliminary findings to start getting feedback from -- from -- from our members while we -- while that data becomes available.

So that was our intention in doing this, not to do promotional materials, just really to improve the process, but I understand your comments and appreciate your comments, Tyson.

CHESTER BRITT: All right. Thank you. The next person who has raised their hand is Janice Lin. Janice, if you could unmute yourself?

She disappeared off my screen, so maybe she took her hand down. I'm not sure.

JANICE LIN: Oh, sorry.

CHESTER BRITT: Go ahead, Janice.

JANICE LIN: I'm here. Can you hear me?

CHESTER BRITT: I can hear you now, yes. I'm glad I waited. So, if you could introduce yourself for the court reporter and then make your comment or question?

JANICE LIN: Of course. My name's Janice Lin, and I'm the founder and president of the Green Hydrogen Coalition. We're an educational nonprofit that is seeking to displace fossil fuels as fast as possible through the development of green hydrogen at scale.

And, I guess, what I wanted to say is -- is thank you, because we're one of those groups who found the technical reports to be very detailed, very helpful, and maybe a little difficult to absorb. And, you know, generally speaking as one extremely busy person, having the summary, I think of it like an executive summary, will be incredibly helpful to -- to us to -- looking over all of this material and identifying where we may want to do a deeper dive.

We, also, recognize this is extra work, and -- and it's appreciated. I -- I guess it's the same reason why many books and technical reports always have an executive summary. So that's -- that's how we're thinking about this, and so I just wanted to say thank you.

CHESTER BRITT: All right. Thank you, Janice. The next person who has raised their hand is Sarah Wiltfong. Sarah, if you could unmute yourself?

SARAH WILTFONG: Hi. Sarah Wiltfong here with the Los Angeles County Business Federation. Thank you so much for the material today.

We represent a variety of stakeholders, about 240 different businesses, and we represent about 420,000 employers in Los Angeles County from every industry you can imagine, and we're very interested in -- in having green hydrogen in the future as well.

I -- I have to agree with some of the other commenters that the -- the materials that were sent previously regarding, you know, Angeles Link and this working group were very dense and hard for a lot of our industry members to really absorb.

So, having this summarized view especially what, you know, Jessica outlined, we should find this very, very helpful, so we can provide meaningful comments. I think it's great that the detailed summaries are still there.

So, if we need to do a deeper dive, we can look back into them. And, you know, certainly, we like to -- to look at other commenters and their letters as well to see how they look at the materials too, so we do incorporate that into -- into all of our assessments so, you know, all of the presentations.

But anyways, we just wanted to quickly add that we do like the new format, and we are looking forward to seeing more of what gets put out and in commenting alongside them, so thank you.

CHESTER BRITT: Thank you, Sarah.

Lauren Gallagher, you're next. If you could unmute yourself?

LAUREN GALLAGHER: My name is Lauren Gallagher. I'm with CBE today. I wanted to, kind of, follow up on my initial question that I asked in the chat and with a few other points that, specifically, Tyson made and what Frank and Jessica have been talking about.

I think that it's both confusing procedurally and as, like, a consumer of the information that you've been pointing out to have two distinct time periods for comments. One for this executive summary, and one for the more detailed data, it's duplicative. It's also going to create two different deadlines.

For people who want to be involved in the comment process, it's twice as much work now. One, to identify areas that we would need to, you know, then follow up on later in the larger data that -- study that will be provided.

That's two distinct periods when we could -- that could be done at once. It's wonderful to make information accessible, but this information is not accessible. These are just conclusions.

You can provide a streamlined analysis. You can provide data that is understandable. Those are achievable things. There are, you know, an array of ways to represent data that are not long sheets that are challenging to understand.

And I -- it is important that the data is released so that those who do have an interest in comprehending it fully and commenting on it have the opportunity, and those responses should be together so that they can be looked at together. Thank you.

CHESTER BRITT: Okay. Thank you.

FRANK LOPEZ: Can I comment here, Chester?

CHESTER BRITT: Yes, please, Frank. Go ahead.

FRANK LOPEZ: Okay. Thanks. So, I think, you know, just -- just to clarify one more time, we want to give people multiple opportunities throughout this process to comment.

So, you know, one, folks are not required to comment. If you feel like you don't need to -- you don't want to comment, you don't have to.

Also, they are preliminary findings. If you think we got the preliminary findings wrong, you can -- you can comment and submit comments, and I know we've received comments. I mean, Tyson just mentioned some right now.

But we've been wanting to give folks multiple opportunities, from the beginning of this, to comment so that we didn't have to wait until the very end of this process to comment on a lengthy draft study.

So, we wanted folks to comment on -- on scope and methodology. We wanted folks to give -- folks an opportunity to comment on preliminary findings and to give us comments at the end on the draft study.

So, you are not required to comment at any point in that, but we wanted to provide multiple opportunities at each step so that folks are getting multiple opportunities and different bites of the apple to, actually, comment from beginning to end.

CHESTER BRITT: All right. Thank you so much.

Karla Sanchez, you have your hand raised. If you could unmute yourself? Karla?

KARLA SANCHEZ: Can you hear me now?

CHESTER BRITT: I can.

KARLA SANCHEZ: Sorry about that. Hi everyone.

CHESTER BRITT: No problem. If you could just introduce yourself?

KARLA SANCHEZ: Of course. I'm Karla Sanchez. I'm the Director of Communications at the Harbor Trucking Association. And I appreciate the opportunity to comment here today. We represent a range of carriers on the West Coast ports. And I'm just here to express our support for the proposed process change aiming at facilitating effective comments from all stakeholders on this important project.

And although the timelines for comments are tight, we do believe that this is going to allow more informed feedback on the plan. And ultimately, we look forward to continuing our engagement and dialogue with you all, and thank you so much.

CHESTER BRITT: Thank you. We appreciate your input.

Arthur Fisher?

ARTHUR FISHER: Good morning, everyone. My name is Arthur Fisher. I'm with the Public Advocate's Office at the CPUC.

Just one observation, one suggestion as far as feedback is concerned, I note that you have a court reporter recording and scripting all these comments as we speak in these meetings.

CHESTER BRITT: Yes.

ARTHUR FISHER: Given that those comments are being taken by yourselves and actually being used to potentially influence what you are doing, can I make the suggestion that you make those scripts available as part of the actual -- as part -- parts of -- of all of the other information material that you make -- that you make available?

CHESTER BRITT: I'm pretty sure we do on the Living Library, Arthur, but I will verify that.

ARTHUR FISHER: The actual scripts themselves? I don't see them. I appreciate it if you do. That is great --

CHESTER BRITT: Yeah. Yeah.

ARTHUR FISHER: -- because, at least, there's a record.

CHESTER BRITT: Not a problem.

ARTHUR FISHER: Okay. So, with that said, then I have a couple of -- just comments. I just want to second, basically, what Lauren and -- and Tyson have said previously.

For some of us, the detail is important. I understand the -- I understand the need for executive summaries etc. Summaries that detail is important. And so far, we have not seen any -- any actual response to detailed analysis or detailed alternatives or scenarios that are being put forward.

Back in December, Tyson and I, and that by Tyson, I'll point this out, had fairly substantial input into the demand study. Following the preliminary findings, we didn't -- and then in the actual release demand study, we didn't see any real change to that study from the preliminary findings.

There was no -- so, so far, we have no evidence that you're taking account of what we are saying. You are hearing it. You are recording it. You're demonstrating that you're -- you're hearing it, but we aren't seeing any results. There's -- so -- so, to maintain confidence in this process, we really need to see some results in the next studies coming up.

You're taking account of what we are saying, and then you're running additional scenarios. You are demonstrating additional roots from where we suggested. Things like that. Just as -- and you are making the data available so we can actually run alternative scenarios because that's just not happening at the moment.

Okay. So, that's my comment. I just want to, like, read into the transcript. Thanks very much.

CHESTER BRITT: Thank you so much, Arthur.

Frank or Shirley or Jessica or Amy, I guess, or any of our panel members, any of you want to respond to what Arthur mentioned?

FRANK LOPEZ: Yeah, I mean, I -- I'll -- I appreciate your comments, Arthur. I -- I appreciate your patience during this process. I will assure you that we do read all of your comments and listen to all of your feedback.

You know, one of the -- this is one of the reasons too; right? We've given four weeks when we release the preliminary findings previously. We have to wait for that -- that window to close until we receive all of our comments to review them; right? We circle back with our subject matter experts, but we take all of these seriously, and we get some really good comments.

I mean, we get lengthy comments and response. We read all of the material, and we do plan to address all of the comments that we've received in the studies themselves at the end.

CHESTER BRITT: All right.

FRANK LOPEZ: I think -- I think Arthur -- I think Arthur wants to respond.

CHESTER BRITT: Follow up? Arthur, did you want to follow up? I don't see him unmuting himself. There you go.

ARTHUR FISHER: You know, I was unmuting myself. It takes three clicks to unmute yourself on this thing.

CHESTER BRITT: Yeah, sorry.

ARTHUR FISHER: First of all, I can't get to that link that you just sent me on the transcript, so you better check your links are broken or -- or my machine is broken. One of the two, but I just -- just --

CHESTER BRITT: I know some people have had the issue with the double authentication that Microsoft imposed, so we can work through that with you. If -- if --

ARTHUR FISHER: Just -- just -- I'll just tell you what it actually says to me. "This item might not exist or is no longer available." So, it has been deleted or expired. Just FYI.

Okay. So, I do have concerns about getting the transcripts.

CHESTER BRITT: Sure.

ARTHUR FISHER: As far -- acknowledging that we've been making comments is one thing. Acting upon that acknowledgment and demonstrating that you're actually steer -- re-steering the boat and actually have things like alternative scenarios, alternative routes that actually take into consideration what we're saying is something very different because that requires -- I -- I appreciate that requires a lot of more effort.

I've seen you acknowledge that we -- you've taken to account and read and thoroughly understood what we've said, but we've not seen the result in the actual -- in the actual -- in studies themselves yet.

We've seen the demand study. I'm thinking of those specifically. We didn't see alternative scenarios in demand studies. We saw the three scenarios you ran in the preliminary, and then we saw that the same three scenarios, ultimately, in the end -- in -- in the final study. And so, it's not -- it's not tracking yet. That's just my -- my -- that's just my -- my response.

CHESTER BRITT: Got it.

ARTHUR FISHER: Okay. Thank you.

CHESTER BRITT: Thank, you, Arthur. All right.

Rashad, if you could unmute yourself?

RASHAD RUCKER-TRAPP: Sorry. I was looking up the link there --

CHESTER BRITT: No problem.

RASHAD RUCKER-TRAPP: -- like you said. Maybe I didn't have --

CHESTER BRITT: If you could introduce yourself? I'm sorry.

RASHAD RUCKER-TRAPP: Yeah, my name is Rashad Rucker-Trapp, Executive Director and co-founder of Reimagine LA Foundation. And just, kind of, listening in on all of this, I, Number one, I appreciate the work that you guys -- that you guys continue to do in terms of, you know, keeping these meetings open and as well as providing as much information regarding this project. I do appreciate the -- the more-condensed summary. I think it's a little bit easier to follow.

And then, you know, I -- I -- I can say that, you know, for the most part, if we had questions or concerns on different -- on different portions of the report, that you have guys have been very open as far as explaining.

To my understanding, I think we are still in the first phases though, so I'm sure that there are much -- there are things that we -- that probably need to be reported on, but, you know, I think we should, you know, just collectively as this -- as we go through all of this, I think we should, you know -- I think we should definitely run -- you know, allow, you know, SoCalGas to run through the project and be patient with, you know, the information that is being -- that we -- that we're requesting.

It may not come to us right away, but, you know, I'm sure as we continue to ask and -- and -- and -- and request that, ultimately, the questions that we have may be answered.

So, you know, not -- definitely not saying that this is going to be an easy process, but as far as -- you know, as far as I'm concerned and my constituency is concerned, we definitely appreciate, you know, the more simple we can, you know, provide information to people so that they can, at least, understand the basics of it.

You know, I think that's -- that that's, you know, fantastic. So, you know, I do take my hats off to you guys for, you know, being very accommodating in that area.

CHESTER BRITT: All right. Thank you, Rashad.

FRANK LOPEZ: Thanks, Rashad. Hey, Chester, I just wanted to acknowledge that the link did work for Jay. So thanks, Jay, for letting us know that you had access to it.

So, Arthur, if you still have trouble accessing, we can follow-up with you and anybody else. I know there's some chat -- some folks that dropped that information in the chat about having access to it. Let us know, and we can make sure those get resolved for you.

CHESTER BRITT: Yep. All right. Joon Seong? You can unmute yourself, Joon?

JOON SEONG: There we go. Hi, I'm Joon Seong, S-e-o-n-g, from EDF, Environmental Defense Fund. I just wanted to echo the comments made by Tyson and Lauren and Arthur and, also, Theresa in the chat about the feedback and the -- the feedback provided by the PAG members and other participants in the feedback process.

I -- I truly appreciate the fact that the Angeles Link team is trying to break this down into pieces, so we're not just bombarded with a very dense material at the end of it, and we get a chance to, kind of, comment on the various segments of reported or segments of the study, but it does feel like when we share these comments, there really isn't a feedback loop coming back to the PAG members and to the people that provided the feedback.

And it does make us wonder are the comments we're -- we're -- we're providing or the alternatives that we're suggesting, are they being taken seriously?

So, I was wondering if, you know -- what -- what kind of feedback process are you guys thinking of to address these -- I -- you guys said that you're taking a look at these, giving it due attention, which I -- I truly believe. I was just wondering, what, kind of, a process are you envisioning to -- to come back to all the PAG members -- to come back to all the different parties that provided feedback and, kind of, address those concerns and questions? Thank you.

CHESTER BRITT: Thank you.

Jessica, do you want to weigh in on that?

JESSICA FOLEY: Sure. I can show them, and then I think Frank may want to expand on those a little bit. But thank you very much for your comments, Joon. These are really helpful. I think the feedback loop that we need to be providing is -- it's really very much appreciated that you're -- you are making these points.

I think a little bit of the challenge right now is that the demand study is the first study that has been released. And so, as you'll see additional studies being released, I think we have had some really great dialogue and some additional input through our quarterly reports that -- where that input is going to be incorporated specifically in this study, you haven't been able to see that yet because the studies haven't been released.

So, that -- we -- we hear you, and I think (unintelligible) responded demand study, those comments did come in and would be addressed in our upcoming quarterly report. So, and I think Frank mentioned Yuri is not here, so unfortunately, we can't dive into those today. But, Frank, if there's anything else that you'd like to add, please feel free.

FRANK LOPEZ: Well, no. Thanks -- thanks for covering that, Jessica.

Joon, do you have any suggestions on how we can better have that feedback loop on comments? I know folks are taking, you know, a lot of time in putting the comments together. We do read them. You know, we try to address them in our quarterly report. We are attaching the full comments now. We plan to address them in the draft study, but we are open to suggestions on doing things better. So, do you have any suggestions for us on how we can do that better?

I think he's asking to be unmuted.

CHESTER BRITT: Joon, can you unmute yourself, and we'll do it the same way?

JOON HUN SEONG: Yes. Yes. Yeah, Frank, thank you. I guess a couple suggestions would be, I think feedbacks can largely be broken down into, sort of, two buckets. One, would be a request for more information. For example, the assumptions used in these studies and where are you getting these figures, where are you getting these numbers from? I think that -- those, kind of, requests, those, kind of, questions could be addressed pretty quickly and directed by the Angeles Link team.

And I understand as Jessica explained, you guys are taking a lot of the -- the harder parts, the analysis and alternative part, and that is going to come later -- later on, which I fully understand.

That may be -- you can, kind of, say, "Hey, we're going to put a pin on this. We'll get back to you on this. This is the process we're engaged in right now, but I think for the first bucket of comments, first bucket of feedback on the request for assumptions and more data."

That, kind of, stuff I think can happen on more expedited timeline, and that way we can feel okay, like, the comments that we submitted, the feedback is being taken seriously and the things that can being addressed right way are being addressed. But that's one suggestion I had.

FRANK LOPEZ: Great. And did you -- did you feel like that wasn't done when we went through methodology and approach?

JOON HUN SEONG: There were -- there were certain details that I think were -- were missing and weren't fully addressed that we had raised in the comments, and --

and yeah, weren't fully addressed in -- in the feedback process that followed.

FRANK LOPEZ: Okay. Thank you for these comments. I think that we -- we might follow up with you, too, and just focus on a little bit more detail, but I appreciate that.

CHESTER BRITT: All right. Lourdes Caracoza, Alma. If you could, unmute yourself, Lourdes?

LOURDES CARACOZA: Sorry. Thank you. I'm Lourdes Caracoza with Alma Family Services Nonprofit, and I'm excited to hear that you are going to do a summary report. Because I have to tell you, I've had a heck of a time explaining, to people, this project. And I hear the comments from organizations that are, to their necks, involved in -- in this kind of work.

We're social services' project. We are connected to the community. We serve the community, and we are involved in projects and causes that affect the well-being, the -- the health, and of our -- of our families.

So, I just want to say thank you for listening and thank you for coming up. I look forward to seeing the material that I can share and that will be received and understood as to how it's going to impact them.

I -- I'm also hearing for those that have been putting in their suggestion and comments, and they come more from a scientific background, I appreciate their -- their comments because they bring up things that as a non-science major, didn't know were there.

But I -- I -- I like what they are saying as well to understand your response in answer to their comments or questions would be helpful as well to share this information. But I'm excited to -- to know that I'll be able to have something that is more practical when I share it with social workers and teachers and so forth. Thank you.

CHESTER BRITT: Thank you.

Michael Fisher, I don't think we've heard from you today so good to see you, Michael. If you could unmute yourself?

MICHAEL FISHER: Yes. I'm glad to be here. You can hear me; correct?

CHESTER BRITT: I can, yeah.

MICHAEL FISHER: Okay. Great. Good morning to everyone. First, I want to say whoosah. Whoosah.

And then, the next thing I want to say is that I've been here since the beginning of the project, and I can appreciate that you guys have tried your best to, kind of, truncate all the information, making it palatable. I mean, I don't think we'll ever please everybody; right?

So, but at the very beginning, just to reiterate, most of the comments, if not 80 percent of the comments both in person and online, were very much all saying, "This is too much information. This is too broad, too many technical terms. I'm not a scientist, I represent the community. Please make this smaller. You know, make this more palatable." So, you guys did that.

I do want to say, though, that in the timeline of being able to submit suggestions and comments that maybe when you are creating the timelines from presentation to deadline, that you take into account that there are social organizations that may only meet once a month, and that a lot of people never want to give feedback autonomously; right? Just -- they're all feedback.

They like to consult first with their organizations. For example, I'm a president of a CDC, but at the same time, I'm also the pastor of a 3,000-member congregation. At the same time, I also represent the community of Compton.

And so, those are three different significant communities that I may not see all of them or touch all of them between now and the time that I need to give feedback.

So, that is just, maybe, something that I would add that, you know, when you put these deadlines as far as comments on there, that we just take into the consideration that some people are representing communities or organizations, and they want to take into consideration their audience first before they actually give feedback. So, just to, kind of, just add that.

There was one more piece I think I wanted to say, but I forgot. There you go.

CHESTER BRITT: Good to see you, Michael. Thank you so much.

MICHAEL FISHER: Yeah. Oh, I remember.

CHESTER BRITT: Okay.

MICHAEL FISHER: Wait a minute. I remember. There it is. There it is. I remember now.

Have we considered -- I think I brought it up maybe or two or three meetings ago or whatever -- just making sure that we are going to calendar having some, like, in-person or even some online event that would help to, kind of, include the community in this entire informative process along the way and that we're not just waiting until the end of all of this to tell the community this what we've all decided and then now we just want to, kind of, spring this on you?

So, I just want to just, kind of, bring that to our remembrance as well about that. There it is.

CHESTER BRITT: Yep. Frank, do you want to direct any input to the last comment that Michael made about going public?

FRANK LOPEZ: Yeah. Well, first of all, those are just great comments and -- and all -- all the comments that he shared were really helpful. I think he, kind of, highlights on one of the challenges of -- of trying to do a -- you know, a robust stakeholder engagement process on a really large, complicated project like this, because you're always trying to balance the needs of the members; right?

Some members really want to get into the minutia and all of the details of the studies, and others don't. And some members only care about certain things about -- about the project; right? We have 16 studies, but they may only care about one thing within one study, and others want to comment on everything; right?

So, I think what we're trying to do is just balance those needs and give folks opportunity to comment in a way that -- that best works for them; right? Folks can comment at any step of the process.

They can -- you know, we're trying, you know, provide, you know, summaries of documents so that they -- they can understand it better, and other folks are going to get the full-detailed report. And they can comb through all the minutia as well.

And then in terms of, you know -- you know, determining a project before the community, we're not going to do that. I think we've committed to doing robust stakeholder engagement very early on.

Obviously, we know -- we convened the -- the PAG and CBOSG to provide us input on, kind of, the conceptual components of this project.

But we're going to continue to do more -- more robust stakeholder engagement, you know, once Phase One concludes; right? -- and we start moving in -- into the future phases and actually identifying routes, doing more, you know, community-based actual feedback and meeting with -- with individuals; right? -- and communities and partnering with CBOs that do that outreach.

So, we're -- we're -- we're far away from that at this point, but we're -- you know, we're committed to working with CBOs to improve the process and make -- and to Enrique's point, make sure that -- that -- you know, we're -- that this can serve as a model for how to do stakeholder engagement phase steps for projects in the future.

CHESTER BRITT: All right.

Tyson, I think you've raised your hand again unless you just left it up from the last time, but go ahead and unmute yourself.

TYSON SIEGELE: Hello. Tyson Siegele again with Utility Consumers' Action Network. I wanted to respond to a couple things that I heard.

Number one, Frank, in response to EDF, you had asked if there were particular things that we've asked for that we haven't received. And so, I wanted to -- to provide, at least, a few of the -- the major things that the Utility Consumers' Action Network has requested and has not received yet.

Number one is the calculations -- the spreadsheet calculations for the demand study. Number two is the spreadsheet calculations for the -- the NOx study. Number three is the contracts with the subcontractors, the experts that SoCalGas is -- is hiring to -- to work on this so that we know what the -- what the consultants have actually been asked to provide.

So, we can provide feedback to say, "In addition to X, Y, and Z, it would be great if SoCalGas is actually taking a look at A, B, and C to inform the overall study."

So -- so those are -- are three major things that we -- we definitely have not received yet. Love to -- to get those as soon as possible.

In addition to that, I wanted to echo what -- what Michael said about the -- the length of time for responding. It's -- it's concerning to see that the feedback windows are being shortened. We -- we definitely can use all the time that -- that is available to provide feedback.

You know if -- if it takes an extra couple of months before the final studies are released, I think it's very much worthwhile in order to get a -- a full feedback from the community, from stakeholders. And so, I would request that, if anything, the feedback window be extended instead of shortened.

Then the -- the next piece that I wanted to -- to ask about is I -- and maybe I misheard, but what I -- what I think I heard was that SoCalGas said the -- the comments are going to be addressed in the draft demand studies -- or, I'm sorry -- the draft studies of the various reports.

With that, I -- I see as a main issue there is that until the demand study is corrected, then all of the other studies, all of the work that is being done on all of the other studies is going to be wrong.

I -- because, again, the demand study is not off by just a little bit. It's off by a factor of, at least, ten. So, it would be great if -- I -- I don't know -- I don't see Amy still there. Maybe --

AMY KITSON: Yeah, I'm here. I'm here, Tyson.

TYSON SIEGELE: Oh, great. Amy if -- if you have any -- any thoughts on this, any feedback on when the demand study corrections will take place, I'd be very interested in hearing that.

AMY KITSON: Yeah, thank you, Tyson. I connected with Emily yesterday, so I will -- I'm going to take that to review your comments, and then we'll get back with you. Okay?

TYSON SIEGELE: I really appreciate that. Thanks, Amy.

CHESTER BRITT: All right. Thank you, Tyson.

I'm going to go to a couple of people we haven't heard from yet. J.P. Gunn? J.P., if you could unmute yourself?

J.P. GUNN: Okay. J.P. Gunn, Air Products. I've got a -- a two-part question. The new simplified preliminary findings, they are described as a way to summarize the detailed studies. Could I just get clarification that these are being generated, you know, after the completion of these draft study reports?

I assume that's, like, the -- the normal format, like, an executive summary would be done after it's been completed. Could I get a clarification or confirmation?

FRANK LOPEZ: I think someone can correct me if I'm wrong here, but these are being -- these are being done before the draft study is completed; right? So, yeah, we've gone through a methodology approach.

Then the next step is to issue preliminary findings; right? -- before the draft study is complete. And then, once we get feedback on the preliminary findings, then we'll release the draft study itself and take comments, once again, on the draft study with more detailed information; right? -- and then release the final study after that.

J.P. GUNN: Okay. So, if I'm hearing you right, these are preliminary, and they are being generated before the completion of the draft studies, and so it may not represent the actual conclusions that the draft studies represent?

CHESTER BRITT: Jessica or Frank, did you want to follow up on that last comment?

FRANK LOPEZ: Yes. That is correct. They're preliminary findings. They are not final.

J.P. GUNN: Okay. So -- so, really not -- not a true summary of the -- the draft studies then, just being written before.

FRANK LOPEZ: Yeah, they are actually not a summary of the draft study at all. The draft study --

J.P. GUNN: Okay.

FRANK LOPEZ: -- is still available; right? They -- they're just a -- they're a summary, essentially, of the preliminary findings, which used to be released in, kind of, a Word doc format.

And we thought it would be easier to, kind of, put it in this new format so it's easier to, kind of, follow the flow and to point individuals where we, in particular, are looking for feedback.

So, as opposed to putting out a Word doc, we're just doing it in more of a PowerPoint format. But we'll released the full-draft study in the Word document with all of the detailed information at a later date.

J.P. GUNN: Okay. No. Thanks for clarifying on the -- call it reformatting of the existing document. Now, this is not actually a summary of the draft studies. Thank you.

FRANK LOPEZ: Yeah.

CHESTER BRITT: Yeah. And just to re-clarify that we're already clarifying, it -- it is very -- when we started this process a year ago, we were very clear that there was four steps to the process. There was going to be scoping, technical approach, preliminary findings, and then draft studies.

So, we've gotten through the scoping and technical approach last year. And now we're getting to the preliminary findings. And as Frank mentioned, some of the preliminary findings were almost as long as the draft documents.

And so, instead of putting all of our members through two separate steps to go through the preliminary findings and hundreds of pages of that across 16 work studies, and then to do it again with the draft studies, you know, a couple months later, it's -- we've basically created a process, based on the input we got from the community members and the participants in the PAG and CBOSG, to make the preliminary findings easier to understand and digest.

And then, you will still get the full-draft studies, and then we also are doing an executive summary for the draft studies as well.

So, we're giving you, basically, the same two steps we always said we were going to give you, which is the preliminary findings and then the draft studies. We're just giving you the preliminary findings in this template format, and then we're going to give you the draft studies, plus an executive summary to go along with that at the end.

So, that's -- that's essentially what we've been talking about today, in case anyone is still a little bit confused about that. Marcia --

FRANK LOPEZ: Yes. Hey, Chester, I wanted to just do a quick time check, because I still -- I know -- this is a good conversation by the way. I don't want to shut it down. I wanted to make it -- I'm glad --

CHESTER BRITT: Yeah.

FRANK LOPEZ: -- to get all the feedback on this new process. It's very valuable, and I appreciate all of the great comments. But I also want to make sure, you know, we -- we have Emily's presentation; right --

CHESTER BRITT: Yep.

FRANK LOPEZ: -- on -- on, kind of, the calendar, and then we also have the CBOSG compensation so --

CHESTER BRITT: Yeah -- I was just going to take Marcia and Andrea because -- Andrea, I mean, because I haven't heard from either of one of them --

FRANK LOPEZ: Yeah, let's do it.

CHESTER BRITT: -- and then we'll wrap this part up, and then move on to the next part of the agenda.

So, go ahead, Marcia.

MARCIA HANSCOM: Thank you. Can you hear me now?

CHESTER BRITT: I can, yes.

MARCIA HANSCOM: Thank you so much for taking my question.

CHESTER BRITT: I'm sorry. Can you introduce yourself just for the court reporter?

MARCIA HANSCOM: Sure. I'm Marcia Hanscom with the Ballona Wetlands Institute, part of the community -- community -- CBO group. I'm not sure what that means even anymore. But my questions are what I put in the chat.

And I'm -- I'm very serious about this. We've talked about a lot of technical issues related to the Angeles Link. But we're still -- there's still no clarity about what is the Angeles Link going to support?

If you are going to have hydrogen in some of the pipes next to where the methane is already going and there's going to be some, kind of, blending or mixing of the hydrogen and methane for certain purposes, the question still is, what is -- what is this hydrogen Angeles Link going to be supporting?

Is it simply for the trucking in the ports and the ships, or is it for the jets at the airports? Or is it for powering up electricity plants like Scattergood, Long Beach Haynes, et cetera, or -- and/or is it, also, intended to use the methane gas storage fields into the future?

Methane gas, which we know we have to get off of if we're going to really be addressing climate change seriously. So, these questions still haven't been answered, and yes, I have attended all of these meetings since last year and still haven't heard the answers to those very simple, clear questions that a lot of us have.

CHESTER BRITT: Amy, do you want to weigh in on that or Shirley?

AMY KITSON: Sure. Thank you, Chester, and thank you, Marcia. So, I think in -- in -- thank you for the question, Marcia.

If -- even when you look, we've talked a little bit about the demand study today. So, as an example, the -- the industries that we are looking at supplying hydrogen to is -- for this project are both electric generation or heavy-duty transportation, like, trucking, as well as industrial opportunities.

So, that's the -- those are the customers that we're looking at. And then each one of the 16 studies are looking at different facets of -- of that demand composition.

So, you know, as we are looking at the routing study back in March, it's overlaying both our demand study, production, the green hydrogen production, and -- and our current, you know, pipeline right-of-ways and corridors as -- as Katrina went through. So, is that helpful to you?

SHIRLEY ARAZI: I, also, wanted to recognize --

MARCIA HANSCOM: So, I -- I would -- I didn't -- the very beginning of what you said, I didn't understand. Were you saying it is for electricity generating as well?

AMY KITSON: It's for --

SHIRLEY ARAZI: Okay.

AMY KITSON: Yeah, those are -- those are -- the demand sectors we're looking at, Marcia, is the electric generation, the heavy-duty trucking, as well as the heavy and industrial.

MARCIA HANSCOM: And what about the methane gas storage facilities?

FRANK LOPEZ: How about -- let's -- Marcia, if you don't mind, maybe we can follow-up with you and schedule a call, and we'll walk you through and answer all of these questions about what the scope of Angeles Link is.

And in the meantime, I just want to make sure we get to any questions about the process improvements that we're making today. I -- I want to make sure we don't run out of time. But I hear you. I acknowledge your -- your question, and we'll make sure to follow up and get this clarified for you. Thank you.

CHESTER BRITT: All right. Andrea, we're going to go to you, and then we'll move on to the presentation. So, go ahead and unmute yourself.

ANDREA VEGA: Hi, everyone. Andrea Vega with Food & Water Watch. I want to say that there has been a gross mischaracterization of the many concerns that, you know, the CBOSG members have had throughout this process.

Reports that are detailed are very much needed, so that organizations can provide meaningful feedback. This is a project that will impact many Californians as SoCalGas is looking to create new pipelines for highly volatile and highly dangerous fuel.

These slide decks are not enough. We need full reports, and we need longer feedback windows than what's been allotted so far.

And this attitude that SoCalGas has that we should be grateful for their, oh, so just generous amount of feedback is absolutely nauseating. Okay?

SoCalGas's track record of putting communities in danger with their fossil fuel infrastructure should make every member of the PAG and the CBO Stakeholder Group, at the very least, cautious and weary.

Because this whole process from the beginning has been frustrating, and SoCalGas has not been transparent with any of us. So extend the feedback window, give us the full reports done by independent researchers, and stop wasting our time.

CHESTER BRITT: All right, Andrea. Thank you for your comment. We're going to move on now to the --

EMILY GRANT: Hey, Chester?

CHESTER BRITT: Yes.

EMILY GRANT: Sorry, we had one more hand. If we could just take Jay from CBE? And then he'll be the last one.

CHESTER BRITT: Okay. I'm sorry. I did not see him.

EMILY GRANT: No.

CHESTER BRITT: Go ahead.

EMILY GRANT: That's okay.

CHESTER BRITT: Jay, if you could --

JAY PAREPALLY: I appreciate that, Emily. I -- I think you did see me but decided to skip after choosing someone else to go twice, but that's okay. I know we're tight on time.

So, one, I think was answered. It sounds like these preliminary findings have to be done before the draft studies; otherwise, I would say they should just be combined in one stage.

An executive summary is supposed to summarize the document that comes with it, not be a standalone list of a few bullet points.

And second, I -- I hear there are other comments about how appreciative people are of the streamlined versions of things. I would urge you to look at the routing and preliminary rights-of-way, franchise -- whatever that deck is called. There are, like, six images of maps of California that just have blobs and lines, with no names of any cities, no names of any regions.

I know that your exact corridor is not chosen, but, like, that -- that's just insulting, if not obfuscating, that I have to layer your maps along with a map of California to find out which communities might be directly affected by this.

I mean, don't bother with this with stage, I'd say, if you are going to give us full reports later on. But I appreciate the opportunity to -- to squeeze that comment in. Thank you.

CHESTER BRITT: Thank you.

FRANK LOPEZ: Hey, and, Chester, before we transition to the next speaker, I just want to also make ourselves available. If you didn't get an opportunity to ask a question or if you have additional questions, we're happy to have follow-up one-on-one meetings to -- to discuss those.

CHESTER BRITT: All right. Thank you, Frank.

All right. So now we're going to go to the next slide maybe -- there you go. Emily Grant, the Regional Public Affairs Manager for Angeles Link is going to make a presentation on the stakeholder calendar.

EMILY GRANT: Thanks, Chester. Hi, everyone. Good to see you all this morning. We appreciate your participation in today's meeting.

If we could go to the next slide?

So, one thing that we've continually heard throughout the past year is, when is our next meeting? So I'm trying to do the best that I can to plan out the calendar for you for the remainder of the year. So, with our hope, of course, being higher participation and especially in-person attendance as well.

So obviously, we'll start with today's update that you all participated in. We appreciate that. Our next meetings -- set of meetings will be our quarterly meetings for Q2.

So, the first one is going to be the CBOSG on Tuesday, June 18th, and that's going to be a hybrid meeting, our -- our typical meeting format, but we would love to see you in person again. That's going to be from 10:00 a.m. to 2:00 p.m.

Thanks in advance to the Port of LA who will be hosting us at Banning's Landing Community Center in Wilmington. And the topic of those meetings will be Beginning to Review Draft Study Reports. As soon as we have available what those Draft Study Reports will be, we will get that information to you as quickly as possible.

And then similarly, the PAG will be on Friday, June 21st, and all of the details will be the same. It's from 10:00 a.m. to 2:00 p.m. It will be at Banning's Landing, and same thing, we'll be reviewing some draft study reports.

So, in a moment, you are going to have an opportunity to let us know what you think of a July or August interim workshop. We've all participated in those before where we continue reviewing some of the studies with the milestone step we're on. So, we'll be at Step 4 which is the Draft Study Reports.

So, we did this. First, we had our scope, and then we went into our technical approach, and then now we're at preliminary findings. We're going to be moving on to Step 4, which is our Draft Study Reports.

So, if you do feel the need to have that July or August interim workshop to review some additional Draft Study Reports, we'd love to hear from you on that. And then we would look to September to have our Q3 quarterly meeting to wrap everything up.

CHESTER BRITT: All right.

EMILY GRANT: And that is it. Thanks, Chester.

CHESTER BRITT: Thanks, Emily. Next slide.

I'm going to now turn it over to Alma who is going to make a presentation on the -- it says the stakeholder calendar, but I think she's going to be presenting on the compensation.

ALMA MARQUEZ: That is correct. Thanks, Chester. We'll move onto the next slide.

I hope everyone knows me by now since we've been meeting for over a year. For all the new folks, welcome.

I wanted to give you an update on the Compensation Plan, because what we've been doing in practice doesn't match what was originally submitted to the PUC when we started Phase One.

First, let me start by saying that you will not feel a change as we are already doing these things in practice. This is solely an administrative step to revise paperwork so what is on file with the PUC accurately reflects how we have been operating. So again, nothing will change for you. We are already working in the manner, but we wanted to make you aware of this administrative step.

This has been due to these procedures being developed prior to the launch of our CBOSG. What we -- what we ended up doing, compensating CBOs, was a better system. This is also due in large part to our partnership and feedback we received from you all.

And as a reminder per the Angeles Link final decisions, SoCalGas is directed to point it with both the CPUC energy division, which they've completed, and the PAG and on the CBOSG Compensation Plan.

SoCalGas will be accepting any feedback you may have on this update until Friday, May 3rd. I'll be glad to take any questions at the time regarding these updates.

CHESTER BRITT: All right. Anyone have any comments or questions to Alma?

EMILY GRANT: Yes, Chester, I see a comment in the chat from Anthony. He asked, "Who is being compensated?"

Anthony, the answer to that question is any -- any community-based organizations. Per the final decision, SoCalGas was directed to compensate the community-based organizations for their time, energy, and effort on our stakeholder group.

CHESTER BRITT: Great. Thank you, Emily, for that. All right. Then we're going to, now, do a quick survey, if I'm not mistaken, Stevie. We're going to do two quick polling questions.

Would you be interested in an interim workshop over the summer to review select draft study reports? You heard Emily mention that our itinerary right now looks like we have our agenda or calendar, it looks like we have meetings scheduled for June and then August, if needed.

And so, we were interested to know from you if you think that we would benefit from having an interim workshop over the summer? So, if you could just answer yes or no to that, we'll just take a quick survey from you guys.

The second question is, of the remaining studies, what are you most interested in? So again, given the limited time and certainly the PAG and the CBOSG might look at things differently, so if you are interested in certain things, we would want to know what that is.

And the second question, we list out all the different study options so that you can just, I think, rank those. That's how the question is set up so that we can then see the results.

So, we'll just -- I can see as you guys are entering in your answers, so I'm just going to patiently wait for you guys to answer, and then we'll just have a brief comment about each of the questions, and then we'll go to the Next Steps and wrap up our meeting.

So far, it looks like about -- almost 45 percent have entered in the answers. It's at 58 percent. If everyone could just answer the questions? Then we can move on.

I'm going to give you guys just a few more minutes. We're almost -- I think we're a little over 66 percent, 68 percent, 70. When we get to 75, then I'll start showing the results. And if you guys continue to answer the question, we'll make sure to calculate it after the meeting. But I'm going to go ahead and just get started now, because it looks like we're stuck on 70.

So, the vast majority of you answered the first question, if you would be interested in an interim workshop over the summer? 86 percent said yes. So, I think that's a decisive answer to that question. So, I would look forward to seeing you guys during the summer, because we'll set up another meeting to make sure we have the time to cover the different topics we need to cover.

Of the remaining studies, what are you most interested in? It looks like the highest answers were for A, B, and C. The high-level economic analysis and cost effectiveness, project options and alternatives, environmental, and environmental social justice analysis, those were the highest-ranking answers. So, those look like something that would be definitely, if we're not already preparing to talk about those, that we would make sure that those were added into the discussion.

Again, we'll get a full report out of the analysis of all the results. You can see the different choices that people have made. It's a bar chart -- a colored bar chart. And it -- we'll -- we'll print those out, and then we'll go through the information, make sure that we are addressing your input.

So, thank you so much. That was very helpful. It's hard to get everybody to weigh in when you have over 60 people on a call. So that was a quick way to just take the temperature of what you guys thought about those two questions.

And now we will move to Next Steps. I'm going to turn it back to Emily who can wrap us up with the Next Steps, and then we'll adjourn the meeting.

EMILY GRANT: Thank you, sir. Okay. So, a reminder that our feedback on preliminary findings is due Friday, May 3rd. We've listed out which preliminary findings data you should have right now. And again, those are due Friday, May 3rd, along with any comments that you may have on Alma's update as well. We'd be happy to hear those.

And then we go into our June, Q2, quarterly meetings. I talked about that earlier, hybrid format. All of the details are listed there for you, and we would love to see you in person. If not, we would be happy to see you online as well. If you have any questions about that, please do let me know.

So, the survey results were very helpful. Thank you for participating. It looks like we will have a July or August interim workshop. If you have any feedback on when or how to do those meetings, all ears on that.

So, we'll likely be hosting that completely virtual. And we'll let you know which select draft studies we'll be covering -- or draft reports we'll be covering and -- at that time.

And then as usual, if you have any questions or comments, please submit them in writing to the email addresses listed below, but, you know, we're always available to you as well if you have any other process concerns or things you'd like to discuss, I'm happy to get in touch with you. And that's it.

CHESTER BRITT: All right. Well, thank you Emily. And with that, we are adjourned.

(The hearing was adjourned at 11:32 a.m.)

HEARING REPORTER'S CERTIFICATE

I, the undersigned, a Hearing Reporter in and for the State of California, do hereby certify:

That the foregoing proceedings were taken before me at the time and place herein set forth; that any witness in the foregoing proceedings, prior to testifying, were duly sworn; that a record of the proceedings was made by me using machine shorthand, which was thereafter transcribed under my direction; that the foregoing transcript is a true record of the testimony given.

Further, that if the foregoing pertains to the original transcript of a deposition in a federal case, before the completion of the proceedings, review of the transcript [] was [] was not requested.

I further certify that I am neither financially interested in the action nor a relative or employee of any attorney or party to this action.

IN WITNESS WHEREOF, I have this date subscribed my name.

Dated: May 2, 2024.

DALAUNA J. CARDOZA, HEARING REPORTER

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HEARD BEFORE SOCALGAS

ANGELES LINK TEAM

In the Matter of the Meeting RE:)
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CBOSG (Q2) Quarterly Meeting)
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TRANSCRIPT OF PROCEEDINGS

Remote Meeting via Zoom Videoconference

Tuesday, June 18, 2024

Reported by:

FABIAN SCHWIN,
Hearing Reporter

Job No.:
48601LEE-VC

HEARD BEFORE SOCALGAS

ANGELES LINK TEAM

In the Matter of the Meeting RE:)
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CBOSG (Q2) Quarterly Meeting)
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TRANSCRIPT QUARTERLY MEETING,

taken via Zoom Videoconference, commencing at 10:00 a.m. and concluding at 2:00 p.m. on Tuesday, June 18, 2024, heard before SoCalGas, reported by Fabian Schwin, a Hearing Reporter.

APPEARANCES:

SoCalGas:

Emily Grant,
Regional Public Affairs Manager
with Angeles Link

Frank Lopez
Director of Regional Affairs

Jessica Foley

Yuri Freedman

Chanise Allen

Shirley Irazzi

Lee Andrews Group:

Alma Marquez, Vice President,
Governement Relations,
CBOSG Facilitator

Arellano Associates:

Chester Britt,
Executive Vice President,
PAG Facilitator

ARCHES:

Joy Langford,
Chief Community Officer

Panelists:

Robert Sainz, New Ways to Work

Veronica Soto, LA World Airports

ALSO PRESENT:

See Roll Call, page 12

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Tuesday, June 18, 2023

10:00 a.m.

MS. MARQUEZ: Good morning, again. My name is Alma Marquez. It's my pleasure to welcome you today to the Angeles Link CBOSG Stakeholder Group June meeting. I am the Vice President of Government Relations with the stakeholder group Lee Andrews and the facilitator. I'll be co-facilitating with my colleague here Chester Britt. We'll be leading some of the member discussion today.

I want to thank everyone who was able to join us this morning especially those who are here in person. I know it was a little bit of a drive, but I think it was well worth it for this beautiful view that we have here at the Wilmington Waterfront.

Fun fact: The Wilmington Waterfront just opened up this year. It cost a little over a billion dollars to build. It was quite a bit of community input the was put into the development of the Wilmington Waterfront and it took over 20 years to build where we're at right now. So you're in a very important location for the community of Wilmington.

And fun fact: I went to Banning High School down the street so this was not what it used to be when I went to school here so I'm appreciative of the big development.

So I want to make sure we move meeting this forward. I want to go over some housekeeping rules. We are recording the meeting, and for those of us joining via Zoom, we want to encourage you to turn on your cameras as we're engaging in some of the questions and also raise your hand to use the hand feature. We are using wireless microphones here at the facility so just raise your hand and we have Tammy who's going to be passing around the microphone this morning.

Also some of you received a folder. You have an agenda in your folder, you have some worksheets that are going to help you as we go though some of the topic discussions today, and as well as some notes in the back for you to take down some notes, and some bios for our two speakers that are joining us later this morning who are Robert Sainz and Veronica Soto.

Okay. So this is today's agenda: We'll have our Safety Moment from our SoCalGas team, our Land Acknowledgement by Rashad -- who I don't see here actually so I may ask someone else to do it -- and then we'll have Roll Call. We have our official welcome by Frank Lopez. We'll have some introductions to another speaker who we have here, Joy Landers from ARCHES, and then we'll kick it off into our discussions and reports from -- we'll be hearing about the Options & Alternatives and Cost Effectiveness from our SoCalGas team, followed along with some member discussion. Then we'll go into Preliminary Findings for Environmental Analysis given by Jessica. And then we'll go into a lunch and then we'll have our panel discussion, followed by some breakout group discussion. And then our Next Steps will be given by Emily Grant. And then we'll adjourn, so I hope everyone braces themselves for a very enjoyable meeting that we'll have this morning.

And with that said, I'd like to hand it over to Chanice Allen who will be giving us our Safety Moment that is typical of SoCalGas to give a Safety Moment at all of their engagement meetings. With that, Chanice.

SoCalGas Safety Moment

MS. ALLEN: Thank you, Alma. Good morning. It's been warming up quite a bit this past weekend and coming into the following week -- can you hear me -- with the following week temperatures may be getting up to the 80s locally and potentially up into the 90s. So as we prepare for the summer, just wanted to share some tips to be aware of as far as preventing heat illness and some fun safety topics to share.

So what is heat illness? Heat illness happens when our bodies overheat and do not have enough water to cool us. We have an internal thermostat that controls our temperature by sweating and cooling. So heat illness can happen pretty quickly so it's important to recognize the systems and know how to respond.

Personal risk factors that we should all consider would be our age, our health, our fitness, and how we adjust to the weather. Keeping in mind that water and caffeine and alcohol consumption would be key. And potentially even prescriptions you should be aware of how they may affect the body when it comes to hydration.

Some of the heat-related illnesses that we should be aware of potentially for heat rash, which could be a red cluster of small blisters that may look like pimples on your skin or usually on your neck or your chest. If that happens, first aid measures could be making sure you stay in a cool, dry place; keep the rash day; use a soothing rash ointment or creams that may be able to make sure to help to prevent the skin from -- making sure that it's dry.

And then for heat exhaustion for symptoms that could potentially be headache, nausea, dizziness or weakness, or there could be a thirst. If you're thirsty make sure you are hydrating.

First aid measures would entail making sure that if there could be medical help or taking -- being able to have access to a facility to make sure you're treated or evaluated. Encouraging frequent sips of cool water and placing cold, wet clothes on your head, neck, or armpits.

Other heat related illnesses are heat cramps, which could be muscle pain or spasms caused by heavy sweating during (indiscernible). First aid that you could apply would be to minimize physical activity, move to a cooler place, drink water or a drink that has electrolytes, and just minimize the physical activity. If the cramps continue or last over an hour, to seek medical assistance.

For potential heat strokes, symptoms could be if you have a body temperature over 100 degrees Farenheit, if your skin is hot and dry, and if you're sweating excessively, if you have a rapid and weak pulse, or seem to be confused or disoriented.

First aid for heat stroke would be to seek medical attention immediately. Call 911 and if possible if you're aware of any emergency response procedures please proceed with that.

In order to prevent those illnesses altogether, there are many key measures that you can take into place starting off with hydration. Drinking three to four cups of water each hour would be helpful or just frequently drinking small quantities of water throughout the day.

You want to just make sure that you're not thirsty. If you're thirsty, then that's too late. Making sure that you limit caffeine and alcohol where possible.

And for cover, shade, and rest that is also very important. Having access to shade whether that's your home, utilizing public buildings whether that's a library or a mall. If you're going to be outside working or doing any physical activity, try to do that in cooler, shaded areas or during cooler times of the day. Taking breaks frequently. Wearing and reapplying your sunscreen. And wearing light colored and loose fitting clothing.

And so with these tips, sharing that with your, I hope you're able to enjoy your summer and be able to have a fun and safe next few months.

Thank you.

MS. MARQUEZ: Thank you, Chanise. And there is plenty of water here so please hydrate yourself this morning as Chanise reminded us to do so.

And with that, we're going to go ahead and move forward with our Land Acknowledgement. Typical to every one of our meetings that we host we like to read our acknowledgement; acknowledge the folks that were here before us and their ancestors and generations before them.

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LAND ACKNOWLEDGEMENT

MS. MARQUEZ: We respectfully acknowledge the Indigenous peoples on whose ancestral land we gather -- of the diverse and vibrant communities of Tongva, Tataviam, Serrano, Kizh, and Chumash people -- who for generations have cared for these lands and make their home here today.

We honor and pay our deepest respect to their elders and descendants -- past, present, and emerging -- as they continue their enduring stewardship of these lands and waters for generations to come.

We acknowledge our collective responsibility and commitment to elevate the stories, culture, and community of the original ancestral lands.

We celebrate the resilience, strength, and unwavering spirit of Indigenous peoples and are dedicated to creating collaborative, accountable, and respectful relationships with Indigenous nations and local Tribal governments.

And with that, I'd like to then move it on forward with our Roll Call. We're going to go ahead and get started with folks who made the drive here because I think it's only fair. So let's start with Michael Burns. If you can please state your name.

Could we pass the microphone so that folks joining us via Zoom can hear you.

If you can please state your name and organization.

ROLL CALL

MR. BURNS: Michael Burns with California Greenworks.

MS. MARQUEZ: Thank you, Michael.

MR. ESTRADA-DARLEY: Kenta Estrada-Darley with the Coalition for Responsible Community Development.

MS. MARQUEZ: Welcome.

MS. HANSCOM: Good morning. Marcia Hanscom with the Ballona Wetlands Institute in Playa Del Rey.

MS. MYRA: Hi. Good morning. My name is Faith Myra and my pronouns are she/they. And I'm here with Protect (indiscernible).

MS. MARQUEZ: Welcome, Faith.

MR. VAN DER HOEK: Good morning, Alma and everybody. My name is Roy. Full name Robert Young Van der Hoek, and I'm with Defend Ballona Wetlands. It's one of the organizations defending and protecting the precious wetlands in Los Angeles.

MS. VEGA: Good morning. Andrea Vega with Food and Water Watch.

MS. IRAZZI: Good morning. Shirley Irazzi with SoCalGas.

MS. LANGFORD: Good morning. Joy Langford with Water

Replenishment District and ARCHES H2 Hub.

MS. ALLEN: Good morning. Chanise Allen, SoCalGas.

MS. GRANT: Good morning. Emily Grant, Regional Public Affairs Manager with Angeles Link.

MR. BRITT: Good morning. I'm Chester Britt with Arellano Associates. I help facilitate the PAG and the CBOSG.

MR. LOPEZ: Good morning. Frank Lopez, Director of Regional Affairs for SoCalGas.

MR. FREEDMAN: Good morning. Yuri Freedman with SoCalGas.

MS. FOLEY: Good morning. Jessica Foley with SoCalGas.

MS. MARQUEZ: Okay. And I believe that's everyone. We're going to move forward with the folks joining us on Zoom. I believe I see Enrique. If you can please unmute yourself and state your name and organization you're representing this morning.

(No response.)

Okay. We'll get back to you. If we can please go on to -- let's see here. I think I see Rashad in the room; is that right?

All right. Let's move on to Andrea Slater.

MS. SLATER: Hi. I'm Andrea Slater with and UCLA Laker's Center and the LA Black Workers' Center.

MS. MARQUEZ: Welcome, Andrea.
MS. SLATER: Thank you.
MS. MARQUEZ: And we'll move on to the next Andrea, Andrea Williams.
MS. WILLIAMS: Good morning, everyone. Andrea Williams (indiscernible).
MS. MARQUEZ: Nice to see you, Andrea.
Gerry Salcedo.
MR. SALCEDO: Good morning, everyone. Gerry Salcedo, Executive Director of the southeast Rio Vista YMCA and the City of Maywood.
MS. MARQUEZ: Welcome, Gerry.
Jill Buck.
MS. BUCK: Good morning, everybody. I'm Jill Buck, and I'm representing the Go Green Initiative.
MS. MARQUEZ: Hi there, Jill.
Hyepin Im.
MS. IM: Good morning. Hyepin Im with Faith and Community Empowerment based out of Koreatown.
MS. MARQUEZ: Hey there, Hyepin.
Kristin Fukushima.
MS. FUKUSHIMA: Hi, this is Kristin Fukushima (indiscernible) community council. So sorry my computer and internet are being weird so I'm on phone currently.
MS. MARQUEZ: Well, you sound great, Kristin. Thank

you.

Lourdes Caracoza.

MS. CARACOZA: Good morning. Lourdes Caracoza, CEO and President of Alma Family Services. Happy to be here.

MS. MARQUEZ: Great to see you, Lourdes.

And we have Roselyn Tovar. If you could please unmute yourself.

MS. TOVAR: Hi. Good morning, everyone. This is Roselyn from Communities for a Better Environment. I'm the energy researcher.

MS. MARQUEZ: Great. And I think I got all of the CBOs. If I did not, if you could please unmute yourself and state your name and the organization you're with.

MS. ALVAREZ: Morning. Thelmy Alvarez with the Watts Labor Community Action Committee. I'll be in person in a little while, but I didn't want to miss the start of the meeting. Just backing up other meetings in my day. Short work week.

MS. MARQUEZ: Great to see you, Thelmy.

And I think we have Jay Parepally.

MR. PAREPALLY: Yeah. Jay Parepally, Legal Fellow at Community Serving the Environment. Thanks.

MS. MARQUEZ: Great to see you, Jay.

And I believe we have Lauren Gallagher with CBE.

MS. GALLAGHER: Yes. Also with CBE. She/they pronouns. Thank you.

MS. MARQUEZ: Great. And I'm pretty sure I got everyone; is that right? Okay --

MR. AGDAIAN: I'm sorry. Tigran Agdaian. I'm here with Breath Southern California. I'm filling in for my boss Mark Grill.

MS. MARQUEZ: Great to see you, Tigran. Thank you for joining us this morning.

And thank you all for really taking the time to be here. As you know we have quite a bit to go over and you know just really want to encourage you to ask questions and -- oh, we see someone else coming in.

Rashad you just made the last final roll call. Rashad with Reimagine LA. Thank you for joining us this morning.

And with that I want to go ahead and introduce Frank Lopez who is our Regional Public Affairs Director for SoCalGas who will be leading us in our welcome this morning.

SOCALGAS WELCOME

MR. LOPEZ: Thank you, Alma.

And I want to start off by thanking all of you for attending the meeting today, especially those of you who drove out here. I want to thank our host, the Port of

LA. They're part of them for PAG. They're not present here, but I want to thank them for providing this space for us to have this meeting at this beautiful waterfront. It's been a couple of years since I've been out here to Banning's Landing so it's really great to come out here and see all the wonderful work that's taking place and the amazing space so I encourage all you during the break or after the meeting if you want to hang around and walk around the waterfront and take a look at all the great amenities that are part of the facility. Really enjoy the day out here, especially for those if us who drove out here make the most of the day.

Couple of things I just want to give you a heads up about. So feedback and process improvements. I want to thank everyone who participated in our April meeting that took place where we rolled out our new preliminary findings deck. I think we've released several preliminary findings of the new format. We've started to receive some comments. So thank you for the feedback that we received on that. We appreciate all the feedback. We take all that feedback in. We're learning. We're getting better every single time we have meetings on how to make it easier for folks to come in and incorporate that feedback into our work streams.

Based on some of the feedback we've also made some other changes that I wanted to highlight. You'll notice today when we do our presentations on our topics that there's going to be at the end a feedback summary. It's going to be a summary of comments we've received on the preliminary findings for those presentations. It's not going to be a comprehensive list of every single comment we've received, but we are going to pull out some of those themes that emerge and we'll summarize them and also present our response. And of course we'll also have a discussion if there are any additional questions on that.

Some of you may have noticed too that we released our first quarterly report for this year yesterday. It went out late. Not sure if anybody had a chance to read it. You'll notice they're also under a slightly different format. We have summary of comments that we've received, we also have some global responses to themes that emerge, and then we're also including all of the comment letters. And including brackets for each of the comments in those letters and then responses to those comments. So make it a little easier for folks who submitted comments to track how we responded to those comments and how to find our responses. So hopefully you'll get a chance after today's meeting to go review that report and see the new format, and how we've incorporated your feedback into our work.

And then in terms of the letters that we've received, I want to thank folks for taking time to provide us with written comments on our work. Our goal is to post those letters to the living library as quickly as we receive them. Hopefully within a few days of receiving them. We understand that we were a little behind with those quarterlies so we're trying to work much faster to get those quarterly reports out so that the timeline from when a quarterly report goes out to receive comments is going to be shorter.

We also heard that you want us to communicate a feedback window status, updates on milestones and process. So in the emails that you've been receiving you'll notice that we're attaching the feedback window matrix to emails so you don't have to go into the living library to dig that information out. Just make it easier for you to see when comments are due.

And then we're also providing you with a preview of what reports we expect to issue next. Obviously that's subject to change, but we're trying out best just to be more forthcoming with the information so you can plan accordingly.

In terms of the draft studies we're making a lot of progress. I believe all of the preliminary findings have been issued. To date we've issued a draft study on hydrogen leakage assessment. That's out. Went out at the end of May and I think comments are due in a few days on that draft study.

We're also working on releasing additional draft studies over the next several weeks. So you'll notice after today's meeting over the next couple weeks that a lot of studies are going to start to come out. So a lot of that detailed information that you've been asking for will be released to you for feedback.

As a friendly reminder, you're going to have four weeks to comment on the draft reports. And while we put a lot of time and effort into drafting these materials, we hope that everyone reads them, has an opportunity to comment on them.

We understand that for some of you you just may be unable to comment on every single study. That's fine. It's not necessary for you to provide written comments on every study. We're providing multiple opportunities for folks to provide us with feedback in meetings like this, in written for, in one-on-one meetings, whatever works best for you. And please contact us, but please expect this information and plan ahead.

We have a really good meeting today. We have some really important topics we're going to be addressing today. We're also going to have some great outside speakers that will be joining us including Joy Langford who I'll turn it over to in a few minutes.

I also want to announce that we're adding a new member to our Planning Advisory Group. It's Ray Salas of the Fernandeno Tataviam Band of Mission Indians. We have three organizations as part of the CBOSG that represent Tribal communities. We've been hearing from all of you about the need to increase representation from those communities.

So we've actually been in conversations with Ray several months ago about joining, and he decided to join. He actually wanted to join the Planning Advisory Group so he wouldn't be attending these meetings, but he will be part of the process. And he feels that even though we're towards kind of the end of this Phase 1 process that he could still add value. So I wanted just to flag that for all of you.

And just as a look ahead, please save the date for our summer workshop meetings. The CBOSG meeting is tentatively scheduled for July 23rd. Hopefully you got that invitation, and the PAG meeting will take place on Wednesday, the day after, on July 24th. That's going to take place back at our Energy Resource Center in Downey from 10:00 a.m. to 2:00 p.m.

Some of the topics we're hoping to address at that meeting includes routing, pipeline sizing and design, permitting, production, and the presentation of our environmental and social justice plans. So a lot of important topics that I know all of you will be interested in.

So I just have a couple of slides I want to go through real quick. Here's our projective draft reports (indiscernible) if you want to go to the next slide. Just to kind of show you the studies that have been released so far. So we've issued Demand. We've released Hydrogen Leakage Assessment, and we have about a dozen or so studies that are set to be released for review.

If you go to the next slide, just to kind of -- I think some of you may have seen this slide previously. You know we provided four major milestones for each study and when we're receiving comments: At the initial scope of work; we come back on the technical approach and solicit input on that information; preliminary findings, which I mentioned most of those have already gone out; and then the final milestone will be the draft report where we'll receive comments. So we're just kind of outlining where the multiple opportunities are for you to engage as part of the study development process.

So with that, I'm going to turn it over to Joy Langford who I'm really happy took the time to drive out here and join us. I know you were going to join us virtually, but I'm glad you showed up in person.

I had the opportunity to meet Joy a few weeks ago and get to know her. Really a remarkable career for you. A woman that wears many hats. Many of you will know her as the Chief Community Benefits Officer for ARCHES but also a Director on the Water Replenishment Board. It's been a long time working in the legislature working with governmental agencies, has a lengthy environmental background including an environmental justice background, and I'll turn it over to Joy to do maybe a little introduction about her background.

Thanks for joining us today, Joy.

INTRODUCTION TO ARCHES FROM ARCHES CHIEF COMMUNITY OFFICER

MS. LANGFORD: Thank you.

And I happen to know a few people in the room: Marsha and I know Mister -- (indiscernible) group very well. Thank you for having me. I'm here today -- as you said I wear many hats -- I'm also the director of Groundwater for LA County. I'm on my way down to my meeting in Long Beach right now, but it was easy for me to stop through here.

My other hat is I'm the Chief Community Benefits Officer for ARCHES H2 Hub. It's California's new hydrogen infrastructure rollout basically moving the State forward with hydrogen as a clean source of energy. It picks up where electrification can't.

It's clean burning. We're trying to get to the net zero goals of 2035 and 2045 just as soon as possible, and we can't do that without hydrogen. So with that, we have the lofty goal at ARCHES not only to create this hydrogen infrastructure but bring the communities along on our journey as we do so.

So just a few highlights and I'll probably come back and I'm hoping that you'll join our community groups, log on to our website at archesh2.org. We hold a community benefits section every two weeks on Thursdays from 12:00 to 12:45. It's a great group of various environmental groups, various community members, all interested in finding out how we're going to make this multi-billion-dollar project work in the State of California.

Our goals are lofty here. We are going to create 220,000 green jobs that are life-sustaining green jobs, not fly-by-night. Labor is one of our partners in this endeavor. With those 220,000 jobs there will also be auxiliary jobs: Hair dressers that also move in, community stores.

So we're really trying to make this a push for the community to really be involved in the workforce training, get the younger kids out of the thought pattern of, you know, being social influencers. Not everybody is on a college career path. These are good, life-sustaining jobs where people can live the American dream by creating a clean future for all of the residents of California and future generations to come.

So I wanted to come here and spread the gospel on hydrogen. Please take a look at our website: archesh2.org. Our community benefits plan is very well laid out. It was approved by the Department of Energy prior to us getting the award, and our plan is so good that the Department of Energy is actually implementing it with the other smaller hubs -- California being the largest hydrogen hub -- across the nation and mandating it for the other hubs as well.

So please take a look at it. Come to our community meetings, and you can also reach out to us at community.engagement@archesh2.org with any questions. Again please join our meetings. Our meetings are pretty lively. We have various speakers, doctorates in both engineering, transportation, doctors that talk about the health benefits of hydrogen in underserved communities. We are hundred percent committed to it.

So with that, if there are any quick questions for me I'd be happy to take them. Otherwise, I look forward to seeing you on our calls, especially people who are working on workforce development. We want you to be engaged in our plans for workforce development. This is one of your only shots to really be engaged with Labor at the highest levels. The head of California State Trades is one of our board members as well.

So we're hoping that everybody gets involved and helps us put together the pieces of the puzzle.

MS. MARQUEZ: And I believe your next meeting is this Thursday; right, Joy?

MS. LANGFORD: Yes, it is this Thursday. So please sign up at community.engagement@archesh2.org. If you miss this meeting, don't worry. There will be one in two weeks from now, and we look forward to engaging with you on that platform.

MS. GRANT: Thank you, Joy.

And in case you didn't notice I want to call your attention to the QR codes on the slides. I just checked them. I'm really proud of myself. They work. So please do sign up for the meetings.

The one on the left as Joy referenced is their community benefits pathways. It's a great document. I really encourage you to take the time to read it.

And then also the meetings, to sign up for the meetings. It will give you the email address -- the folks at ARCHES you need to contact so you can join those Thursday meetings. They're 45 minutes, biweekly, and they're well worth your time.

MR. LOPEZ: For our PAG and CBOSG meeting you have to be a member to attend the meetings, but that's not the case for your meetings; right? Your meetings are basically open the to public and anyone who's interested in ARCHES can join to learn information about it?

MS. LANGFORD: Yes. Our community benefits is open to the public. You do not need to sign an NDA to be part of those groups. We also have other working groups like for the ports, for transportation, the trucking industry where you would have to sign an NDA and show that you are engaged in that part of the process with the ports, what have you. Buy, yes, come one, come all to the community benefits meetings.

And we probably have about 60 to 100 people log on every week, and we're always trying to grow it so we can spread the word, get the excitement out there about the clean jobs and the clean air benefits that are about to take place from net zero goal.

MS. MARQUEZ: Thank you, Joy.

With that I'll --

(Simultaneous crosstalk.)

MR. LOPEZ: Do we have any questions --
MR. BRITT: -- any questions for Joy?
MR. LOPEZ: -- either in person or online?
MS. MARQUEZ: If you can please wait for the microphone. State your name and your organization for the court reporter.
MS. HANSCOM: Sure. Marcia Hanscom, Ballona Wetlands Institute. We asked a question, oh, maybe a year ago or so about what is the difference and how does it connect; Angeles Link and ARCHES? And Maybe some of you all know that more now, but we were told there wasn't a link. They were totally separate. So now maybe there is a link and I'd like to understand -- I know some of us would like to understand better how it works together.
MS. LANGFORD: Right. So I'm not quite sure if Angeles Link itself is exactly involved with ARCHES, but the gas company is. The gas company as they move toward the net zero goals too see the benefits of hydrogen and has been putting input in -- not so much on the scale of community benefits section that I control, but they've been working hand-in-hand with ARCHES' other leadership to find ways to get hydrogen to be part of their projects. And they are a member ARCHES. They had to go through a whole process to become tier members of ARCHES along with us and the DOE.

MS. HANSCOM: When you say "they" you mean SoCalGas?
MS. LANGFORD: Yes.
MS. HANSCOM: That's good.
MS. LANGFORD: You want to add on to that? You've probably been involved in the negotiations.
MR. FREEDMAN: Thank you, Joy. I appreciate the comment. I agree with everything you said. Maybe to add a little more I happened to be yesterday at an event in Sacramento, California Hydrogen Leadership Summi.
MS. LANGFORD: I was a speaker.
MR. FREEDMAN: I know. I know. I just wanted to help to link this together. And this is actually going to be helpful as a pretext to my presentation.
Tyson Eckerle, one of the leaders of ARCHES, he's with the Governor's Office of Economic Development, Go Biz. He has pointed out, as he has many times before, that pipelines are critical to implementing that mid-century vision of ARCHES where there's going to be a large amount of clean, renewable hydrogen around the State used for various purposes. And pipelines are crucial to that because pipelines are a way to deliver this large amounts at low cost and safe reliable fashion. That's what Angeles Link aims to do.
So the best way to think about nexus between Angeles Link and ARCHES is to think about the end-state

vision of ARCHES and think about the pipelines such as Angeles Link are going to be critical in accomplishing that vision.

Hoping that makes sense.

MR. LOPEZ: I just want to clarify too that in very simple terms, Marcia, to be clear that we are a member of ARCHES. When the Public Utilities Commission approved our memorandum account it did direct us to join ARCHES. So we've been part of ARCHES since the beginning and do have a project as part of ARCHES.

(Indiscernible.)

MR. LOPEZ: Teamwork.

MS. MARQUEZ: I believe we have one more question.

MR. VAN DER HOEK: Thank you, Alma. Hello, Joy. Good to see you too. Good presentation.

Now I'm a little bit curious based on what Marcia Hanscom says -- and, again, this is Robert Van der Hoek, Defend Ballona Wetlands.

How does it link into the State politics like Governor Gavin Newsom? I mean I think -- may have missed it, but I don't think you mentioned the governor's office and then his Secretary of Natural Resources -- Wade Crowfoot, thank you -- CalEPA --

(Simultaneous crosstalk.)

MS. LANGFORD: It's a big mesh pot. Yeah, it's a big mesh pot. Originally it started off as a project between the UC system, the Governor's Office, Labor -- and who's the fourth person?

MR. VAN DER HOEK: UC?

MS. LANGFORD: Yeah, the UC. They all came together to put the application together for the Department of Energy. And it is a partnership with them and -- private industry, that's the fourth one. It's a partnership between our hub and the Department of Energy. We all come together as one part and the Department of Energy is the other part that's funding the initial part of California's hub to the tune of $1.2 billion.

All of our other partners are putting in -- we are helping our business partners such as California -- SoCalGas become -- helping them along with their project as part of it.

MS. VEGA: Hi, Andrea Vega with Food and Water Watch. I just -- since you've been heavily involved in all of this community outreach, I just wanted really to see what your perspective or ARCHES perspective in regards to the widespread community opposition to the sham that is the Ballona Restoration Project.

MS. LANGFORD: I'm sorry. What did you say?

MS. VEGA: I want to know what is your take or ARCHES take on why the community has been giving a lot of pushback to this absolute sham of a project. Because rather than just solely just decommissioning the wells at Playa Del Rey, now there is the push for more fossil fuel infrastructure.

So how do you explain that?

Oh, I don't -- don't know anything about that. I have worked on the Ballona Wetlands, but this it -- I'm here for ARCHES.

MS. VEGA: All right.

MS. LANGFORD: So you might want to ask them. They are the gas company.

MS. VEGA: Perfect. I might have to.

MR. LOPEZ: We're here to discuss -- thank you for your question.

MS. LANGFORD: And I do need to leave. I did come down here -- but, yeah, we don't -- ARCHES. You can join our community meetings. I don't see how there's a correlation, but --

MR. LOPEZ: That's okay. It's not within the scope of this meeting. But I'll stick around and make sure maybe during the break we connect on that.

But, Joy, I want to thank you for joining us. I know we kept you a little longer, but I appreciate you driving out here and meeting with us in person. It was really valuable. Thank you. Safe travels.

So I'll stick around on the break and maybe we can connect on that. I want it keep this discussion today focused on the Angeles Link and the topics at hand.

Thank you.

MR. BRITT: All right. Thank you.

Sir?

MR. VAN DER HOEK: Frank, I think you mentioned or it was Chester when Joy was speaking about the UC system so one of you knows about that. Which -- is there a particular UC campus or several UC campuses?

MR. LOPEZ: I belive it's the UC Office of the President, but there are faculty from multiple universities that are part of the process.

MR. VAN DER HOEK: And the CSU schools are not --

MR. LOPEZ: I'm not aware of that.

MR. VAN DER HOEK: Okay. Thank you.

MS. MARQUEZ: I believe another question by Kenta.

MR. ESTRADA-DARLEY: Sorry. So we have time for one more ARCHES question?

(No response.)

MR. ESTRADA-DARLEY: So I remember seeing a map with the ARCHES projects and other Biden Administration mega projects which was cool cause they called it mega projects; right?

But do we know where the ARCHES hub is going to be located already or they're still scoping out that piece?

MR. FREEDMAN: We can't really speak for ARCHES because we're a member, one of many members. I think the public materials that they released so far give a sense of the scope. And, again, ARCHES was created and meant to be a statewide hub.

So clearly by definition the projects are going to be northern California, southern California. And there's a good amount of production projects as well as the end-use projects in ports -- in the industries that need hydrogen and that's probably what you've see in the public is I think all that's available until they complete negotiations.

MR. ESTRADA-DARLEY: And will the timing of that project and then the studies we're doing for, like, Angeles Link line up well? Cause I'm assuming there's going to be a direct correlation between the hydrogen hubs and --

MR. LOPEZ: Well, we're just one of many projects that are part of ARCHES; right? There are dozens of projects that are part of ARCHES, and I think as soon as they finish up their negotiations with DOE they'll be releasing more public information about the specifics of those projects. We're just one of many of those, and we're kind of following our own timeline here.

MR. ESTRADA-DARLEY: Well it's definitely exciting. I mean it brings real life to the conversation; right? So.

MS. MARQUEZ: Yeah, and I would encourage you to join the meeting on Thursdays so that Joy could give more information regarding -- because that's a really good question. Thank you for that.

And I don't think we have any more questions on Zoom. So we're going to go ahead and move forward with the next section of our agenda. And with that we're going to move it over to Yuri who's going to go over the first presentation: Project Options & Alternatives and High Level Economic Analysis and Cost Effectiveness.

PREVIEW OF DRAFT REPORTS: PROJECT OPTIONS & ALTERNATIVES AND COST EFFECTIVENESS

MR. FREEDMAN: Thank you, Alma.

And good morning. The first study -- I'm going to review two studies. As Alma mentioned first one is the study of Options & Alternatives which effectively answers the question, what other ways are there to provide the benefits that Angeles Link aims to provide. The second study is going to look at the sum of those options and alternatives in an economic standpoint, comparing their cost effectiveness if you will to accomplish the objectives that they aim to.

And thank you. Too fast.

So the first of the studies The Project Options & Alternatives LA's portfolio of hydrogen delivery alternatives as well as non-hydrogen alternatives. As we were directed to do by the CPUC, non-hydrogen alternatives are including electrification and localized hydrogen hub.

Hydrogen alternatives are several ways of delivering molecules of hydrogen other than the pipeline within the -- (indiscernible)

Next slide. One second I'm going to -- the -- what may be worth spending a minute on is to explain the relationship of this study with others because there's many studies in Phase 1 and we wanted you to understand how they relate to each other.

For example the study of pipeline sizing and design. You can understand intuitively that once you do the study the date of the outcome of that is going to help to develop cost estimates. Because once you design the pipeline, once you know its physical parameters you can translate it to the costs. These costs are part of the cost estimate which are going to be using the cost effectiveness work.

The second bullet point is the study I mentioned. We'll talk about this in more detail later, but effectively the second study takes the outputs of the first study we're talking about right now and calculates what we call the levelized cost of hydrogen. Or sometimes the (indiscernible) cost of electricity.

And the third one of course is my mental analysis and environmental social justice plan. The alternatives that meet the criteria to establish the project's options and alternatives are carried forward to these two studies, to environmental analysis as well as the environmental social justice plan.

Let me remind you I think you may have seen numerical slides from the previous conversation, but it's always useful to step back and make sure that we remember the framework that we used in approaching this. We have first identified those alternatives, compiled the list, and then we related them as we'll discuss in more detail later against a criteria.

We dismissed those that do not meet the criteria, that's Step 3. And then we selected alternatives to carry forward for further analysis, Step 4. And then the Step 5 is what I described briefly before that's to feed alternatives to the cost effectiveness work as well as the other studies. And ultimately the final step is to incorporate the findings from Step 6 into the analysis of what we call fulfillment of purpose in either project.

Let's go now a little bit deeper into the list of the alternatives. And on the hydrogen delivery alternatives again I want to emphasize that they analyze the delivery within the State of California.

It is localized hub. It's also power transmission distribution effectively within basin production or asking differently, can it bring electrons to the basin and make hydrogen in the basin as opposed to shipping it from outside by the pipeline.

Liquid hydrogen tracking and gaseous tracking. Hydrogen can be delivered by truck as a gas or as a liquid so want to look at these two options as well as liquid hydrogen shipping. And hydrogen can also be shipped in derivatives. You can imbed hydrogen into different chemicals such as methane and ammonia and you can ship it and the extract. So wanted to consider those as well as the liquefaction will be part of the process as well.

And then non-hydrogen alternatives the two most important ones are electrification, State of California is on the path to electrify as many end uses as possible and we firmly support that. Within that we wanted to explore whether Port Angeles Link is providing can be accomplished by the electrification.

The second non-hydrogen alternative is carbon sequestration. That's effectively continuing to use natural gas but then capture and sequester carbon dioxide to get it to emissions neutrality.

And then there's a range of options which we have considered but chose not to include into our analysis and a list of them falls below. You can see there's renewable natural gas is one. RNG plays an important roll in the State, but RNG is mostly going towards transportation so it may not be the right feat for these purposes. As well as the other sources: Nuclear, hydro-thermal and many others.

Next slide. Again I skipped one over. Trying to make sure that what we have here -- I am missing a slide. Well let's talk about the slide here which gives you the first impression if you will of how we depict power analysis. It's a lot especially on the right-hand side. The way to think about that is on the -- in our rows we have various alternatives: You can see Angeles Link, shipping, and so on and so forth. On the columns we have various parameters that we have used to assess these alternatives. And the color gamma depicts as legend from the bottom as really good level of fit or the positive assessment which is the dark blue to the lowest fit which would be depicted here in pink.

So the parameters that we've used are listed on the left in bullet point. It's State Policy, whether or not an alternative is aligned with California policies.

It's Range which is really important because the large amounts of hydrogen that are needed to make the State's carbon neutrality vision a reality are going to be transported over long distances so we need to understand what alternatives can deliver hydrogen over these long distances.

Reliability and resiliency is very important attribute. That is becoming increasingly clear to everyone as we move towards decarbonization we have to do so in a resilient fashion. We cannot compromise the reliability of our power and energy supply.

Implementation is important attribute of course as is scalability. So the question of scalability is different from technological maturity because the question is technology may work well in the lab, it may work well in a confided scale the question is again whether it can be scaled up to reach the levels that the State aspires to accomplish.

And we will go more into the line by line review of that in the following slides.

For now let's -- this is a recap of the six-step process. Now it describes what we took forward for a deeper analysis and you can see the list of those on the right. It includes hydrogen trucking which of course is hydrogen is being delivered today. Mostly as gas but liquid is also an option. We are going to examine liquid hydrogen shipping as well as methanol shipping and in basin production and localized hub.

We did examine two non-hydrogen alternatives: Electrification and CCS is an acronym for carbon capture sequestration. And let's spend a minute talking about what they are. This is the slide that talks about the cost effectiveness analysis. And let's spend a second thinking about what we'll be talking about that.

Compared to the various alternatives the economics takes place on the basis of what is the cheapest way to bring a molecule of hydrogen to a user if we're using hydrogen or for the non-hydrogen uses how we are going to deliver that and what is the lowest cost of electricity. So effectively something which we call LCOH, levelized cost of hydrogen, is comprised of cost of production and most important the transportation/distribution storage.

We touched on this a little earlier, but I think for now, again, this is the relationship between the various studies. What also is important here and I know that the topic can (indiscernible). There are other studies that we've performed before and we've seen the preliminary results of them. The production study is the one that assessed the third-party production. We remain clear in that SoCalGas is not looking to be hydrogen producer.

There's a large amount of activity on the production side which has been spurred by the Federal incentives to produce hydrogen and that is what is very well captured in documents of ARCHES. And then we are looking to bring this production to market. But ultimately what we need to assess is the cost of production as well as cost of transportation by various means.

There's also a very important aspect of analysis, the water study, which is separate work. And the water study estimated water-related costs that will be used as a component of this levelized cost of hydrogen production.

We are now transitioned to cost effectiveness conversation as you can see here. And again we talked a little bit about the LCOH the cost effectiveness analysis. Let's talk a little bit about the non-hydrogen alternatives. We are asking the question of can we accomplish by means of electrification what Angeles Link aspires to do. Then the question becomes let's take the power sector because one of the sectors which Angeles Link aims to serve is the power generation power plants.

Instead of burning hydrogen at a power plant, the alternative would be to put significant amount of batteries to provide this functionality and the question is, is it cheaper or is it more expensive. And that's why we talk about the parameters called levelized cost of electricity. We're ultimately asking question from the electricity standpoint. Is it cheaper to bring hydrogen to a plant and combust it or is it cheaper to put batteries and provide the same level of service with batteries.

It's a different magic for the mobility sector because again recall that a very large portion of Angeles Link is going to serve mobility, transportation. The question for this sector is different question. It's not the electricity question it's the question of what is your lowest cost to own this truck including the capital cost and upgrading cost. That's what we call total cost of ownership, TCO.

Obviously fuel is an element of that but so is the cost of (indiscernible) and so many others. So the question becomes in zero emissions world is it cheaper to own and operate the battery electric truck or fuel cell electric truck. That's the question we asked and answered.

In the industrial sector again it becomes very what we call use-case dependant because it's a different analysis for co-generation. Co-generation is power generation within the industrial facilities. And it's a different question for the different answer for a finding because a finding today is hydrogen as an equal to their process. So for them the cost of hydrogen becomes what's relevant. So I know it's probably a bit dense but we'll try to demystify it a little bit in the following slides.

What's important to mention here is that this study has been informed to very significant degree by various inputs and assumptions and modeling work that has been done elsewhere. We're not starting this from scratch. We are building on what has been done in national laboratories, the model that had been developed in California agencies.

And in fact, we made sure our assumptions are very consistent and aligned with this work. So we wanted to put the slide here to give you a sense of not only of the scope and scale that we are looking at -- remember on the rows the three key sectors of demand: Power, mobility, and industry. But we want to be sure that you understand that the work that we are doing is built on the foundation that many state and federal agencies have been looking at this for a long period of time.

This is probably one of the more important if not the most important slide in cost effectiveness study.

This ultimately brings together the calculations and comes up with this levelized cost of hydrogen as it's being delivered to the end user.

You can see that the, unsurprisingly, the largest category cost is production. That's the dark blue category at the bottom. You will see that it's fairly similar for several alternatives.

It is quite higher for one alternative. The second from the right is localized hub. The reason it's so much higher is because there's a limited amount of land in the Los Angeles area. If you really want to produce hydrogen in the basin, there's very little land for that. And small parcels of land result in high costs per unit, which intuitively may be clear if you're developing a small one megawatt project. It's probably going to be more expensive hydrogen if you're to develop what we call a to scale large project. That's why the costs for production for localized hib aren't so high.

You can see the other elements that are of course the storage, transmission. If you deliver it as a liquid, you need to liquify and re-gasify it. Bring it from gas to liquid and then back to gas. And then the last one is distribution. So again, we can spend more time on this slide. You can see Angeles Link comes up as the lowest cost alternative. The next one is liquid hydrogen shipping which is why it's significantly more expensive and then it gets even more expensive as you go to alternatives such as gaseous tracking, localized hub, and liquid tracking is pretty expensive as well because it costs a fair amount of money to turn gas into a liquid and then turn it back to gas.

So that's really an important slide because that is really the summary of significant quantitative work that as we mentioned brings these assumptions together, runs them through the models, and comes up with those numbers. I wanted to be sure that we spent proper time on that.

We have a little bit more granular look at that for the non-hydrogen alternatives which again as we mentioned electrification is a really important one. And as you can see in the left upper quadrant we're looking at the power and the question we're asking again is is it cheaper to run power plants on hydrogen or is it cheaper to install batteries and run on battery storage. You can see the results. The dark blue is Angeles Link. The light blue is the battery. And battery is significantly more expensive. As we go to the lower left quadrant that's the mobility sector and there I can see we did analysis for several categories: For the sleeper cab trucks, transit buses, dragee trucks, and day cab. There are various categories according to the area source board of transportation of the vehicles. And again, the numbers seem to suggest that the fuel cell mobility is significantly less expensive toward sleeper cabs and transit buses. It is close for dragee and is relatively close for day cab. This is the quantification of the fact that when you need to bring your load over long distances or for long period of time, fuel cell is a superior technology because of it's high energy density. And that's been a point of consensus now among many of the industry (indiscernible) as well as practitioners.

So again the takeaway is that Angeles Link appears to be more economical to serve the key sectors which we've explored which is the power generation, mobility, and last but not least I didn't talk about the industry.

Industry is comprised of many different sectors. We showed food and beverage as one here and this is the lower right quadrant. You can see that food and beverage again the hydrogen is significantly more cost effective way to accomplish the decarbonization objectives compared to alternatives.

This is a chart that in a sense brings it all together with some commentary here. I'm not going to read commentary because obviously it's there for you to read, but maybe the easiest way to go through this is to look at the color gamma and to assess if you will or just to capture the information included here which asses the, as you can see, the various decarbonization pathway laid out in the rows against various criteria which are here in columns.

We did the same for non-hydrogen alternatives. And here we assessed them, as I mentioned before, based on the use case -- just give me one second. Sorry. I'll turn.

So you can see on the use case on the power side some parameters are comparable between Angeles Link and electrification. For example, electrification is very much in line with the State policy. That's why both Angeles Link and electrification are dark blue.

However, electrification is going to be inferior to Angeles Link in terms of reliability and resiliency. It is on the other hand more attractive from the standpoint of mature -- maturity. But again where it comes in is the end user requirements and the cost effectiveness which is what we were looking at before. That's where Angeles Link appears to be superior.

If you look at mobility the comparison is different. It's actually similar on the State policy because clearly electrification of mobility is the State policy. If you recall that both battery vehicles and fuel cell vehicles are electric vehicles. They simply use different energy source.

As we move further to the right on mobility you can see that Angeles Link provides higher liability and beats the end user requirements in those categories that we mentioned, specifically long haul heavy duty and the bus transit is where the fuel cell mobility really shines.

As we go to the industrial hit, I'm not going to go this blow by blow so to speak but you can see the dynamics where on one hand Angeles Link brings -- and the theme here is resiliency and reliability -- on another hand in some of the sectors you know electrification is more mature today than hydrogen so the comparison is to go sector by sector within the industrial. And we wanted to highlight attractive pathway for cement even though carbon capture sequestration but just wanted to show it up here. I realize there's a lot that's included in the slide and going through this fast so maybe spend some time now or in a minute so I want to be sure give you the opportunity to review just realized how much preparing the boxes and colors more in depth.

The next one --

(Indiscernible.)

MR. BRITT: Thank you, Yuri. So before we get to your questions and comments today, I wanted to take an opportunity to remind you that the slide that Frank covered with the arrows -- when we started this process over a year ago we had mentioned to you that we had 16 work studies were in the preliminary feasibility phase, Phase 1 -- and we were going to give you four opportunities to look at those work studies starting with scoping, we then moved on to technical approach, wrapping up preliminary findings which almost all of the work studies have gone through that process.

And as you heard Frank mention we're about to release the draft findings very shortly and were going to begin that Step 4 process where you're going to have a chance to review those.

To date we have received comments from you on those previous elements: Scoping, technical approach, and some of the preliminary findings. And before we get into the comments today from the presentation that Yuri mentioned, we wanted to just at least give you the thematic comments that we've received.

Again this is not a blow-by-blow list of all the comments we've received. It's not intended to be that. But we did feel like it was important to give you a sense since not all of you are making those comments just to know what your peers are making comments about thematically and what we're hearing, and what we're doing with that.

So to present that today we have this slide which just really encapsulates the four main thematic inputs to date that we've received. The first one is the need to demystify hydrogen to the average consumer. I think from the very beginning there's this notion of what is hydrogen. There's a lot of misunderstanding of hydrogen in the public workplace and out in the general public.

So this need to demystify hydrogen is something that we've heard. In Phase 1 the PAG and the CBOSG meetings that we're having are meant to expand and educate information related to hydrogen. This process I think even early on we heard the CBOSG say, hey, it would be great if you brought in third-party vendors or some hydrogen 101 information so that we can better understand what hydrogen is about.

We've attempted to do that and I think this process has resulted in that. But just to it be clear, outreach will be expanded in future phases to ensure that disadvantaged communities and all levels of stakeholder are engaged.

So this is, again, the preliminary feasibility studies in Phase 1 that are going on. Phase 2 will be much more in depth, and Phase 3 will be much more in depth after that. So that's pretty much where we're at.

The second thematic thing that we have been hearing is pipeline would provide lowest cost pathway to deliver clean renewal hydrogen to meet demand expectations. Our initial findings support that Angeles Link is low cost method to bring clean renewable hydrogen to the LA basin.

The third thematic thing that we've been hearing is the cost effectiveness study doesn't justify the rate payer investment. Studies in the Phase 1 feasibility studies estimate levelized costs of delivered hydrogen via Angeles Link compared to other various alternatives. However, rate payer investment is not part of the Phase 1 study.

So there will be an opportunity to look at that in other phases, but Phase 1 does not get into the rate payer investment. That's not part of the ongoing scope of work.

And the fourth thematic thing we've been hearing is renewable hydrogen is expensive. Reasonable cost estimates are needed in the demand forecast calculations. Again, as part of our feasibility level studies in Phase 1 using levelized costs of energy framework to compare Angeles Link to other clean, renewable hydrogen alternatives and non-hydrogen alternatives is appropriate for this stage of the project. Again, we're not at the point in our analysis where that level of comparison is being done, but that will be done in the future.

So that kind of just gives you the big picture of what we've been hearing, how we're addressing those comments as we go forward. Again it's not a blow by blow. You get the quarterly reports which gives you the detailed list of comments as well as the detailed responses to those comments.

We felt like before we got into the group discussion today we should at least brig forward what we have been hearing over the course of the last year and a few months that we've been doing this. And now if you have any comments specifically -- if we could go to the next slide on Yuri's presentation we would welcome those comments.

But before we actually get into and specific comments I just want to reiterate some of the guiding principles we've talked about as a group to make sure that we're all paying attention to that. Please announce your name and speak directly into the microphone. We do have a court reporter that's documenting everything. We want to make sure we capture that. Be concise and focused on the discussion topics; right? We know that you have a lot of interests.

As Frank mentioned, Frank and Emily and Yuri have made themselves and will continue to make themselves available outside of these meetings for any detailed conversations you want to have about whatever it is you're concerned about. But these meetings are designed to cover specific topics. We have a lot of these meetings. They're happening every month and we cover all the different topics along the way.

But -- so if you could really focus your comments on the topics at hand that we're talking about. Please understand that verbal comments are not the only way to provide input. Feel free to type a chat. We are capturing that as well. If you want to send an email separately after the meeting, we're accepting that information. Written information is just as good as you verbally talking about that.

And then we just want to remind you to just be respectful, you know, of each other. Be again concise, direct about what we're talking about, and try not to have any personal attacks along the way. All right.

So with that, let's see if anyone has their hand raised online or if anyone in person. We have this tradition now you just turn your name card up in its end and I'll know that you want to speak so we'll do that in person. And then if you're online please just raise your hand and we can see any of your hands raised and we'll call on you in that way.

All right. Faith, you've raised yours first so we'll bring the microphone over to you.

MS. MYRA: So I did review the slides that you sent on this topic beforehand and in one of the slides -- I didn't catch it in the one that came out today, but it said, "comprehensive system-level electrification would require detailed load forecasting, power system dispatch modeling, and power flow studies and therefore is outside the scope of Phase 1"; correct?

MR. FREEDMAN: Correct.

MS. MYRA: But in the slide you come to the conclusion that electrification does not compare and solidify it has to be Angeles Link. How can the two of those coexist? I'm a little confused on that.

MR. FREEDMAN: Thank you. Fair question. The way to think about that is that the use-case analysis is the initial step of what needs to be analyzed and it also is something which is by its nature going to be conservative. And I'll try to explain why.

Use-case analysis looks at this from the end user standpoint. When we're asking if you're the truck driver, are you better off using the battery electric trucks or fuel cell trucks? And that's effectively -- I'm bringing mobility as an example.

On power generation, again, a different question, but the same approach. If you're a power plant operator, can we provide lower cost with hydrogen or with batteries.

Now what this analysis does not include is the costs of upgrading the grid of the State that will need to be incurred in order for the grid to do what we want it to do in the carbonized world as I'm sure you know the forecast are for the power demands to double, perhaps more than double depending upon the source. That will require capital investments which will incur additional costs.

So we internalize those cost but for now let's just say if the analysis from the end user standpoint suggests that for long distance, long haul heavy duty trucking the fuel cell is a superior option. It likely is going -- the superiority is going to increase once we analyze the cost of upgrading electric grid. So that's how these two fit together, so.

Does that make sense?

MS. MYRA: Yeah. So my follow-up question would be: If these are things we're saying we can't study quite yet and is outside the scope of Phase 1, what are the things that are outside the scope of Phase 1 for the Angeles Link as far as costs? Are we factoring in how much it's going to cost to get the resources to make the hydrogen?

Are we factoring in -- I know that you keep talking about how you're not production, but you also talk about how you're wholistically looking at this project. And to wholistically look at that project, you're to look at the whole. So what are the other costs that are not being studied in Phase 1 that are related to Angeles Link?

MR. FREEDMAN: Yeah, that's a good question. There is no cost component which is excluded from the chart that we talked about. Actually everything from production to transportation, storage and distribution is included in that. So I think that's part of the answer.

I think it's fair to say that the granularity of this analysis is going to increase as we go deeper into that in future phases, but in terms of categories, all the categories of hydrogen costs are included into the numbers.

MS. MYRA: So then in that case you do know who the production is, I would assume, if you do understand that those costs are included and you would then also understand what the cost per mile for the transmission, high points, might be. Are there reports that have recently come out that maybe I haven't had time to look at?

MR. FREEDMAN: I think that it's fair to say that the ARCHES process, which Joy was here and talked about that, is still underway. The negotiation with DOE is underway. Once that gets concluded I think we all will know significantly more about production --

MS. MYRA: So their might --

MR. FREEDMAN: I'm sorry?

MS. MYRA: So there might be more costs with production that we weren't able to put into Phase 1?

MR. FREEDMAN: I don't think there's any basis for drawing that conclusion. I think that what I'm saying is the work we have done is based on the analysis identical to what the developer does when they look at the cost of land, cost of equipment, put this all together, and do the analysis. It's also in line with what other agencies and sources suggest so there are no hidden costs that will be revealed later.

The precision of these estimates will increase.

MR. LOPEZ: And just to clarify one point: We didn't use a bottom up approach to come up with costs. Right? It's not like we had a list of all of the hydrogen production facilities in the State and use that as a basis for the cost. This was done top down.

MR. FREEDMAN: What we did is we looked at the availability of land. We combined this with assessments of equipment costs. These are not the costs -- we didn't go to any factories of electrolyzers and ask them for that.

What we did is take data from the industry, but we did this in a sense by putting these components together, coming up with a cost analysis which seems to be quite in line with what other studies have computed.

MS. MYRA: I would be interested to find out what the cost as a whole for rate payers and for us in general would be compared between the two. But I understand that's not what we're covering maybe right now in Phase 1.

MR. FREEDMAN: Yeah, the cost of repairs was outside the scope of this work. Let's be clear: There's a cost per kilogram of hydrogen that we have explored. What you're mentioning is for the future phases.

MR. BRITT: All right. Michael, I think I saw your card come up next. If you could pass the microphone. Start with your name and organization.

MR. BURNS: Thank you. Michael Burns with California Greenworks. This is a three-parter: So I'm wondering what SoCalGas's definition of environmental social justice is, how is that quantified, and was that used in the economic analysis?

MR. FREEDMAN: Let me go back to the chart which I think we have here. (Indiscernible). The environmental justice here was assessed as part of the State policy approach. We have not described numbers but parameters.

MR. LOPEZ: I'm sorry, Michael. Can you repeat your question one more time just to make sure we fully answered it?

MR. BURNS: Just SoCalGas's definition of environmental social justice, how do you guys quantify it? If using the State metrics and methodology, that answers the question. And then if that was taken into the economic analysis?

MR. LOPEZ: Okay. So I think that we received this question in a previous meeting too. So we use the CalEnviroScreen and the Federal EJScreen tool to identify environmental social justice -- or disadvantage communities. We use those tools.

The CalEnviroScreen that's the State's online database that helps identify disadvantaged communities. Some of this information I believe was released as part of the routing study and preliminary findings.

And we're also performing a desktop analysis of environmental social justice communities which we plan to present at our July workshop. And we'll be releasing several maps that identify those and include how we identified those communities as part of that study.

MR. BURNS: So under cost effectiveness is any environmental justice impact calculated or is it simply monetary?

MR. LOPEZ: For the purpose of this study, economic environmental justice was not a criteria. We're looking at just purely the cost effectiveness from a financial perspective or economic perspective for this particular study. But we do factor in environmental social justice as part of other analyses.

MR. FREEDMAN: Yeah, the dependancy here was the reverse if you will because what we identified as the preferred alternatives, we then carried them forward for the analysis from the environmental social justice standpoint.

MR. BRITT: All right. Roy, I think you're up next. If you could grab the microphone -- the purple one right next to you.

MR. VAN DER HOEK: Yes, my name is Roy -- Robert Young Van der Hoek, Defend Ballona Wetlands.

I'm not going to be able to ask everything I want to ask here because there just isn't the time.

Yuri is smiling. I can see that because he knows he presented a lot of information.

So Faith had just mentioned a few moments ago "wholistic" and Michael had mentioned quantifying and so cost effectiveness is the topic or one of the topics versus just cost. But I don't want to talk about just costs, which is the direct cost. I want to talk about cost effectiveness and I want to the understand -- I want to know more about quantification and wholistic.

And I know there are terms up there and lots of experts that have evaluated the genuine ability of cost effectiveness. You can do a very thorough one that again would be wholistic and look at all the various costs even the ones that can almost not be imagined like you can't predict when a truck carrying hydrogen has a fire or blows up, has an accident. These unpredictable things.

Batteries, if we look at that, where are the batteries? Not for the hydrogen, but where are the batteries initially built? Where there's pollution to a watershed adding that cost in.

The stress of mental and psychology on Indigenous peoples and peoples of lower income who are not worried -- you know, when you look at things genuinely you find out a lot more things than are there. And I know there are terms out there for the comprehensiveness of cost effectiveness.

A metaphor I'll wrap up with is when somebody is -- the cost effectiveness of writing a report and you count the hours of the writer and, as an example, but there are all these kinds of invisible costs that are lower down that often are not counted.

And I think by mentioning -- so one other thing:

Sequestering carbon dioxide under the cost effectiveness so that's a great thing to sequester the carbon dioxide sine we have so much in our atmosphere and increasing all the time. But there's also to really get down to the nitty gritty of it -- I hate to bring up phrases like that because not everybody even understands because it's generational -- but I'm just really worried about getting to the -- having a really genuine, honest, truthful cost effectiveness that then could also be presented to the public that quantifies things.

And I'm glad Michael mentioned quantification because how do you -- one thing you had was industrial E, which could kill all the tress in a region, for example. How do you quantify the value of a tree, the value of the wellbeing of a Native American Indigenous person who is worried about their land rights.

We do a land acknowledgement at the beginning of this session but have we really covered -- I'm just trying to be very -- it's kind of a philosophy involved in all this thinking too. To have honesty right at the front.

Thank you.

MR. FREEDMAN: Thank you for the question. I think you're absolutely right in that there's enormous complexity in the fact that various aspects of energy assets, energy projects are intertwined in them and economics is only one of them. There's no doubt about it.

Frankly that's why we embarked on the study within Phase 1 where we have 16 studies, which is a significant list. But that's been our attempt to capture all these various facets of the issue. In our thinking it is better to make sure we treat each of them carefully and separately and then bring it together.

So the way we approach that is that with the cost effectiveness just on economics, but then take the ones which are economic and bring them further for the environmental social justice analysis, for the safety analysis. (Indiscernible). But we're more than open to other ideas on how to approach this methodically. So we welcome your thought about this approach.

Again, I think we are trying to get to the same place to capture that complexity, make sure that we are going to account for all the factors that have developed, and all the pathways. So thank you for your question.

MR. BRITT: And, Yuri, just to follow up on that. Obviously in the Phase 1 feasibility studies we don't have a defined corridor yet. So that makes all of our studies a little bit more challenging in the sense that we don't have an actual alignment yet to define some of the quantifiable things that we could quantify if we did have that; right? If future phases we will have that.

MR. FREEDMAN: I think that's right. And I think the key is we are reducing the uncertainty as we go gradually because that's the nature of any process. And that's why we start wide, casting a very wide net with those 16 studies, and then zero in on alternatives that by totality of their attributes seem to be more attractive and delve deeper into that, yeah.

MR. BRITT: All right. I'm going to switch to a couple online and then we'll come back to the people in person.

Lauren Gallagher you raised your hand early on in the process. I want to give you the opportunity. If you could unmute your microphone. We'll do the same and we should be able to hear you.

Please introduce yourself.

MS. GALLAGHER: Hi, all. I'm Lauren Gallagher. I'm with CBE today. Thank you for pivoting to Zoom. I apologize for the split format. I want to echo what Faith, Roy, and Michael have asked. Those are very valuable questions. I would like to request initially that the data regarding cost to rate payer or cost per mile or any other information included in the cost effectiveness analysis be provided when you complete

Options & Alternatives study as presented.

I also have a couple questions. It's really three so I apologize I'm going to present them in one so maybe we can circle back if we need to. The first one is that I notice there's some differences between the presentation presented today and the presentation that was provided in May. I'd like to know why these presentations were different.

Which leads me to my second question. Today we talked a lot about cost effectiveness in particular there was new information provided that was not included in the May study and a particular focus on cost effectiveness that was not represented in the more criteria approach that the presentation provided in May demonstrated.

So I'd like to know how this criteria is being weighed and if any criteria in particular cost effectiveness is being given a greater weight than the other criteria.

And then my final question is just that -- it's not really a question. It's more of a request. Like Michael I'm deeply concerned about how environment justice is being considered in this criteria analysis and I'd really implore you to develop an environmental justice criteria that adequately weighs environmental justice concerns when looking at options and alternatives for this project, especially at this early phase.

Thank you. I'll pass it back to the room.

MR. BRITT: Thank you. Yuri or Frank, do you have anything?

MR. LOPEZ: Yeah. I'll just say you know we're not doing a rate payer analysis at this point because we don't have a project that we're proposing. We're doing a high level cost estimate. We are going to provide a range of costs from our production study which is -- will be coming out soon so you'll have that information.

In terms of the information that we presented in May, I don't believe we presented this information. We did release it as preliminary findings and used that deck as the basis for this. We did combine cost effectiveness and project options and alternatives, but the information is the same. If there's a particular area though that you want to point to that you think is different, please bring that to our attention. We're happy to address that.

I agree with you about ESJ. ESJ we're going to get into in greater detail in our July workshop. There are multiple work streams on that one. As I mentioned, we are doing a desktop analysis; right? We identified some of the tools that we're using to identify those communities, but we heard loud and clear that we shouldn't rely solely on those.

So we're developing an ESJ plan which we plan to present in the near future. We're also open to suggestions. If you have better tools that we can use or strategies, by all means please send those to us and we'll consider them as part of our ESJ outreach.

And just to reiterate, this isn't the only -- you know, cost effectiveness isn't the only thing that we're going to be looking at whether or not to advance this project. As Yuri mentioned, there's multiple feasibility studies and factors we'll consider. This is just one data point that we're looking at that we're required to assess as part of our CPCU direction.

Did I cover everything? Anything else I missed? There are a couple questions and comments.

But Lauren, just back to you. Did I address everything that you mentioned first to make sure it's responsive?

MR. BRITT: Emily had something.

MS. GRANT: Yeah, I was going to say I'll add to Lauren's question about the differences between what we released in May and what she heard today -- what we all heard today. In May we released preliminary findings. Today's a preview of the draft report. So those were two separate steps. So that was Step 3, information. And now this is a preview of Step 4.

MR. BRITT: All right. We also got a chat from Thelmy --

MR. LOPEZ: Chester, one thing. Emily mentioned it's a preview of what's to come in Step 4, but Step 4 will actually be a draft study. It will not be presented in this format. We're presenting the information in PowerPoint format, but Step 4 is an actual detailed in a Word doc with all the underlying information so you'll have all that information to comment on it. And you'll have an opportunity to comment on that as well, four weeks.

MR. BRITT: Yep.

Thelmy Alvarez online. You chatted, "going back to the previous slide, clearly each column will have an extensive analysis worth studying, but why exclude the environmental impacts from color categorization?

So I think the question, Yuri or Frank, is why is the environmental column blanked out?

MR. FREEDMAN: I think that goes -- I may not be able to give a full complete answer, but that goes to the nature of the relationship within the studies. This is not an attempt to black anything out. It simply the interface of various study that's captured here.

MR. LOPEZ: Jessica Foley is going to present on environmental right after this.

But do you want to just address it now? Or do you want to hold off until then? You want to just do a quick sneak preview of what's to come and then there's still a question to address when we get to that analysis?

MR. BRITT: And Jessica, if you could just introduce yourself for the court reporter.

MS. FOLEY: Good morning. Jessica Foley. Mic check you can hear me? Great. Correct. So we'll be talking about the environmental analysis a little bit later this morning and can get into some of the questions you may have specific to some of the areas of consideration.

I think as you've heard several folks say today that the environmental analysis is at a feasibility level. We'll be getting into that process later down the road when we file applications. So that's California Equality Act and a national policy as well. So we'll be talking about those later, but happy to take questions when we get to that point in the presentation.

I'll turn it back over to Yuri.

MR. BRITT: Thanks, Jessica.

Andrea Vega, I think you're up next.

MS. VEGA: Andrea Vega with Food and Water Watch.

Now I know that rate payer impact was not analyzed and there's no plans to analyze apparently during Phase 1, which I think is a huge and strange oversight and omission. Which is why I want to ask why if you're not going to be looking at rate payer impact at this phase, why is it that SoCalGas sent a notice earlier this year to rate payers to request an increase -- rate payer increase request to the California Public Utilities Commission for hydrogen blending demonstration projects? It says application No. A22-09-006 in which SoCalGas is requesting a total of 80.4 million in forecasted revenue requirements.

So why are you attempting to raise rates for customers to cover this cost for hydrogen projects, but you're not taking this into account for Phase 1?

MR. LOPEZ: Andrea, I'm aware of that notice that went out. I think you might be conflating our application for our hydrogen demonstration project that we filed with other utilities not with Angeles Link, which are two different projects. So I'm happy to, on a break, talk to you about the hydrogen blending demonstration which is not related to Angeles Link. We have not sent out a notice for Angeles Link.

But I'm actually going to ask for help on this one. Shirley, we are required to send out these notices even though it is for a different project; right? We are required to send out notices when there are rate payer impacts with proceedings? She'll know the details because she has more regulatory background than I do.

MS. IRRAZI: Yes. This is Shirley Irrazi, SoCalGas. You were spot on. So the hydrogen blending application is a separate project from the Angeles Link project. Angeles Link is a dedicated hydrogen pipeline project that would be including all hydrogen pipeline. The blending application is a demonstration or pilot projects that were separately noticed to customers.

Anytime you request a project approval or funding from the CPUC, you have to notice the rate payers associated with that or what that potential impact may be. That's the notice that you're referring to.

MR. BRITT: All right. I think Marcia you're up next.

MS. HANSCOM: Macia Hanscom, Ballona Wetlands Institute. My question relates to how I kept seeing in your charts, the last one you had up, was similar to some of the others about electrification versus Angeles Link. So my question is, how are you including what's happening daily in terms of the renewable energy sources of wind, solar, water all those things that have been in the pipeline for a while.

And I would refer you to Mark Jacobson from Stanford who daily is posting things on Twitter about -- like for instance, just a few hours ago he posted, "records keep falling." This is just a short Tweet.

"Records keep falling. Batteries discharge 29.52 gigawatts of electricity to California's grid on Monday June 17th. A new record. Also the 92nd of 103 days in which wind, water, solar exceeded 100 percent of demand on the grid."

So how are you including this -- every day we're breaking records in terms of the genuine renewables that have been in the pipeline for a while -- how are you including that in the economic analysis here? And are you? And if not, why not? And how do we -- you know in other words, you've said every time here your conclusion is that Angeles Link appears to be superior and yet we're actually showing how fast we can get up to speed because all of this has been in pipeline.

So how are you including that in cost effectiveness?

MR. FREEDMAN: Thank you for the question, Marcia. I would say -- start by saying that we are far from alone in seeing hydrogen as indispensable element of carbon neutrality. That vision is now at the State level, which is why State is supporting the ARCHES through the Federal funds. It is now shared by the California Energy Commission and by (indiscernible) boards. All these agencies have come to the conclusion that hydrogen is key to reaching the State's goals. As far as we are concerned we are looking at this on the what I would say is the use-case basis.

For example, the significant debate whether or not hydrogen is going to have a roll in light duty sector because of large penetration of battery vehicles in light duty sector. However, in the heavy duty sector because of physics of carrying high heavy payloads over long distances, it's virtual consensus that fuel cell electric mobility is going to be -- that's how we approach as we look sector by sector.

As you can see we look at this from power generation, mobility for industrial use. So it has to be granular analysis and this is a significant body of work which allowed the State to go forward in the State of California to conclude hydrogen is going to play a large roll.

MS. HANSCOM: Okay. Let's just take the power generation, which is your first one there. I mean we just passed the harbor power generation plant on the way in today and I know that's one of the ones you're talking about using this changing from natural gas to natural gas plus hydrogen. So in all of these other power plants, how is the cost effectiveness in that though how are the other renewables that are showing up in big ways right now, how are you integrating that into the cost effectiveness? I mean that one -- maybe you're right. Maybe the big trucking and generators maybe that is one place the hydrogen is going to work better.

But in all of your charts it shows Angeles Link including power generation is there and that just doesn't seem to me given all this new information that's coming out daily for the renewables, how are you including that?

And I'm just asking that you do include it because I think you're not -- of course the California State Government is for this. They're getting a billion plus dollars from Federal Government. I mean these are political decisions and monetary decisions, not cost effectiveness decisions. And that's where I'm asking you to tell us how you're going to include that.

MR. FREEDMAN: I would say that the view on hydrogen's roll in power generation is very eloquently and convincingly expressed by Los Angeles Department of Water and Power. As you may know they made a decision to convert the plant in Yuka from full to mix of hydrogen/natural gas. It's intermountain power plant. That plant is going to start operating next year. So it is not future. It's pretty much now.

They went through analysis of options and alternative, which was very, very deep. And if they could find other solutions, they would deploy them. They ended up determining that hydrogen is their preferred solution for providing its resiliency when the City of Los Angeles needs that. Then they replicated this approach and did the same analysis for scattergood. And as you know the City Council took a vote on that and that project is moving forward.

The questions you're asking is the right one. And that question has been asked by LADWP and answered by them in a very conclusive fashion. It's consistent in what we see in terms of the reliability and resiliency because let's just say the more we believe in climate change, the more we should assume that the weather events will become more prolonged and more severe. And it's those multi-day events which require the molecular application because batteries cannot store large amounts of energy for long periods of time. That's ultimately what undermines the need for molecules for hydrogen power generation.

And, again, it's a deep topic. Happy to continue the conversation with you.

MS. HANSCOM: It's still using 70 percent methane which is now -- the science is now saying it's 25 percent more of a pollutant to our greenhouse gasses than CO2. This -- I mean, California Secretary of Energy just said that. So if we're still using that much methane gas, it's not -- you know to blend or mix with the hydrogen you're still contributing to climate change in a big way.

MR. FREEDMAN: The intent of power generation facilities in California to run pure clean renewable hydrogen by 2045 to reach carbon neutrality.

MS. HANSCOM: I understand that -- are you saying --

MR. LOPEZ: Hey, can we take a break for a second --

MS. HANSCOM: Are you saying that by 2045 you now are pretty sure that it won't be 70 percent methane? That it will be hundred percent methane -- I mean hydrogen?

MR. FREEDMAN: That is indeed the plan that power generators have articulated, yes.

MS. HANSCOM: And who's -- what science is saying that?

MR. LOPEZ: Marcia, just to reiterate: We're not proposing to blend hydrogen with natural gasses as part of Angeles Link. We committed to 100 percent clean, renewable hydrogen source from renewables.

But I want to just take a pause for a second because these are really good questions and I don't want to cut off conversation but we're 30 minutes behind and I want to make sure we get to our other speaker. If you don't mind, can we just take a five-minute break?

And Yuri, I know you have a flight to catch but do mind sticking around for a few minutes for those of you that still have your cards up maybe you can talk to Yuri before he heads out.

And if we still don't get an opportunity to address your questions, we'll stick around today. You know, we're always available to meet after this meeting to address any additional questions plus we have the draft study coming out, which we'll take comments on.

If you want we can continue taking question, we're just going to have to work through lunch because we're 30 minutes behind so.

How does -- and there's other people here so I want to make sure --

MS. MARQUEZ: Yeah, we're planning to take a five-minute break and then go into Jessica's presentation. But if you want to go through these last questions and then --

MR. LOPEZ: But to your point, I understand your question so if you want to send us questions, you know we're going to respond formally in writing; right? So if you want to send us questions in writing we're obligated to respond as part of our quarterly report.

(No audible response.)

No, we just issued our first quarterly report. we're working on our second quarterly report so we're catching up. Our commitment is to be timely with our responses.

Okay. So we'll take five minutes?

MS. MARQUEZ: Yeah. Take five minutes and grab some lunch. Oh, not yet. We'll take a break, go to Jessica, and work through lunch. Thanks, everyone. See you in five.

(Recess.)

MR. BRITT: All right. If we could come back to our seats. Try to stay on schedule. And by the way lunch did get delivered while we were on break. So if you want to grab your lunch real quick we can just work through lunch.

All right. We're going to get started. Hopefully you had a chance to have a break and grab something to eat.

We're going to move on to Jessica Foley, the Regulatory Strategy and Financial Controls Manager for Angles Link. She's going to give a presentation on environmental analysis.

But before we turn it over to her, I'm going to turn it back to Frank who wanted to make a clarification from our previous conversation before we transition to Jessica.

MR. LOPEZ: Thank you, Chester. I just wanted to correct something that I incorrectly stated earlier that my colleague brought to my attention. So I mentioned earlier that we would be releasing a high-level cost estimate for Angeles Link as part of our production study. That's incorrect. We're actually going to be releasing that as part of our pipeline and sizing study. So I just wanted to correct the record on that.

MR. BRITT: All right. Jessica, I'll turn it over to you.

PRELIMINARY FINDINGS: ENVIRONMENTAL ANALYSIS

MS. FOLEY: Make sure you can hear me all right.

So thank you for the introduction. Jessica Foley, I'll be here today to talk about our environment analysis and so just want to say thank you all for being here and for the great conversation we're already having. I think I have the slide clicker here.

So definitely want to talk here today -- and I think you heard mentioned by Frank earlier that the preliminary findings for our environmental and environmental social justice study were released and had both the environmental analysis as well as the social justice in one findings deck for awareness.

We have moved forward with the environmental justice component being considered in its own separate stand-alone environmental justice plan that will be discussed in July. So I just want to be clear we'll have a great opportunity to talk a lot more specifically about that topic.

Today the focus is on the environmental analysis which is more focusing on the construction, operations, and maintenance of Angeles Link.

So this is touching on a preliminary finding and what this study is intended to do is take a high-level evaluation of the construction, operation, and maintenance of Angeles Link as well as alternatives to the project.

So you heard Yuri earlier today talk about several alternatives. I'll get into a little more detail about how those are considered in our environmental analysis. One thing to point out is that this environmental analysis is at a feasibility level of review at this time. So we are not at a California environmental equality act or CEQA or national environmental policy act or NEPA level of review at this time. So again, feasibility level.

We also started with the 1300 miles that were originally contemplated as part of our conceptual pipeline alignment. That math is available in the living library. You're probably familiar with it, but it's a green pipeline alignment map. So that's the 1300 miles we originally started with. I do want to emphasize that is not what Angeles Link is going to be. It's not

1300 miles. That was just the universe we started with. That will continue to be refined as we continue to go forward with our Phase 1 process and future phases of the project.

So relationship to the other studies. I think that you just heard me mention the conceptual pipeline map. So that was heavily discussed in our routing study. Our routing study will also be coming out in the near future. It was discussed in our routing study findings and also in our preliminary findings for the environmental analysis. You can see some of the alignments that we have looked at and are discussed further in the actual study when it comes out.

So our study approach, as I mentioned, takes into consideration a larger universe that will ultimately be widdled down to a preferred route or routes associated with Angeles Link. We did look at and make assumptions that were based on publicly available databases at this time. So there was not field work conducted as part of this. That is something we would absolutely expect to do in future phases of the project. But, again, it's publically available datasets.

We do make the assumption that the pipeline would be located underground and at previously disturbed areas to the extent feasible, so roads and other right of way.

We also looked at the potential impacts of a corridor within a hundred feet from either side of the pipeline. So we looked at a presumed pipeline route and took a corridor outside of that. And we did look at certain topic areas that were at this time topics we think we can more readily evaluate because we have a little bit more information about them.

So certain topic areas would be very difficult at this feasibility level. So for example if you wanted to look at transportation and circulation, those topics would need a much more defined project. You'd need much more defined staging areas, and we will get to that in that point in time. But for purposes of this analysis we had to look at certain topics areas that we could more readily define.

And these topic areas for those of you who are familiar with CEQA will look familiar. It is not entirely based on the CEQA analysis. We did use the CEQA Appendix G checklist as a general benchmark to help define the study areas. So that is for those of you who may be unfamiliar with CEQA, Appendix G is kind of the gold star template that's used when you do an environmental analysis in California. There's, I think, 21 topic areas that are normally looked at in a CEQA analysis. Again, for this level of where we're at with the feasibility study, we had to widdle down those topic areas so that we could more readily define based on what we know or can assume about a pipeline alignment at this time.

So those topic areas were air quality, greenhouse gas emissions, biological resources, energy, hazards, HAZMAT materials, hydrology water quality, land use planning, and environment justice, which, again, we'll talk more about in July. We did also look at Tribal and cultural resources as well.

And then another assumption is that we would construct the pipeline potentially in stages so that not all of the pipeline would be constructed all at one point in time.

Next one. Okay. So looking at our preliminary findings we did look at the variety of CEQA/NEPA environmental laws that we could look at related to air quality, Tribal/cultural and at this time at a high level we think we can construct a pipeline like Angeles Link consistent with environmental laws and public policies.

We also looked at the -- as I mentioned -- the pipeline routes at this time based on the level of information we can make reasonable assumptions about. But those will continue to be refined as we move forward in future phases. And we would anticipate at such time when we file an application with California Public Utilities

Commission via the certificate of public convenience and necessity and proponents of environmental assessment, all of those will be taken into consideration by the CPUC and other entities and then looking at the CEQA and NEPA process that would look in detail at the potential impacts associated with the project.

All right. So as a mentioned the analysis at this time takes into account Angeles Link and the eight alternatives that Yuri mention earlier today. And it does look at those topic areas I mentioned: Air quality through land use planning, water, hydrology. The study looks at it from the standpoint given the level of detail we know now as whether we think there could be a potential impact or no impact. That also takes into account at this point in time we're not making any conclusions about the level of significance in a particular resource area.

So again, it's impact or no impact. Looking at things from the standpoint as well is that we would not necessarily be able to account for benefits of particular options as well. So in looking at, say for example, the gaseous trucking or any of these other types of alternatives if you're looking at vehicle miles travelled or if you're looking at localized hub how that would equate to potential benefits to the basin. Are the benefits more significant than other options, but at this point would be outside the scope of the study.

And again, the full detailed analysis would happen at such point in time as we get to the CEQA/NEPA process which would be several months down the road when we get to a point where we have a more defined alignment that we could then submit an application.

I just want to do a mic check. Is my sound quality coming through okay?

(No audible response.)

MS. FOLEY: Okay. Perfect. Just wasn't sure clear (indiscernible).

So with that I think I can turn it over to Chester for any similar high-level findings and we can certainly answer many questions because I imagine you may have some.

MR. BRITT: All right. Thank you, Jessica.

If we could go to the next slide. Similar to what we talked about earlier there's the four steps that were in that arrow chart that Frank covered. We covered the scoping, technical approach, preliminary findings and now we're going to be getting closer to the draft document that we're going to be releasing.

As part of Jessica's presentation we want to take comments and questions just like we did for the last one that Yuri presented on. But before we do that, we want to just give you again the high-level thematic comments that we've heard to date regarding this topic.

And also a point of clarification, which I think the thematic comment that you see on the left kind of helps us do that. "The ESJ considerations are a priority and must encompass more than projected impacts forecasted with desktop tools."

You heard Frank mention that we are going to -- we did separate out the ESJ discussion and we'll be having a separate meeting in July about that specifically so that we can give it its just due and really the attention it deserves along with some other considerations that we've heard from you as part of that process. So we will be doing that.

We do understand that ESJ's analysis will not only involve desktop tools but also feedback that we've gotten from CBOSG and the communities regionally as appropriate in subsequent phases. So as we get more narrow in defining the project, the corridors will get more defined as well as the communities, and we will obviously bring along those communities into the process and integrate them into our discussion.

Our overall July workshop will be tailored to address ESJ in particular.

So with that I'm going to open it up to any questions or comments or -- yeah, comments that any of you have related to what Jessica presented.

So, Marcia, go ahead.

MS. HANSCOM: I know that -- I think you're still looking at the pathways that you have that SoCalGas already has pipelines in. I think that's still what you're saying. And when those pipelines were built, that was before a lot of the environmental laws came into being. So I'm wondering -- one of those is the coastal act. And I think from the maps we saw, some of that does come into the coastal zone.

So you will be doing analysis for the coastal act as well?

MS. FOLEY: That's a great question, Marcia. So as the pipeline alignments are further refined we'll definitely need to look at the applicability and if it is in the coastal zone and there is a coastal permitting trigger -- because as I'm sure you're well versed with your experience with the wetlands -- certain areas of the coastal zone are retained by the coastal commission for their permitting authority and certain are transferred to the local entity.

So I think it would depend on what ultimately that pipeline alignment would look like and then necessarily if there are coastal development permit obligations we would work through the coastal commission or that local agency.

MR. BRITT: Thank you, Marcia.

Roy, I think you're up.

You're on now.

MR. VAN DER HOEK: Roy, Robert Young Van der Hoek, Defend Ballona Wetlands.

Thank you, Jessica, and also Chester for going along side that.

As you were mentioning CEQA I was writing down the phrase -- I put my parentheses around it -- about the pipelines will be underground. And here's what I noticed, I put "to the extent feasible." And I go, oh, that's typical CEQA. And that's a loophole because I think there is a way to get all the pipelines to wherever we need to go without having to do something different even if it costs more money to go through to make it safe you can't really say if there's a cost or not. So there's that.

And then a little bit as we were wrapping up with our last -- section and on the break before our lunch I was talking to Chester and I brought up a metaphor story of one of Dr. Seuss's last books, The Lorax. And the concept of biggering and biggering and biggering. You know that we're big and getting bigger, biggering. And the Truffula Tree is still being cut down for the economy and polluting the water.

Then the birds leave and then all of a sudden there's just one person left to tell the story, the Wexler who lives in a tree and talks through a megaphone. He's isolated and this group -- a little boy and another person talk to him and then it's realized that every time a tree is cut down the Lorax comes out of the tree and says, "I speak for nature."

And when we -- this comes back to the concept of heavy lifting, and Yuri brought up needing to have -- and the idea that things that are big, heavy-lifting things and then being here meeting today with the container ships with five containers and we all know recently the Suez Canal had one of these container ships get stuck and then we had a container ship hit a column in the bridge in Maryland harbor that then, you know, caused this expensive damage and it's all --

Just before the meeting started I talked to a union from the Historical Birth 181 project his family and them working and how everybody has accounting in detail for all the profit that can be made and cutting costs.

This all comes around to me now in the big picture that we have to ask under a cost benefit analysis is biggering, is going faster -- we want to go to fast food restaurants get our food faster. We're a throw away society on everything. We're trying to embrace recycling for decades now, but we're still out of control and filling up landfills you know more waste, more waste.

Do we need to have under a philosophy and psychology social analysis alongside social justice -- and even the message coming to us from Native American peoples, you know, that this is our land and our home -- do we need to -- the profit -- the idea of making money and that being one of the goals, do we have to do an even more basic whole new thinking about, you know, if maybe we don't justify hydrogen because we need some heavy-lifting things.

Maybe nothing should be heavy lifting anymore. We should subdivide it into smaller sections so you don't have to do any kind of heavy-lifting tucks or other machinery and slow -- and I know that adds cost, but it slows down and will make the environment and help us with climate change and all the other concerns that the next generations are all thinking about.

So I guess it's kind of a comment. A little bit of a question.

MS. FOLEY: Could I follow up with just a quick -- and I appreciate your Lorax reference. I am the Lorax. I speak for the trees. I speak for the -- I read that to my kids and at one point could probably quote that word for word, but I digress.

Couple of things on your point about waste management. I just wanted to touch on that. I think it's a CEQA point of topic under utilities and service systems. So I think that's a good point that as you move forward with any project you would need to be looking at waste management and how -- especially now with more recycling goals how that can be taken into consideration on how that can help reduce any kind of byproduct from a construction project not just with Angeles Link but with any type of construction project.

But I did want to touch on you had mentioned something about underground construction and you had a thought about underground -- how to construct something. Did I understand you correctly? I just wanted to make sure I heard you. Because I would be very interested to understand if you had a broader methodology type that we could take into consideration.

MR. VAN DER HOKE: I get the picture having worked for the US Department of Agriculture and the National Forest Service, and I also worked for the Bureau of Land Management in the Department of Interior. Both of those agencies think about multiple resources and they thing about easy permitting for pipeline routes in our deserts.

The Federal Agency of Land Management is trying to green light public lands for solar panels and we're going down the path of these -- when you have a pipeline and you want to go to a new place, it's sometimes thought to be cheaper to go across the public land because the Federal Government gives a lower price to go through the forest or the desert with the pipeline. And it's more expensive if you run the pipeline along an existing freeway and burying it.

And way back at the beginning of this -- not today. Several meetings back. I brought up even the idea of maybe we don't even want to bury pipelines. Maybe we want them all exposed above the surface because that's actually the cheapest way to build them rather than burying them. If you eliminate all the other things than just the economic thinking having it above ground so you don't have to use any money digging or inspection. You can readily inspect any pipeline that's above the ground, but there's this concern about the visibility to the public, vandalism of them. Does the public asks questions of critical thinking when they see pipelines visible instead of buried. Out of sight, out of mind. But If it's visible, people wonder why is it so close to my house or a road that I drive. But these are under the cost-benefit analysis these are all questions of we want the public to be -- that's why we're here today and you as well -- society, people are wanting to know more about questions to our safety, our health, and linking it to the environment. And everybody is untrained academically in a lot of sciences and I'm still even saying I don't want to be a scientist. I want to be a student to still be learning it. Which is why I just took an astronomy class because I never took one in my university training. And it's just been mind blowing to think about, you know, we are on a planet and we are -- it is Earth, and it's our home and we're out of -- sort of out of control.

And I just switched off into philosophy but it's connected to the -- Jessica, you specifically asked me about furthering that. Sorry.

MR. BRITT: No worries. We do want to keep on subject if we can. And I digress as well.

But, Faith, you had your card up so go ahead.

MS. MYRA: Yeah. Mine should be pretty brief. I just have a request so I have noticed that the maps of the pipelines have gotten, you know, slowly a little more detailed over time. I saw in the last iteration that there's some EnviroScreen data has been added.

What I think a lot of people are asking for, for example, I work for communities. I'm here today representing my community. I need a map I can zoom into and see what communities it's going through. I need a very detailed map. So that's what I'm asking for when I'm giving back feedback. I think that's what a lot of other people are asking for.

So that's the request I have that you could share a much more detailed map that I can zoom into communities, see where these pipelines are going to be going through, and what communities could potentially be affected. I appreciate the other layers that have been added, but doesn't help if I can't see more detail, so.

MR. LOPEZ: I hear you and we will be releasing more detail as part of the routing study.

MS. MYRA: Will that be before the July meeting where we're going to be talking about environmental justice?

MR. LOPEZ: Yes. I think we'll be releasing the draft study prior I think that's -- I don't remember the specific dates, but --

MS. MYRA: I guess my request would be if we could have a more detailed map we could zoom into before that meeting so we could have a more meaningful discussion, I would appreciate it.

MR. LOPEZ: Okay. Thank you.

MR. BRITT: All right. Kenta?

MR. ESTRADA-DARLEY: Thank you. Kenta from Coalition for Responsible Community Development.

So one, just wanted to recognize that the ESJ component being separate is definitely important and you know that's an extremely important part of the discussion for everyone. It being separate from the EJ analysis makes a lot of sense, at least in my mind. And as that process moves along the ESJ component should we expect more groups to become a part of this group as far as the impacted communities? Because I see the feedback from impacted communities is part of that process as we get more specific on the pipeline and you know that would be an important part of this. So just curious about that.

And I had a question around the analysis. I think we can all kind of understand what the construction part looks like or potentially looks like depending on whether it's new pipeline or using existing pipeline.

But what is the operation and maintenance piece look like? Do you mind speaking to that a little bit and just giving us a layman's idea of what that part looks like.

MS. FOLEY: Let me -- so there's a couple pieces there I'd like to respond to. Thank you for your question.

So you made a comment about pipelines. I just want to be clear when we're talking about Angeles Link it will be it's own pipeline that would potentially align with some of our existing pipeline right of ways, but it's not this -- we're not co-mingling the Angeles Link pipeline with the other pipeline. There will be two separate pipeline. So I want to be clear about that, so.

From the operations and maintenance standpoint, we do have our pipeline study that's coming out that will be talking about some of the pipeline parameters. We have our safety study that's also going to be looking longer term at how we're going to be managing those pipeline assets.

And to be totally candid, I am not an operational expert on pipelines. I have an environmental background. So I can speak to looking at how the air quality emissions would be looked at and any infrastructure that would be associated with that. But I would defer to our safety experts and our operational experts for any of the more detailed questions.

So I would please encourage you. We will take that comment back. And if you would like to submit a written comment as well, we can get back to you on that as well.

MR. BRITT: All right. We're gong to go to Andrea and then one we have one comment online we'll take and then we're going to keep moving because we have a full agenda and we want to try to stay in track.

So Andrea, I think you're next.

If you could pass the microphone down to her that would be great. Thank you.

MS. VEGA: Hi, Andrea Vega with Food and Water Watch.

So it was mentioned that the pipeline would not be 1300 miles. So just for a point of clarification, currently what is the mile estimate for this?

MS. FOLEY: Thank you for your question. As you mentioned, we did look at a universe of about 1300 and we're continuing to refine that. At this point in time we think it will be around 450 miles, but that could change depending on future routing alignments, depending on input from stakeholders, there's a myriad of different variables that could change that specific distance.

MR. BRITT: All right.

I'm going to go to a comment that was typed into the chat by Enrique. It says, "we have discussed repeatedly the importance of a revisionist approach to the history of environment injustice and toxic hot spots in southeast LA, south Los Angeles, and Wilmington to name a few. In the eight alternatives and the impacts, no impact being proposed, how will the cumulative impact of an adverse impact largest in communities of color that have historically targeted by multiple sources of -- I don't have my glasses on -- stationery and mobile sources of population be factored for when it comes to make decisions about routing and pipelines?"

MR. LOPEZ: That's a really good question. If you don't mind, I'd think I'd like to hold off on responding to this and address it at our July workshop when we'll have a more in-depth conversation about ESJ. I think it's more appropriate to tackle at that time.

MR. BRITT: Okay. And I think we have one more chat if I'm not mistaken. Was there one more? No, we're good?

Rashad, I think you had your hand up.

MR. LOPEZ: Hey, but I just want to acknowledge from Enrique I'm not forgetting about his comment. It's a very good one.

MR. BRITT: Exactly.

MR. LOPEZ: Very insightful. I'm making a note and I'll be sure to bring this up when we have that conversation.

MS. MARQUEZ: And this question is recorded.

MR. LOPEZ: Yes, thank you.

MR. RUCKER-TRAPP: No, my question was answered from my friend here. Also would just like to piggyback on -- I can't see. The one in the middle. Next to you. There we go.

I wanted to just piggyback on her comment about having a more interactive map to where you can definitely see exactly where the proposed pipeline is going. It would definitely help for discussion and you know do hope that as part of the construction we do keep the pipes underground seem as nowadays we have brave people in the world that are now stealing hydrates and all that stuff, so. That was pretty much what my comment was.

MR. BRITT: All right. So we're now going to transition back to Alma, and she's going to present the panels.

But before I do, I just want to reiterate what Frank had mentioned, which is we're going to have the opportunity for you guys to get all the draft reports now coming out and please take the time to look at those and provide any written comments that you have. Very, very important. We've been talking about this for a long time now and they're finally going to be coming to you in detail. So just be aware of that.

And if you have any questions or follow up when you get those reports or something you don't understand, you always have the opportunity to call Emily or Frank or myself or Alma and ask questions and we can point you in the right direction.

MR. LOPEZ: And just a friendly reminder: The preliminary findings for environmental and ESJ analysis is out for comment. The comment period closes on the 25th. So if on the way home something comes to light that you wish you would have asked, you can still submit comments on it up until then.

MR. BRITT: All right. I'll turn it back to Alma.

MS. MARQUEZ: Okay. I think Robert and Veronica got comfortable back there. We apologize for being 30 minutes behind schedule. Thank you for making the time out of your very busy schedules to be here.

PANEL: BEST PRACTICES & CASE STUDIES: COMMUNITY BENEFITS PLANNING

MS. MARQUES: It brings me great pleasure to introduce the following distinguished panelists: Robert Sainz and Veronica Soto.

I'm going to start with Robert. Robert is the President and Executive Director of New Ways to Work a nonprofit focusing on advocacy and technical assistance for the improvement of workforce and education programs for at risk youth.

Robert recently concluded a 30-year public sector career in the City and County of LA. He's established the City of LA YouthSource System and the LA Performance Partnership Pilot, co-founded LA: RISE to serve homeless and re-entry populations, and created HIRE LA, one of the largest public-private youth employment initiatives in the nation.

Robert was previously the Executive Director of the LA Youth Opportunity Movement and worked as the Assistant and Interim Executive Director of the City of LA Commission for Children, Youth, & Their Families.

As a national voice on workforce, Robert served as past President and Trustee in the US Conference of Mayors Workforce Development Council, and is an advisory member for the National Dropout Prevention Council. He's also a board member of School & Main; Alliance for a Better Community; and Co-founder of the Reconnecting LA's Youth (RELAY) Institute at Cal State Northridge.

He's also married and father of three children and grandfather to four.

And you also will have their bios in your folders for referenced.

Robert, feel free to add anything I may have missed to your very impressive biography. And welcome, Robert.

Next I'd like to introduce Veronica Soto. Veronica is the Senior Advisor for Workforce Development and Economic Impact for the LA World Airport $30 Billion Capital Improvement Program. Previously she also served as the Inclusivity Workforce Administrator for the Landside Access Modernization Program.

She has over 25 years of experience developing public agency economic and workforce development programs that promote diversity and economic inclusion based on high standards of equity, open competition, and transparency on capital programs with a combined value of over $60 billion.

Veronica developed nationally and locally recognized programs serving small and disadvantaged businesses with a $2.4 billion Alameda Porter Project that's around the corner from where we're at. $27 billion for the LA County School District School Construction Program, $6.2 billion to the LA County College District Bond Program, and the LA County $350 million Martin Luther King Medical Center Project.

She also served as the LA Director for Emerald Cities Collaborative and performed economic inclusion work in New Orleans post Katrina.

Veronica's commitment to creating connections between industry and youth is also long standing. She also lead the effort to launch the Hire LAX Youth program for Angelenos ages 18 to 24 to help cultivate a skilled workforce and address high unemployment among youth of color. She also created the ACES Engineering Pathway Program to increase the diversity of students entering the design and construction industry by eliminating barriers to higher education and providing paid internship experience on major capital projects.

Veronica also serves on various boards, is a member of numerous industry organizations, and the recipient of local, regional, and national awards for her work building the competitive capacity of small, diverse firms and creating pathways for local and disadvantaged workers. She recently completed the Massachusetts Institute of Technology Mel King Fellowship on Transitional Economic DEMOCRACY that heightened her awareness of international comparative approaches to creating community wealth and empowerment.

Veronica collects teapots and supports animal conservation on her spare time if she has any after everything I read.

So combined these two speakers have over 75 years of experience working in economic development and working on community benefits plans and this is part of what this conversation is about is having a very early start on these conversations. We have some prepared questions that we'll ask them and then we'll open it up to everyone to ask some questions as well.

Veronica, I don't know if you want to add anything before moving forward with the questions?

MS. SOTO: No, I look forward --

MS. MARQUEZ: Let's get you a microphone. Sorry.

MS. SOTO: I look forward to hearing from the committee.

MS. MARQUEZ: Okay. With that we're going to go ahead and start with some of these general prepared questions that we have for you and either one can answer first.

It is very early to start planning for the structure of community benefits plan; right? Have you been -- is it ever too early -- sorry -- to start planning for the structure of a community benefits plan?

And the second part is, have you been part of a project that started planning for a CBP this early and what were the benefits? And it's a little heavy-loaded, but you guys are pros.

MS. SOTO: So first of all I want to go ahead and commend the team here for starting this process early. This does not happen very often unless you have owners that are committed to the communities in which they do work and provide service. So this is really commendable. And I think I mentioned that before to Emily and to Alma.

It's a great opportunity. I don't think it's too early. And in most cases these start on the owners side and not much input from the community. I have been a part of creating programs on behalf of public agencies to do just that. They were not considered community benefits agreements. They were incorporated into contracts, which for a public agency when you're doing significant public infrastructure work you need to have the contract language.

A project labor agreement, a community workforce agreement is something that's very comparable to a community benefits agreement but that only takes into consideration craft work. There are other situations -- I'll give you an example at the airport. We have a public-private partnership where we're building a train to be able to minimize the carbon footprint of airport operations as well as to provide a better guest experience for all of these travelers so they don't have to commute in, deal with traffic, and so on. We all know what that experience is at LAX.

And so this project we went ahead and drafted requirements, workforce development plan requirements, which is essentially a community benefits agreement. But again you incorporate it into the contract where we establish requirements for hiring, not just during construction. Requirements of the participation of small, local, diverse businesses where we also established hiring requirements for the hiring of individuals doing maintenance and operations.

Again, construction is only five years. Maintenance and operations is 25. And so the 25-year span really provides the opportunity to bring in individuals from the community, provide that training that's necessary to put them on the path to a quality career job where they have good wages, benefits, and potentially a pension.

And so that is kind of the framework that I come from where we did start early but it was not an open forum. It was based on past experience on other major capital programs where things may have turned out great or things may have turned out bad. And so you take the bad and say, oh, I don't want to do what they did. I'm going to go ahead and do this.

But in here, in this situation we have a forum where you can invite that input on the front end of it all. So it's not too early. I think that in order to do it properly you really need to have the framework for it. You know, what is it that this project or whatever project what's it gong to do, where's it going to go, what are the type of opportunities during construction, infrastructure investment, and what are the opportunities afterwards.

In some cases it may be internal all on end type of activity or it may be contracted out. So what does that look like. And so this can be across the board. Not just this project but other projects as community leaders I'm sure there's other projects that you're engaged with, but I would say again that would be the framework. So it's never too early and if you're going to do it just have the right elements.

MR. SAINZ: Good afternoon.

So Veronica and I have worked together for many, many years on various projects and as I tell folks I'm a recovering bureaucrat. I had 30-plus years wearing the government hat and promoting workforce so there's certain constraints when you're in that particular position, but I took the approach that working with the community base organizations and community advocates that it was going to be a better process if you started early. The earlier the better.

Now I can tell you two decades ago there were certain projects that did not have a community benefit agreement that didn't benefit the community, it didn't benefit the project overall. So doing it early and starting the conversation is to your collective benefit.

The only thing I would add -- and you really do have an expert in Veronica here on the community benefit agreement -- but the once piece that I would have you think about early is the monitoring. Because if the projects are not monitored and there's not a public process for that monitoring to be reported out, it doesn't happen naturally.

And oftentimes with all the great intentions the project leaders want and construction managers want to see, but it's not monitored so sometimes it doesn't happen or a lot of times it won't happen. So you need to be able to think about the monitoring as you're thinking about the type of benefits that you would want to be able to see.

And the last thing I will say is that the community is such a broad term. You got your community of environmentalists, you got your community of folks that represent labor, you have your community that represent the neighborhoods, and youth, and you go down this list. So I would say to really be broad thinking as the initial folks that are thinking about this as many folks as you can bring to the table and to have a community benefit agreement that checks a lot of boxes and have as broad a community approach as possible. And to make sure that all voices are included in that.

MS. MARQUEZ: Thank you. Our second question is, in your experience what specific benefits have your projects brought to the community?

MR. SAINZ: I'll start. So from my perspective there's two major things I have always been concerned about: One was the local hire. And so many of the projects -- and I think Enrique's question was really driving at that. So a lot of the local projects are either in communities or go through communities and not necessarily that the local residents actually benefit.

And often when you talk about jobs and don't talk about thousands of jobs are going to be created, well, the reality is that most of it are not new jobs. They're additional jobs, but they're not new jobs. So have to be able to negotiate about how do you bring new people into the, say, the construction field. There was a point earlier about the maintenance and operations, how do you bring local residents into that particular field. So you have a long term benefit for the local folks being impacted. And to me that's one of the primary concerns.

The second piece is really the connection back to the project leads. And I think one example that didn't start off the greatest, but actually ended up turning out really well is the center -- LA Live was a project they had some really good initial benefit agreements. It wasn't monitored as closely as it should have been and they didn't have that local hire.

When the mayor's office and our department stepped in, they course corrected. They did a really great job of doing the local hiring and continued to make that a value of ongoing operations to be able to really address the employment needs around their local community. So that was one example where you really saw the true benefits come through.

MS. SOTO: I'll just have to reinforce the local hire, but through a project labor agreement. Making sure that what we're creating are quality career jobs, not short-term jobs. I think the communities of color tend to have what I call an endless cycle of poverty jobs. And so they never really get ahead, which is why we see some of the social situations that we see now: Homelessness, people unable to find affordable housing or pay for housing, and so on.

So for us it's always been how do we go ahead and incorporate another agreement in the agreement that is going to create a pathway. A pathway for local residents to be able to learn a craft, be able to go into a union apprenticeship program, be able to journey out and have a career. And not just end it there.

Because, again, when you have a project labor agreement it's not just about wages, it's not just about the local hire. It's also what it means for that individual long term. Making sure that the proper payments are getting made into the union trust fund so that their future and the future of their families is also taken care of.

So that would be my addition to local hire, but having a solid PLA. One with extraordinary monitoring because, again, you want to track what's in the agreement. Your contact is only as good as you enforce it. And that goes on both sides. Everyone that signs it needs to be enforced their benefits in that agreement.

The other thing is that there should be a pathway, a defined pathway for all the work. It's not just about craft workers. What about those other jobs, those ancillary jobs, the project control jobs, the construction management jobs. People doing accounting. People doing all these other activities that are part of delivering infrastructure.

And so for that, partnering with the community colleges. We have such a wealth of academic institutions in Los Angeles. We are the envy of other parts of the country. And partnering with them to be able to have access to the classes, being able to have a solid required internship program, which we did at the community college district, which we do at the airport. Making sure that we're cultivating the workforce we're going to need now and in the future.

Again, when you look at who works on these projects now, the most underrepresented in construction are African-Americans and women. So we need to address the issues that those particular populations have. When you look at the professionals in this industry, architecture and engineering, 3.6 percent are women. And when you think about people of color the numbers are just as dismal.

And so what do we need to do? We need to focus on youth. We need to go ahead and work the seminal work that Robert has done and building up youth workforce development is instrumental to be able to do that. But you got to connect the dots the entire pathway. And having industry support. You cannot do this without the people that are going to hire whether it's through a contract or whether it's through an owner, but you need to have industry as part of this strategy.

The other thing is about economic inclusion for small businesses, local businesses, businesses owned by people of color. If we want to have a healthy tax base, we need to find a way of incorporating the participation of small, diverse businesses and infrastructure. And that may be not just knowing about the project work but how do you build capacity.

What are the barriers, addressing the barriers of participation whether it be bonding, whether it be cash flow, whatever it is find a way, find a partner. There are so many partners out there that this is what they do. You don't have to do it yourself. Find the right partner to leverage their resources and their expertise to be able to address the barriers.

Again -- I'm going to say it again because I truly believe in this -- is having structured programs for youth while they're in high school, but start when they're in middle school. Because, again, we need to expose and create excitement about these career pathways otherwise people don't have a baseline of understanding, a baseline of the opportunity, which is why we have the issues with women in these fields.

If we're not engaging with girls early on, how are they going to know what a career in construction looks like or a career as an engineer. How do you get into that? How do you become an inspector? They don't even know they like it yet because they have no understanding of it. And so exposure is really important.

And I'm glad to say that the airport we're lunching a girls camp this summer in order to do that for high school girls. Again making sure that everything we do connects to our goal, which is what? Execute $30 billion of work but we're going to do it with the participation of the community, and we're going to leave LA better than how we found it. So that is our approach.

MS. MARQUEZ: I'm going to open up if anyone here has any questions because we do have some more. And just want to break it up a little if anyone wants to ask them.

And I believe we have Michael, and we have Robert. Microphone, yeah. Please remember to state your name and organization for the court reporter.

MR. BURNS: Michael Burns, California Greenworks. Thank you for the presentation.

I would love to pick your brains about my biggest roadblock which is industry buy-in. I have great programs that I want to provide for my stakeholders and pathways, but I need to get it in front of the right eyes. So any insights you have into that.

MR. SAINZ: So on the topic of green jobs that's something that has really been an open question for the workforce community and a lot of it stems from the definition of what is a green job. But I've seen the progress over the last 15 years it's been a true discussion. There's a lot more education that needs to actually take place of the workforce development world.

In the workforce development system in Los Angeles -- I don't know if you're familiar with it, but the workforce development boards -- there's seven different workforce development boards that actually control a lot of the training money that comes down to the -- from the Federal Government through the State and local levels. And it's hundreds of millions of dollars that come through.

So I would say that we could talk offline, but getting in front of those boards and educating folks about the pathways and about the work. Because when you look at certain positions that, you know, called an electrician and doing electrical work and now they're working on solar, you know, that does make them a green worker as you would say. And being able to understand what is the future technology and where they need to be investing in.

We did a lot of early investment about 15 years ago in trade tech and helped them build a lot of the curriculum before they had their own resources to do was to get in front of this type of investment.

I was just asking Veronica about the people mover and who's training the people mover on the maintenance side. It's a hundred jobs that would be considered a green works type job. People need to understand that that's what it is. So one is just the education.

The second is demonstration of outcomes, being able to show where these jobs are and how you're able to help fill them. And the workforce development world, which is really not just the funding that comes in, but at those tables you have industry, you have the community colleges and the adult ed, and other social and community service providers. So getting yourself connected to the people system is my greatest advice.

MS. SOTO: I would say I would, one, do what Robert said, but also the USGBC, okay? The USGBC has a strong workforce development program underway, and they have one of the strongest networks with industry. And they always have forums. They just recently had one last month where they brought people in from all over. People flying in for this full conference on sustainability. You should be an exhibitor.

The airport was there for our workforce development program. When you're there and you're connecting with industry, you're telling them what you do, and you'd be amazed that sometimes these industry partners are looking for organizations to partner with.

I can tell that, you know, for the airport on our procurements we make it a requirement: You are going to go ahead and partner with community. What is going to be your inclusivity and workforce development plan and who are your partners? And what meaningful work are you going to do? So when I see proposals coming in, I see who their partners are. Not only do we have community-based partners, but we also have schools that are partners. Now they have adopted schools, okay?

But if we don't ask, we don't get; right? And for an organization like yours, you need to know what we're doing. We could setup a time, we could have a conversation, and I can tell you exactly what we're doing.

You could have a similar conversation with Metro, a similar conversation with other agencies. Metropolitan Water District is doing extraordinary work. Have a conversation with them and see where your organization fits because everyone is committed to cultivating the workforce of tomorrow.

And we are not going to do it alone. We are public agencies driven or operations or deliveries, some type of service and so we need the skilled labor. So you will have -- just got to find your place, but you got to go ahead and communicate to us.

MR. LOPEZ: Veronica, what was that acronym you threw out there? USGBC?

MS. SOTO: Oh, the US Green Building Council. It's not a disease.

MS. MARQUEZ: Okay. And let's move on to Kenta. And then we'll go to Robert, Rashad, and then we'll take the Zoom question we have here. And Andrea.

Hi, Kenta with Coalition for Responsible Community Development.

Thank you both for being here, all of your leadership, and all of the amazing work you've done for Los Angeles over the years.

Obviously local hire and PLA agreements are a core part of community benefits and along with that goes training. So I wanted to see if you could speak to a couple of examples that had robust and funded training elements incorporated into the community benefits agreements.

And also kind of what were the key elements that made those successful because there's so many pieces around timing and education and onboarding and onramps with the community to get all of those right, you know, requires a lot of coordination. So if you could share, like, a couple examples that would be great.

MS. SOTS: I'm going to share two because one was really the birth of local hire. And that was the Alameda Corridor. The Alameda Corridor Transportation Authority was building that freight line from the ports, which was really a homecoming for me because I love that project and I was on it for so many years.

And so on that particular project, we committed that we were going to invest in the community. We were going to go through all these corridor cities, we were going to have extraordinary amount of construction -- it was a $2.4 billion project, and so one of the things we said we would do is train local people.

Again we were a transportation agency. It was a joint powers authority so it's very limited to what we were supposed to do. So we partnered with Century

Freeway. Century Freeway was created out of a court decree when they were building the 105 Freeway. So we said, they're already doing training. Why don't we partner with them, okay?

So we went ahead -- or the active board -- I believe -- of course this was a long time ago. I think we gave them $4 million during the life of the Alameda Corridor to provide training to residents that lived in the corridor cities. So that was one way in which an agency said, we're going to establish the first ever hire policy in Los Angeles.

Number two, we're going to go ahead and find and support a training partner. Our contractor was required to hire from that program. That 30 percent was a requirement. It was not a goal. It was a requirement.

And I can tell you -- and probably shouldn't say it because I'm being recorded -- but one of the biggest portions of work was the mid-corridor. And that general contractor had a history for not being as embracing of these types of programs; right? So the agency itself would hold off on paying they're pay application until that local hire was approved as well as the participation in disadvantaged enterprise firms. So there was power in that agreement.

Again, I go back to the contract. The contract says it all. If it's not in there, it's not going to happen. Good will is wonderful when you have people come together and say, we're going to do it. But those people aren't going to be there for the life of the project, so it has to be in the agreement.

So that was one example; right? When you had an agency that was going to set the tone for LA because that was the birth of local hire.

The second one, I would say I'm going to use the current one which is LAUSD. I could use others, but I'm going to use the airport and that is because we created the hire LAX apprenticeship readiness program, which is an eight-week training program. We utilize the multi-craft core curriculum, which is the curriculum created by the National Building Trades.

So that already gives us credibility. It is a curriculum that is honored across the country. Because, again, it was created at the international level. So we have that curriculum. Knowing what we know -- first of all, we're an airport. We don't do training. What do we do? We partner with a community college, okay?

And so the nearest location to the airport is Southwest college. We wanted to make sure the people who have -- that are impacted the most by airport operations would have the ability to go to training. So we selected

Southwest College, and we partnered with trade tech to come and do the training at the start of a program, which had never been done before.

Again, asking leadership to change the way they do things in order to create opportunity for community. We went ahead and took that curriculum -- and I getting to the section that you were talking about, how do we make it all happen. On that particular program, Hire LAX, cause it's great to have a curriculum, but who are we dealing with? Who are we serving? We are serving a disadvantaged population. And so what do we need to have in place? We need case managers.

So we have full time case mangers, two of them, that work with all our students during training and after. Because it's a continuum. There is a retention strategy. We follow our graduates for four years with the understanding that they'll hopefully journey out.

What we also did was incorporate life skills training. About 35 percent of our students are individuals that have a history with the criminal justice system. And so we needed to do something different; right? Because we're dealing with a lot of distinct challenges.

So we incorporated life skills training so every month we have a team that comes and works with the class and during that class we deal with the issues of anger. We deal with the issues of displacement. We deal with the issues of them losing their families while they were incarcerated. How do we go ahead and restore families? How do we go ahead and build trust with those that we love the most while we were incarcerated and so on.

So incorporating life skills, okay? And then the airport also pays for project labor agreements coordinators, which is Parsons. So Parsons is the LA administrator making sure everyone lives up to the PLA. They are also responsible for managing and administering the day-to-day operations of Hire LAX. So they're the ones that now work directly with the contractors to administer the agreement and now are working directly with the -- say your lack of local hire is up. Hire some Hire LAX graduates.

That is how it comes together. You have an agency with a PLA, you have the building trades that are partnered, you have community-based organizations, the entire City of LA workforce system, the entire County workforce system helping these individuals address the barriers to employment. It's everybody coming together.

So great question. Did I miss anything, Robert?

MR. SAINZ: Well, I guess the one piece -- and if you know Veronica she never misses anything -- to add is who pays for it. And often times that became, oh, Robert will pay for it. And believe me -- Veronica -- I get called into the council's office saying why did you pay for this.

And so what we did is that we negotiated back to make sure that it was a part of the budget. And so if you're spending billions of dollars, you know, it does say you have something to put part of your investment into the workforce. And so that became part of the budget.

And it was a line item cost for the trainings. And in some cases we matched it with our City training funds. So LAX, as an example, (indiscernible) number of the referral agencies are training providers so we're doing the upfront payment for that. But we acknowledged that and we know that the trainings are being paid through the budget through the airport.

So that is really a key element to the others. Somebody has to pay for it. And so collectively you need to be able to have that worked out up front.

And then I'll give you another example that was really well done. It was actually for the Housing Authority when they rebuilt a number of the housing projects and lots. They actually took down whole neighborhoods and rebuilt them. And they built in the direct local hire, folks that were living there who now are being displaced coming back to work on, basically, their future homes.

And they did a really great job of monitoring and meeting and really working together to be able to make sure these folks had employment, but now they had a career to go into the construction industry as well as on the maintenance side. Because maintenance is really a critical aspect through all of this.

I can give you a negative one where folks didn't put money into a PLA -- actually there was no PLA connected to it. It was when they did the first USC hospital and the rebuild for that. The board of supervisors at that time did not move forward with it and there was no community benefit agreement to speak of.

They had best efforts. So they promised the community hundreds or thousands of jobs, but the number of jobs that were actually going to be open because of how it was being done was very, very small.

They had hundreds of folks lining up at a job fair which we knew there was no hope they were ever going to land the job. And so that, to me, was really a disservice in the approach.

So we have things we've seen that have worked and then we have seen things that we know doesn't work.

MS. MARQUES: Thank you, Robert.

Now we'll move on to Robert.

MR. SAINZ: I like the name.

MR. VAN DER HOEK: Yes. Thanks, Robert. I like the name too. I like your name. My name is Roy, Robert Young Van der Hoek with Defend Ballona Wetlands.

And thank you, Robert Sainz and Veronica Soto for a great presentation. And you referred to us as a committee, but there's about 12 more people on Zoom. I didn't think maybe you knew that.

So my academic background is I'm a psy-sci alumni to Robert and I have degrees in geography and environmental biology. One of my first biology courses was population and community ecology and we've both been using those terms. But in that class we weren't talking about humans at all. All we were talking about was the flora and fauna.

And I'm thinking about the country Bolivia. I think it's Bolivia who may be the first country to talk about the rights of the community being the non-humans too that are also sentient animals like us. And it's easy for us to be ethnocentric and anthropocentric because we are thinking about ourselves first and foremost as humans, families, and friends.

But the young people that you want to have jobs at LAX, as example, and elsewhere in Los Angeles and yourselves included the airport is a hub. We've been talking about hubs with the pipelines and stuff too, but there's a place before you get to the hub and after the hub; right? So the airport is just a -- as I think about our Secretary of Transportation talks about it quite a bit, Buttigieg.

So when you go on vacation you go to a National Park or a cultural center to be with the family and so my question is, how do we bring in the community to be larger than just ourselves but the birds?

LAX has an El Segundo Blue Butterfly that it's very proud of and it's at the LAX airport, but it's on the Federal land that the United States still owns and manages in cooperation with the City of LA and LA Worlds Airport. So a little butterfly is very important and it's Federally endangered. And if you hurt it, it's a felony. You can go to jail for life. Wen an animal or plant gets endangered it gets the status of being human because you can be a felon if you hurt that.

You said -- this really great -- it's never too early to start, Veronica, and bring us in all together and unique. And I kind of embraced that the gas company is doing that. So I'd like to hear more about the philosophy in light of what I was just trying to summarize here, including the carbon footprint of the people minimizer.

You know, just as a metaphor to wrap up here, when we came here I don't think anyone estimated the cost of the plastic fork I used or the plastic cup for drinking water when estimating the cost of the meeting here today, but there's a tremendous cost that we use plastic and that we had meat items today. We need to really -- this is -- we really need to bring all these factors -- there's a question in here, but...

MR. SAINZ: I can't speak to the airport butterfly, but I'm sure Veronica can. But I think in general -- it really goes to my earlier point that the agendas that we all bring, oftentimes we come up with very specific agendas, but we need to broaden our agendas even those from our workforce side.

So a lot of our young people have never been our of their communities in any great way and are not exposed to that beautiful butterfly at LAX and don't know what they contribute to keeping that alive an being able -- so there's an education mark take really does take place for many of our community members that it's our responsibility to expose them. To be able to give them, you know, enjoyment and wonderment to them. So that's what I want to share with you.

MS. SOTO: Well, Robert, I wish I had worn my elephant conservation pin that I wore yesterday. You know, in everything that we do -- obviously this is the City of

Angels, City of Los Angeles, and I was (indiscernible) and Angelenos as a whole, but in everything that we do we have the ability to educate, to change people's perception and behaviors.

I'll give you an example, when we do youth programs we teach students about sustainability. Because it's not just brick and mortar. We're not just building these projects. We have to be concerned about the long-term impacts -- the immediate and long-term impacts of that infrastructure investment. What type of materials are we using, how are we recycling those materials in order to not have a negative impact.

These students I always take them on tours to see the Platinum Building. What does it mean to build a beautiful building? You can build a beautiful building; right? But how do we do it in a way that minimizes the use of energy? How do we do it in a way that minimizes water waste? How do we do it in a way where we're using certain materials that grow a lot like bamboo? How do we incorporate different materials? How do we go ahead and take care of runoff water so we are not wasting that water and it's going into the sewer?

All of those things can be taught through infrastructure if we want to. If we don't take the opportunity or the responsibility of doing that with our youth, then we're not going to change behavior. We are not going to do that. And it's not just about taking care of the environment, it's also being responsible for the other human being.

When we did construction training with the kids where I took them out to the carpenters union to build, to learn how to read a blueprint, safety. And when they came back to the bus so I could take them to their campus, you should have seen them. Some of them had Band-Aids because they had hit themselves with the hammer. Some of them had splinters, but they were all tired. You could see the sweat. And so I asked them, how do you guys feel? Oh, we're so tired. Really? You only did that for six hours today. Imagine the worker that does it eight hours a day for 20 years.

All of you who want to be engineers, who want to be architects, or project managers you will have the ability to make a decision as to how to take care of that worker. Making sure that worker gets paid prevailing wages, family supporting wages, or you know like Dr. Colepepper (phonetic) over there at Southwest College he says, these are thriving wages. How do you teach young people to go ahead and have a different perspective and also to have respect for the environment and have respect for another human being?

So we have an obligation to do that, and we incorporate it into our youth workforce development strategy.

MS. MARQUEZ: Thank you, Veronica.

Before we continue with the remaining questions, I see some more hands are going up and I think the discussion is so just wonderful to hear your perspectives and the questions are just all on target this afternoon.

Just want to ask real quickly: We do have another section, which is the breakout groups, which we had allocated 45 minutes to, so I'm just going to ask, should we continue with these questions and then wrap up and not have time for the small breakout groups and move on to the Next Steps?

I'm seeing yes from the people here in person because I think these questions are valuable to this afternoon's discussion. So let's just go ahead and do that then. We'll scratch the small breakout groups and move on to the Next Steps.

So we have Andrea, Rashad, and then I'll take the online questions. Thank you.

MS. VEGAS: Hi. Andrea Vega with Food and Water Watch.

I wanted to know how does in a community benefits plan how can health and safety requirements play a roll in a CBP in particular when the company that these workers are doing construction for and maintenance the company itself does not properly acknowledge what the long-term health impacts of what the project will be? In particular because these workers are going to be on the front lines of this.

MS. SOTO: Excellent question. I can tell you that safety is a core value in construction because, again, it is the most high hazard industry of all. Every contractor is required to have a safety lead. So every single subcontractor a safety lead in their team. And their sole responsibility is to ensure the safety of their coworkers.

Every project is required to have a project safety -- a project specific safety plan so that way there is continuity in safety standards for the entire project. The agency requires it, the general contractor implements it.

We have an entire team that monitors safety on our projects. Any person is empowered if you identify a hazard you have the ability to basically get on your phone and say, I see a hazard. And it doesn't have to be on the construction site. It could be external to the construction site. Because safety is a priority.

I'll give you an example, I was walking to the parking facility at the airport and my coworker almost literally tripped because the sidewalk was broken because, again, everything is under construction. So I immediately contacted the director of construction. I said, hey, outside of P1 there's broken concrete and so-and-so almost tripped, which means that a passenger could have tripped. Anyone could have tripped because of that hazard.

Well, guess what? The next day they came in and covered it with asphalt. Not that that's environmentally safe, but that's what they did in order to address the safety concern. So that gets incorporated throughout.

For people who are working in the office, there are safety standards for them too. So that is health and safety at least on the construction site, but again if you're doing a community benefits agreement and there's a project associated with it, then you tell them at minimum it's the Cal/OSHA standard that needs to be adhered to.

You can always add more. And again, the Cal/OSHA standard is higher than Federal OSHA standard, but if you want to do better you can. LAUSD did better on that because, again, we were building schools for kids. And so we wanted to make sure that every worker -- because they could have been the parents of those kids attending our schools -- that we made safety a priority.

MS. VEGA: I'm sorry. For quick clarification, on my question in particular this is for long-term health impacts. I'm talking about workers who through their exposure of hydrogen that they may develop, let's say, pulmonary illnesses, cardiovascular illnesses, cancer.

How -- what protections go into a community benefits plan for that?

MS. SOTO: You can incorporate all the regulations. The MSDX requirements. Every single project, any contractor that is performing work needs to know exactly what type of chemicals or materials that they're using that may cause a hazard to health. And so that has to be disclosed.

You can go to any job and say I want to see the MSD form for this particular product, and they have to give it to you. If they don't give it to you, then they are not adhering to the policy and there can be repercussions from OSHA. It is a requirement.

It's really having an understanding of all the existing OSHA requirements that can be imposed on projects and you can increase them, you know? Those are minimum standards. Like I said Cal/OSHA standards are higher than the Federal Government's. So again, knowing what they are and then maybe taking it a step further.

But you can go ahead and say that safety is a core objective of your community benefits agreement and what does that mean. It's not just people working. It's the community that also is a part of where that project is taking place. Are we going to have dust flying. Are we going to have noise? Noise is also an issue.

You know, so you have to take all of those things into consideration when you're building something. But again, you can put whatever thresholds you want in your community benefits agreement because it effects everyone, not just the worker.

MS. MARQUEZ: Okay. We'll take the online question from Lauren and then we'll come back to Rashad.

I'm sorry. Hyepin. I'm sorry.

Thank you, Emily for reminding me.

Hyepin, if you could unmute yourself, please.

MS. IM: Sure. Again this is Hyepin.

Good to see you, Robert. You made a very important comment about monitoring which that's been my experience in working with the advocacy arena and so are there recommendations of how we can, you know, best practices of how we can make sure that the monitoring is done and, again, recommendations or how that could be funded?

Because without a point-person who could really monitor, who would be responsible for that and the followup? I think that would be quite difficult and it should definitely be a community convening and not just one person doing the followup as well.

MR. SAINZ: Great question. And great to see you Hyepin. She's been another huge advocate and community activist for many, many years.

So on that when I talked about the monitoring side of it in the community benefit agreements there's choices of who monitors. And it goes from as lax as letting the contractors select their own monitor, which I would highly don't recommend. But being able to have a process that you're able to have a selected monitor that is going to be a third party and that reports to both the community as well as the contracting entity.

And for City projects the City has a really good contractor and monitor bureau. Probably one of the best you'll find around. One of their best practices is they put all the reports online. So when you have the City projects they're available to the whole public.

But they need to see light of day. I've seen projects where the monitoring reports are buried online somewhere that you just can't find. And to me, that's not really a positive practice. So I would say whatever you do in terms of thinking to have a process about the selection, who's going to do the monitoring, but more importantly is that have a process where the monitoring is made public on a regular and consistent basis.

MS. IM: And, Robert, what about the funding? I know that in some other efforts the community -- there might be a community advocacy organization that's part of their organization effort, but in this there's a lot of volunteer community groups so how would that be funded?

MR. SAINZ: Yeah, it needs to be part of the budget. You know, monitoring is a very, very specific function and it takes professionals to be able to do it. So it should be part of the budget.

MS. IM: Okay, thank you. Thanks, Robert.

MS. SOTO: So some of the best practices that we've been using, obviously way back when we did the Alameda Corridor, there were no systems. It was Excel. And so we utilized Excel, formatted Excel, and programmed it so we could do the monitoring.

When I got to the LAUSD school construction program, we created our own online certified payroll system. It was the first online certified payroll system in the entire State of California where we actually had to get approval. We were very fortunate that we had young talent graduates from MIT, CalTech, Berkeley, and Stanford. So we had all these young little minds -- and I was young back then too, so I guess I was one of them -- and so we developed the first of it's kind, an online certified payroll system.

And that's where we were able to monitor the local hire on our projects. We also went ahead and created a system to monitor small business participation and payment to those companies. And so again, you had an agency that understood. We had a bond oversight committee that was responsible for overseeing how the expenditures of the bond program. And so they wanted to make sure that they knew exactly what was going on.

So we created these systems in place. As time went on, we went ahead and utilized LCB Tracker. LCB Tracker is the system that we use at the airport. It's a system that we use at the community college district, on the County projects because that is the best in class.

And we use that to be able to monitor not just local hire, but equity, community, economic impact. How are we going to find the disparities among participation if we don't have the data. So we have custom reports. I can tell you in less than three minutes what's going on in every project. I can tell you what's going on on one project, tell you who is meeting the local hire requirement and who is not.

The same thing for B2GNow, which is the contract compliance system that we utilize to monitor prompt payment, monitor utilization. Again, that is the standard now among public agencies.

We took it a step further for Hire LAX. We created our own system called Workforce Manager in partnership with LCP Tracker to be able to monitor all of our students, all of our graduates, how many resources did they get from the workforce system, what is the value of those resources, what is the ROI on the investment that we made in our Hire LAX graduates. And we can see the long-term career trajectory because we tied Workforce Manager to our certified payroll system across the region.

Now I can track a graduate from our program doing work at Metro, doing work at the County. I can see the line graphs of their success, of their earnings. It is powerful. And again, you only get that through proactive compliance and having the right system.

And also transparency. We're getting ready to launch our new web page at the airport and one of those will be a dashboard. It will be a public facing dashboard. You will be able to see what is going on for inclusivity and what is going on for local hire. Right now you can see local hire, but it's stagnant. It goes up once a month, but with a dashboard you'll be able to see real time.

And so again, commitment to transparency, commitment to meaningful participation, and then ultimately local economic impact though infrastructure investment.

MS. MARQUEZ: Next we'll move on to Lauren and then we'll come back to you Rashad. Thank you for being patient.

Lauren, if you could unmute yourself, please.

MS. GALLAGHER: Hi, all. Thank you, Robert and Veronica.

I just wanted to come back to something that Veronica said in the very first question which was "if you're going to do it you have to have the right elements in place."

I'd really love to explore more what the right elements are. I think we're really at an early stage in this process for Angeles Link. This is something that throughout today we've heard from Yuri, Frank, and Jessica. There hasn't been a lot of information made available to community members in this process so far.

And I want to know in light of this, what can SoCalGas do to begin to get those right elements in place for a really robust and truthful community benefit process?

MS. MARQUEZ: You want to take that, Frank?

MR. LOPEZ: Yeah. I mean that's why we're doing advisory groups like this -- right -- to solicit input from community-based organizations on what a community benefits plan could entail. We've had breakout sessions previously. We've met with organizations one on one based on feedback that we've received from the PAG and CBUSG. They wanted us to expand our outreach beyond the LA basin, which we've continued to do.

Actually I had a question to ask for Veronica and Robert tied to this is when you're building a really large pipeline similar to the Alameda Corridor Transit that's going to traverse though dozens if not hundreds of communities -- communities are not a monolith; right? There's a wide range of diversity including preference for community benefits. You know, what are some good strategies on how you get input from those communities to develop a community benefits plan that will benefit as many communities as possible; right?

So I know for us we have ways that we've done this for other transmission pipelines, but I'm open to suggestions from those of you who have been part of other similar infrastructure projects that you think have done a really good job of addressing this. I'm curious to maybe hear your thoughts on Alameda Corridor because I think that could be a really good example -- right -- traverses through multiple EJ communities.

How do you ensure that project benefits all of those communities along that corridor?

MS. SOTO: On that particular project we met with numerous stakeholders because, again, we needed to get permitting approvals from every one of those independent cities. So we had to identify key organizations that had a roll in economic development and social services. And so we met with numerous organizations and they also met on their own. I can tell you that they did it on their own as well. They were empowered to go ahead and then they came together and said these are the things that are important to us.

So there was already some alignment in what we were doing internally and to what they wanted. And so we were able to come up with a plan where everyone was happy, which really doesn't happen very often. Right?

And the other thing is to really do an inventory of community assets. Know who's where and what they do and how do you match them up. For example, Michael, you know you talked about your program. You're doing great work, but how do you connect to everybody else? You're an asset. You're a community asset. But how can someone take advantage of that community asset? Where does that fit? Where does that puzzle piece fit?

I think you go through an entire process of identifying your asset mapping. I'm doing that right now with youth in order to identify the areas, the gap where we're not participating. Because again, we need to do that type of analysis. And I don't know if that answers the question.

I am happy, you know, Lauren, you asked a question what are the elements, on Friday I did a session with all of industry about what are the elements of an inclusivity and workforce development plan. Everything we do is a matter of public record. I'd be happy to share it with you. Again, it's not going to be exactly what they need to do, but at least it provides a framework for the other pieces that may be necessary that are unique to this project and most importantly unique to all the different organizations that are part of your stakeholder group.

MR. SAINZ: And I would say there's many more tools today than there was 10 years ago or 25 years ago during the Alameda project. So surveying is actually a really great tool to actually reach many, many different communities. But to also make sure it's done in the language that is the predominate language and also that you're able to have the outreach strategies to make the surveys valid. But the surveying tools and sophistication now is just so much greater and it's just a really great way to do it.

We use schools oftentimes for the parents of the schools because we know we have a (indiscernible) population and so we're able to do for much of the work we do on the workforce.

The second piece is of course with the social media now and being able to make it aware because sometimes there are community groups that -- and again not pointing anyone in particular, but sometimes when you talk about a particular subject there will be CPOs there and dominate the conversation. And you're not getting a broader perspective. So being able to have expanded outreach through the use of social media it does actually allow more folks to participate than otherwise have.

MR. LOPEZ: Those are really good suggestions. And I think for us right now that we're in this conceptual stage really been limited to the PAG and CBUSG. We know we try to assemble as diverse of a group as possible that we think represents these communities to advise us.

But as we get to a point where we have a preferred route and a better sense of where this facility could be doing some more detailed stakeholder analysis; right? Like maybe focusing on disadvantaged communities first that could be most impacted and identify who represents these communities and finding more robust ways, whether it be surveying, partnering with schools and other CBOs to do outreach to help us provide input on the next subsequent phases of this project so we have a robust community benefits plan.

So we foresee this work now building on that work in the future.

MR. SAINZ: And it's a complement. Doing any one of these by itself. You have to do multiple strategies.

MS. MARQUEZ: Lauren, I think we answered your question; is that correct? Or did you have a two part to that?

MS. GALLAGHER: That was the only part. I was grateful to hear from Veronica and Robert.

Thank you.

MS. MARQUEZ: Thank you.

And last but certainly not least, Rashad. Rashad, take extra cookies today because you've been so patient. Thank you.

MR. RUCKER-TRAPP: I'll take you up on that offer. Thank you.

Thank you, guys, for this event. I really appreciate this conversation here because it's something that we're always talking about in our groups, in our local groups and community organizations or what not.

My two questions here. One I think you had touched on earlier between the separation between particularly blacks and women being disproportionate in a lot of these job opportunities. I would love to get your take on or your philosophy or your take if you will on why that seems to always be the trend.

And then, number two, I would like to ask on the preparation and preparedness of jobs like this project that is coming forth. Usually we see these jobs, they come in an instant, and before you know it it's almost too late to hire because wither we don't meet the qualifications or we have to go to community college or go to school to do it. And usually we don't learn about that until we're looking online or the announcements are made.

So in this example as we are talking about it and preparing for it, how do we as community leaders, organizers begin that preparation so that when the market opens for this project our communities have an advantage or can take advantage of opportunities like this?

MR. SAINZ: And the first part, there are several different populations that are underrepresented in occupation, but no more pronounced than African-American and women in the trades despite a lot of good efforts that have taken place. So building that in and being able to be purposeful and I think that's really the point is that if you're going to do a program -- and I'll give you an example where Mayor Villaraigosa, to all his credit, identified that in the trades some of the locals had two and three percent African-American representation when it should have been closer to seven to eight percent. And at that point it was about nine percent in the City's representation.

So he worked directly with the trades and his Deputy Mayor, who many of you know, purposely worked with almost every local to get their commitment that they were going to target and specifically recruit in African-American communities and including women. And so being able to have that and we spent a year and a half over the two years we raised the number of first porter apprentices to almost a thousand that were hired within the local trades. And that changed the percentages, but that's only because it was targeted, it was funded, it was purposeful. And it took true leadership to make that happen.

The recession hit and it actually pushed us back, but you have to have initiatives just like that that are included in the community benefit agreements in terms of targets. Being able to say where are you going to be purposeful to actually increase these numbers.

And then great question on the preparing. I spent all day long talking about what we could do for our local communities to have them be prepared and also the responsibility of the local communities themselves, you know, to be prepared for these type of jobs.

The thing is our economy has completely changed and that's including in the construction industry here we're not as much about brawn and more about brain and we need to able to have our young people understand there's certifications that you need to even walk in the door to be able to get these positions.

Twenty-five years ago it was who was the strongest and the toughest got to the front of the line. That is not the case now oftentimes for many positions. So being able to identify the type of positions.

We talk about the people mover, the people mover technician is a whole new job and we've known about it the last five years and I asked Veronica on the side, who's doing the training for these folks? And she said, Trade Tech is doing the curriculum and getting folks prepared in the local community for these jobs.

But if you're not doing that and not familiar with your field -- so I don't know what the hydrogen maintenance tech is going to be but I'm sure there's going to be very unique positions there. So identifying them now, partnering with local agencies -- and there is resources to be able to develop new types of programs if they don't exist to do that now.

MS. SOTO: We were very -- again having the data;

right? For me to make statement I have the data to support it. The data also says -- cause I can run certified payroll by race and gender and also by craft. And I can tell you who is highly represented in what craft.

But then you ask the question, why is it that black and brown are highly represented in laborers and carpenters? It's because of their education, okay? In order for young people to have more options, they have to have a better K through 12 education. They needed algebra. In order to be an electrician, you have to have algebra with a C or better.

So if you -- if as a girl and Latina and I wasn't provided access to an algebra class because they didn't think I should have it. And back then that was the reason -- right -- why only certain kids were tracked through the A through F. Now it's A through G. Kids were tracked. If you don't do this, you aren't going to succeed. And we're going to put all of our investment in you. And that's what was happening.

So fast forward 10 years after that and I see the data, yeah, black and brown are concentrated in the laborers and carpenters because you don't need a high school diploma because you obviously don't need algebra because all you're going to do is use your body. And so, that was the situation. Knowing that, that's what gave birth literally for our efforts in the youth workforce development.

The fact that our kids were being denied an opportunity to pursue a career based on activities that they had no control over. The fact that they were not provided a quality education. They had no control over that. This is the work I did when I was at LAUSD so I can say that freely, okay? And so I said, no, we're going to create a program and we're going to focus, you know, on the kids of Los Angeles. And we are going to put them through this process. We're going to do concurrent enrollment before there was concurrent enrollment.

And then the support that Robert used to give me when I'd ask him for that money for summer youth employment monies, we gave them paid internships working on these projects. Again minimizing the barriers, telling those kids that may not have taken algebra, hey, you're a junior, you still can. And providing them the opportunity to do that.

I had kids that were on the brinks of dropping out of school, but they saw this as a career pathway and that totally changed their perception. I had kids that came in with their pants down their shorts, you know. And guess what, I didn't tell them, pick up your pants.

Positive peer pressure. Because they say Latino and African-American professionals and they weren't with their pants down. They saw themselves in those professionals, whether it be a contractor or a craft worker, but they're professionals in their fields.

So changing that perception is key to improving the educational attainment of those students made a big difference. That's why I keep harping on youth workforce development. We don't focus on youth, we're not going to have a different outcome. I've gone through a lot of town hall meetings on why we don't have Latino or African-American general contractors that can do City work. Why? Because we didn't cultivate them.

How do you expect to have something if you didn't build; right? And so we have to be intentional. The fact that we put life skills training, case management, supportive services, retention strategy where we're constantly engaged with our graduates that's what's going to move the needle. That's what's going to move the needle.

If we are not intentional and don't have a comprehensive approach to building that person, okay, because life happens to black and brown people more often than it does to those who are not and so what do we need to do to prepare for that, okay? So that's what we do.

That's what we've been doing in our programs is acknowledging who has been left behind to a certain degree, why is it that they have not had the same opportunity, how do we rectify that, and how do we make sure that being a craft worker is not the end of their career pathway? How do we create additional pathways after that that will lead to project management, to managing O&M buildings and so on.

So again, I hope that answers your questions, but I can tell you that it is an issue. The girls camp is a way of addressing the fact that I don't have enough women out in the field and how we retain them. I'm also exploring creating a safety regulation, an OSHA safety regulation, on harassment and discrimination.

Because those are two key factors that affect retention out in the field. When someone is being discriminatory or harassing a person of color or a woman out in the field, that person is jeopardizing that person's safety and jeopardizing their own as well as all their coworkers around them.

And so I think we need to look at ways, institutional ways, in which we can address these types of issues. But it is not just access. It is support. It is retention, and it's multiple pathways that lead to other careers that provide quality jobs, good wages, family supporting wages, benefits, and a pension. Because that's the only way we're going to create community wealth. And if we want to help these two populations of people, we need to do.

Sorry for my soap box.

MS. MARQUEZ: Thank you. No, thank you for that. I think that we don't have any more questions at this point. I think you both have done a thorough job of answering all these questions what we had.

Yes, a round of applause for Veronica and Robert.

And I promise you we didn't know you knew each other until we had our prep call and you guys are like the dream team I kid you not. Thank you again for taking the time out of your busy schedules to be here and help us through our process here at Angeles Link project.

And with that, this concludes that portion of our agenda. Now I want to hand it over to Emily Grant, our project manager, who will close us off with Next Steps.

NEXT STEPS/ADJOURN

MS. GRANT: Thank you, Alma. So we'll give the slide deck a -- oh, great job guys. Okay. I'm going to catch up here.

First I want to genuinely thank you all for your flexibility with these meetings. We didn't get to break out into small groups today, which I know is something that we value tremendously being able to have you brainstorm in those sessions. We'll try to do that again, but we don't ever want to cut the conversation off. So we just appreciate your flexibility for the time today.

Second, let's go over next steps. So we have two feedback windows that are currently out. That is the Environment Analysis Preliminary Findings. So as a reminder that's Step 3 of our 4-step process for the feedback windows. That will be the last Step 3 document that we have out for you and that's due Tuesday, June 25th. And then we have our second draft report that's out with you right now which is the Hydrogen Leakage Assessment and that's Step 4 of our process.

So now moving forward, once those Preliminary Findings for Environmental Analysis feedback comes in we will have all of our draft reports being on Step 4 of our process.

We will have our next meeting, our summer workshop, on Tuesday, July 23rd. We'll be back at the Energy Resource Center in Downey, but please note we'll be in a different room. So we'll have signage out front to point you to that room. But we're looking at 10:00 to 2:00 that seems to be the time that works best for everybody and then also a hybrid meeting as well. So we'd love to see you in person, but we'll be available via Zoom also.

As usual we will have today's presentation and the meeting recording posted to the living library as soon as that's available as well as the court reporter transcripts and all the other materials.

And as usual, if you have any questions, comments, concerns please let me know. And we thank you very much for your time today.

MR. LOPEZ: Thank you.

MS. MARQUEZ: Thank you.

(The proceedings concluded at 2:00 p.m.)

STATE OF CALIFORNIA
COUNTY OF LOS ANGELES

I, FABIAN SCHWIN, Hearing Reporter, in and for the State of California, do hereby certify:

That the proceedings in the foregoing Quarterly Meeting was taken before me on Tuesday, June 18, 2024, via Zoom Videoconferencing, in the City of Los Angeles, State of California; that said hearing was reported by me in shorthand and transcribed, through computer-aided transcription, under my direction; and that the above and foregoing pages, numbered 5 to 155, inclusive, is a true record of the testimony elicited and proceedings had at said meeting.

I do further certify that I am a disinterested person and am in no way interested in the outcome of this action or connected with or related to any of the parties in this action or to their respective counsel.

In witness whereof, I have hereunto set my hand this 18th day of June, 2024.

F. Schwin

Fabian Schwin,
Hearing Reporter

Y

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In the Matter Of:

PAG Q2 Meeting

SOCALGAS ANGELES LINK

June 21, 2024

Case No:

REPORTER'S TRANSCRIPTION

ANGELES LINK PLANNING ADVISORY GROUP MEETING (PAG)
JUNE Q2 QUARTERLY MEETING
JUNE 21, 2024

REPORTED BY:
JAKENYA A. JONES, CSR NO.: 14304

ATTENDEE LIST:

CHESTER BRITT	AMY KITSON
EMILY GRANT	NEIL NATHAN
YURI FREEDMAN	ANTHONY D'AQUILA
JESSICA FOLEY	KATRINA FRITZ
CHANICE ALLEN	AARON GUTHREY
ALMA MARQUEZ	BENJAMIN TANG
FRANK LOPEZ	CHRISTOPHER ARROYO
NORMAN PETERSON	JOSEPH ORTIZ
JAY PARPALI	JULIA ROSHALA
JULIA DOWELL	JP GUNN
JOON HUN SEONG	LAUREN GALLAGHER
SOPHIA DUBROVICH	MARYBEL BATJER
JANICE LYNN	MATTHEW TAUL
MIKE GALVIN	RIZALDO ALDAS
ERNIE SHAW	STEFANIA MITOVA
IAIN FISHER	YVETTE SANG
TYSON SIEGELE	SAM CAO
JACK BROUWER	MIKE GALVIN
PETE BUDDEN	JESSICA CANANPOLY
LEWIS FULTON	SARAH WILTFONG
MATTHEW TAUL	ANDREW BURKE

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CHESTER BRITT: All right. I think we're gonna go ahead and get started.

I want to welcome everyone to Banning's Landing here in Long Beach. If you are not with us in person, you missed a beautiful day to come to be here in person because it is absolutely beautiful outside. And for those of you who did make it here today in person, well, I want to thank you for taking the time to do that. Hopefully, the drive in traffic wasn't too bad. It wasn't too bad for me, so hopefully it was the same for yourselves.

This is the planning Advisory group for Angeles Link. It's our second quarterly meeting. Again, I want to welcome everyone. We have a full agenda, so we're going to just jump right into it.

Let me start by advancing the slide if I can. See and if I can turn it on.

My name is Chester Britt. I'm the Executive Vice President with Arellano Associates. I serve as the PAG leader. You should recognize me. Over the past year and a half we've been meeting together numerous times; and again, I welcome the opportunity to lead the discussion today. I have with me today Alma Marquez with Lee Andrews Group. She helps facilitate the CBOSG Group with me as well, and so welcome, Alma.

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And with that we'll go to the next slide, which is just housekeeping items. This meeting will be recorded, both video and audio, and a court reporter will be transcribing the meeting. Please announce yourself before you speak. That's really important for people online to know who's speaking as well as the court reporter for the transcription of the meeting.

The zoom microphones are muted, so you'll need to unmute yourself when we call on your name and we'll unmute you as well, and then you should be able to speak. We encourage you to turn on your cameras, so we can better engage with you. It's nice. We have, actually, big TVS in the room, so it [sic] helpful to us to be able to see you. So if you could turn your microphone -- I mean your cameras on online that would be great, specifically, when you speak for sure it would really be helpful to us.

You can also feel free to use the Zoom chat to provide any input and ask any questions. Throughout the meeting. We are monitoring that I know Emily and our staff do terrific job during the meeting, when they see Chat. Trying to respond to your chat messages and letting you know what's going on, and or answering your questions. If there is something you want to chat, and you don't want to verbally make that comment. We can

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read it off for you ourselves, so that the benefit of the group can hear your comment or your question, and we can address that. If you would like to speak. I and you're on zoom. Please use the raise the hand button. You should be familiar with that at the bottom of Zoom. We can see that, and then we'll recognize you at the appropriate time when we have Member discussion. And then, if you are here in person, we have wireless microphones. You can see the purple one right over here by Katrina. Good to see you, Katrina. And I think we have one other one somewhere over here, the black one and a yellow one by norm. So we have a few wireless microphones. They're scattered around. Just make sure you speak directly into it. I know sometimes it's intimidating to do that, but it's very helpful for people online to be able to hear as well as in the room. So that takes care of our housekeeping agenda. And then for our actual meeting today. We did provide some continental breakfast. Lunch will be coming as well, so feel free to partake in the food and water and beverage.

We will have a SoCalGas Safety Moment, Land Acknowledgement, and Roll Call. We'll do a welcome with Frank, who will give us some background information; then we're going to have three member discussions. The first one focused on project options and alternatives.

We'll have lunch, and then we have the economic analysis and cost effect in this discussion.

We'll have a break if needed, and then we'll get into the environmental analysis and then we'll adjourn our meeting.

I'm going to introduce now Chanice Allen, who is the engineering project manager for SoCalGas, and she'll be doing our Safety Moment.

CHANICE ALLEN: Thank you, Chester. Good morning, everyone. Happy Friday. Yesterday was the official first day of summer, so, as Chester said, today is a beautiful day outside, and so summer is coming in full force, with that will be the weather, and so I would like to share with you some tips and guidelines to help you to be proactive and informed about heat, illness.

Heat illness is a real thing, and so it comes in various forms, and so I like to share some information with you. So what is heat illness? Heat illness happens when our bodies overheat and do not have enough water to cool us We have an internal thermostat that controls our temperature by sweating for cooling and heat. Illness can happen pretty quickly. So it's important to recognize the symptoms. Personal risk factors that you should consider can be your age,

health, and fitness taken into account.

Hydration, as far as water, and then caffeine and alcohol consumption. And then there are prescription medications that you should be aware of that may affect how your body retains water. Certain heat related illnesses that I will share. One of them could be a heat rash which could be red clusters or small blisters that look like pimples on your skin or neck, chest, or elbows.

For first aid, call for medical help or go to a nearby facility if needed, stay in a cool, shaded area and sip from cool water. For heat cramps, muscle pain, or spasms caused by heavy sweating or during intense exercise can happen. So for first aid, stop physical activity, move to a cooler place. Make sure to drink water or drinks that have electrolytes in them, and do not resume physical activity until the cramps go away. Get medical help if the cramps last over an hour or if you're starting to have heart problems.

Heat stroke, which is very, very serious, as if you're have a high body temperature over 103 degrees Fahrenheit, and you have hot, dry skin, or you're profusely sweating, or have a rapid or weak pulse.

Confusion and being disoriented is another symptom, so please seek medical emergency attention as

soon as possible. Preventive measures starts off with just ensuring that you are getting -- covering yourself with light colored, loose fitting clothing, making sure that you have shade, so access to shade whether that's at home or public facilities. If you're going to do outside work or physical activity try to do that in cooler, shaded areas or in cooler times of the day, taking breaks often, and of course, wearing and reapplying sunscreen.

Most important is hydration. Try to drink three to four cups of water every hour, frequently drinking small quantities rather than large amounts would be helpful and focussing on that water replacement and limiting your caffeine and alcohol. And then, most importantly, I wanted to share is that today is national smoothie day. And so with that, I'm a Jamba juice girl. I offer that jamba juice has smoothies this afternoon for a dollar, so please enjoy your summer. Have a happy, safe, and cool summer. Thanks.

CHESTER BRITT: That was a great. At this time, I'm going to turn it over to Alma to do the Land Acknowledgement.

ALMA MARQUEZ: Good morning, everyone.

Respectful acknowledge [sic] the indigenous peoples on whose ancestral land we gather of the diverse and vibrant communities of Tongva, Tataviam, Serrano, Kizh, and Chumash Peoples who for generations have cared for these lands and made their home here. Today we honor and pay our deepest respect to their elders and descendants, past, present, and emerging, as they continue their enduring stewardship of these lands and waters for generations to come. We acknowledge our collective responsibility and commitment to elevating the stories culture and community of the original caretakers of this region, and are grateful for the opportunity to live and work on these ancestral lands. We celebrate the resilience, strength, and unwavering spirit of indigenous peoples. And are dedicated to creating collaborative, accountable, and respectful relationships with indigenous nations and local tribal governments. Thank you.

CHESTER BRITT: Thank you, Alma.

Now we're going to do roll call. So I've already introduced myself. I'm going to pass it over to Frank and we're going to go around the room, and then we'll go to the online folks.

FRANK LOPEZ: Good morning, everyone. Frank Lopez, Director of Regional Public Affairs for SoCalGas.

YURI FREEDMAN: Good morning, Yuri Friedman,

Senior Director of Business Development, SoCalGas.

SHIRLEY ARAZI: Good morning, Shirley Arazi, Angeles Link, SoCalGas.

CHANICE ALLEN: Good morning. Chanice Allen Angeles Link, SoCalGas.

AMY KITSON: Good morning, Amy Kitson. SoCalGas Angeles Link.

NEIL NATHAN: Good morning, Neil Nathan. I'm the senior vice president of engineering major projects and chief clean fuels officer for so SoCalGas.

ERNIE SHAW: What's up? What's up, everybody? Good morning. Good to see you again. Long time, no see. Forgot my name there. Utility workers of America, Ernie Shaw, Local 43 Transmissions and Storage. And thanks for the tip, Chanice. So I'mma get like 10 smoothies, put in my freezer.

JANICE LYNN: I'm down for a smoothie, too. Janice Lynn, founder and president of the Green Hydrogen Coalition.

SOPHIA DUBROVICH: Sophia Dubrovich, and I'm here representing the International Longshore and Warehouse Union.

NORMAN PETERSON: Norman Peterson, Southern California Generation Coalition.

ANTHONY D'AQUILA: Good morning,

Anthony D'Aquila, City of Burbank and Magnolia project.

KATRINA FRITZ: No?

Katrina Fritz, president of the California Hydrogen Business Council.

JAY PARPALI: Good morning, Jay Parpali [sic], out of Legal Fellow at Communities for a Better Environment.

JOON SEONG: Hi, my name is Joon Seong. I'm with Environmental Defense Fund.

CHESTER BRITT: All right. Going to go now online.

I see Aaron Guthrey. If you could unmute yourself, we should be able to hear you.

AARON GUTHREY: Good morning, Aaron Guthrey, LADWP. Thank you.

CHESTER BRITT: Welcome.

Andrew Burke?

(No response.)

CHESTER BRITT: Andrew, can you unmute yourself?

(No response.)

CHESTER BRITT: All right. We'll come back to you. I see Anthony D'Aquila -- Aquila. Oh, okay. You are here. I'm sorry. How are you online as well? You have your laptop open. There you go. That's a first. That never happened before.

Benjamin Tang.

BENJAMIN TANG: Good morning. This is Ben Tang, Public Advocates Office.

CHESTER BRITT: Welcome.

Christopher Arroyo.

CHRISTOPHER ARROYO: Good morning, Christopher Arroyo, CPUC.

CHESTER BRITT: Welcome.

Ian Fisher.

IAIN FISHER: Good morning, Ian Fisher, Public Advocates Office.

CHESTER BRITT: Good to hear from you, Ian. Jakenya Jones, she's the court reporter.

Then we have Joseph Ortiz.

JOSEPH ORTIZ: Hi, good morning. Joseph Ortiz, Los Angeles Department of Water and Power.

CHESTER BRITT: Thank you for coming.

JP Gunn?

(No response.)

CHESTER BRITT: You got to unmute yourself, JP.

(No response.)

CHESTER BRITT: All right. Julia Roshala.

JULIA ROSHALA: Good morning, Julia Roshala with Insignia Environmental.

CHESTER BRITT: Welcome.

Lauren Gallagher.

LAUREN GALLAGHER: Lauren Gallagher. I/her/she pronouns -- with Communities For a Better Environment.

CHESTER BRITT: Welcome.

Lewis Fulton.

LEWIS FULTON: Yep. Lou [sic] Fulton, UC Davis.

CHESTER BRITT: All right. Looks like Marybel Batjer.

MARYBEL BATJER: Good morning. This is Marybel Batjer, California Strategies.

CHESTER BRITT: Thank you for coming.

Matthew Tall.

MATTHEW TALL: Matthew Tall, Public Advocates Office.

CHESTER BRITT: Welcome.

Rizaldo Aldas.

RIZALDO ALDAS: Hi, good morning. This is Rizaldo Aldas, California Energy Commission.

CHESTER BRITT: Welcome.

Stephanie -- Atova?

STEFANIA MITOVA: Stefania Mitova, UC Davis.

CHESTER BRITT: Welcome.

Tyson Siegel.

TYSON SIEGEL: Hello, Tyson Siegel on behalf of the Utility Consumers Action Network.

CHESTER BRITT: Good to hear from you.

Then Yvette Sang.

(No response.)

CHESTER BRITT: I think I got everyone, but maybe -- there is one more than I saw that just popped up. Sam Cao.

SAM CAO: Yes, Sam Cao. South Coast Air Quality Management District.

CHESTER BRITT: And you just came in, Mike. You want to come forward to the table so we can...

You could hand him a microphone.

You could introduce yourself.

MIKE GALVIN: Mike Galvin, with the Port of Los Angeles.

CHESTER BRITT: Alright, thank you for coming, Mike.

And then Jessica, did we introduce you?

(Simultaneous talking.)

JESSICA CANANPOLY: Hi, I'm Jessica Cananpoly [sic]. I'm with SoCalGas Angeles Link. Thank you.

EMILY GRANT: Good morning, everyone. Emily Grant. SoCalGas.

CHESTER BRITT: All right. Did I miss anyone online? If I did just raise your hand and we can call on you.

Okay, Sarah. I think we missed you so if you could unmute yourself.

SARAH WILTFONG: Yeah. Sarah Wiltfong, Director of Advocacy for the Los Angeles County Business Federation. Thank you.

CHESTER BRITT: Thank you.

Andrew Burke. Are you available to speak, Andrew?

(No response.)

CHESTER BRITT: It looks like you're off mute.

(No response.)

CHESTER BRITT: Well, we can come back to you, Andrew, if you'd like.

So we have a full house today, lots of folks participating, which is really good. We're going to move on now to Frank Lopez, the Regional Public Affairs Director for Angeles Link, and we're going to turn it over to him to do the welcome today.

FRANK LOPEZ: Thank you, Chester.

Good morning, everyone. Great to see everyone here at Banning's Landing, in the City of Los Angeles, not in the City of Long Beach.

I want to thank The Port of LA, Mike, for helping us arrange, you know, this facility; and, obviously, to host our meeting here. I hadn't been here in a very long time. It's been several years since I've been in to a meeting here, really remarkable with all the work that you've done to redevelop the waterfront and how beautiful is.

We had a CBOSG meeting earlier this week, and it was a little bit overcast in the morning, and I showed today, and the sun is -- is out and shining, so during the break -- during the lunch, encourage you to walk out there and take a look at the waterfront and take a walk and see all the beautiful amenities. So great job to Port of LA and the City of LA and what they did with the project.

I wanna do a little bit of follow up on a meeting that took place in April. We had a joint workshop with our PAG and CBOSG. Wanna thank everyone who participated in that meeting. We got some really good feedback, really helped us improve our process. You know, every time we hear from you and get recommendations, you know, we learn and we get better at holding these meetings. So thank you for all the feedback that we've received.

Based on the feedback, want to highlight a couple of changes that we've made to improve, how -- how we incorporate feedback into our work. The first one is the preliminary findings, that's what we announced at our April meeting. So you'll notice that we've been issuing preliminary findings under a new format. Hopefully, you find that format helpful and useful and digesting the information and allowing you to give us feedback on the findings.

You're also gonna notice today that every time we do a presentation we're gonna include a feedback summary at the end. This is gonna really highlight some

of the themes that emerge from the comment letters. It's not gonna be a comprehensive list of every single comment we received. We will be responding to all comments in our quarterly reports.

Speaking of quarterly reports, you may have noticed that on Monday we issued our Q1 Report hot off the press. Hopefully, you've taken a -- you know, gotten a chance to review that, got some really good comment letters, and responded to those. I think you're gonna see, too, that we're gonna be responding to themes in global responses. And then anything that doesn't -- that isn't covered in a global response, we'll respond to individually. So hopefully, you have an opportunity to review that.

All of the comment letters that we receive are gonna -- our goal is to post those to a living library within days of receiving them so you don't have to wait for quarterly reports to see what others are saying. You can have quick access to that. So that's just a couple of things.

We also heard from you that you want us to continually communicate feedback, window status, milestones, and process. So in response, you're going to see in the e-mail communications that we're sending to you that we're going to be attaching the feedback

window matrix to all e-mails so that way you don't have to dig for that information in the living library, you'll have it in the e-mail communication. And then we're going to be providing a preview of what draft reports we expect to issue next month.

Speaking of draft studies, all preliminary findings have now been issued and we actually issued our hydrogen leak -- leakage assessment draft study at the end of May. Hopefully, you've had an opportunity to review that. I believe the window for comments is still open. I think, closes on the 25th, I believe -- 25th, so we're close by.

Thanks to all of you who've submitted comments. We've been reviewing all of your comments. I'm proud to announce we're working -- we issued the First Quarterly Report, and we're working on the Second Quarterly Report. So thank you for submitting those comments. We're reviewing all of those.

I do wanna take a moment and just really emphasize that we're very close to releasing a lot of draft studies over the next several weeks. So I wanna kind of just prepare you for the amount of information. I know a lot of you have been asking for more detailed information, underlying information. So please prepare yourselves because in between now and the next several

weeks, there will be a lot of information that we'll be rolling out for some of these draft studies. So I want you to prepare in advance.

As a reminder, you're gonna have four weeks to comment on -- on our draft studies. And while we hope that everyone reads every page of every draft study that we provide and all the appendices, I know that it will be a lot of information. It is not a requirement that members submit comments, although we encourage you to submit as many comments as you can on the material, but it is not a requirement. If you want to prioritize certain studies that are really important to you and -- and your members, please do so.

Speaking of members, I do want to announce that we have added a new member to the PAG: Ray Salas from the Fernandeño Tataviam Band of Mission Indians. Unfortunately, he's unavailable to attend today, but we actually met with Ray several months ago to discuss his engagement here. We have three members -- three organizations that serve on our CBOSG that represent tribal communities. We've heard some feedback from the CBOSG that this group could benefit from additional tribal representation.

So we've been in communication with Ray raise an expert in energy. Ray actually asked to join the PAG in particular. He felt he could contribute more to some of the technical aspects. So we're really looking forward to his engagement and his contributions to this PAG. So hopefully, he can join us at a future meeting.

Speaking of the CBOSG, we did meet with them earlier this week on Tuesday. They received the same information that you're gonna receive today. But we did have a couple of speakers that won't be here today that I wanted to highlight for you. We were joined by Joy Langford [sic], the chief community benefits officer from Arches. She showed up early in the morning in gave some welcome remarks, and introduce herself. Explained to the group about how Arches is starting to plan for some of their work in community outreach and community benefits, and provided some opportunities for members to engage.

And then we also had a panel on community benefits, and we had Veronica Soto from LAWA and Robert Signs [sic], a consultant, and formerly from the La City Community Economic Development Department there who have a lot of experience in developing community benefits.

And I believe it -- it provided a very robust conversation and engagement around how we start to think about community benefits for subsequent phases.

In terms of a look ahead -- kind of wrap up my own remarks here -- please save the date for our summer workshop meetings. We've sent out a notification that our CBOSG meeting is gonna take place on Tuesday, July 23rd and our PAG is gonna meet on Wednesday, July 24th at our Energy Resource Center in Downey from 10:00 a.m. to 2:00 p.m. So please hold that date if you haven't done so.

Some of the tentative topics that we plan to address at that meeting will include routing, pipeline sizing and design, permitting and production, and the presentation of our ESJ plans. So a lot of important information both covered today in that upcoming workshop.

So I'll stop there and turn it back over to you, Chester.

CHESTER BRITT: All right. Thanks, Frank, great update. I'm going to now. Turn it over to Yuri Friedman, the Senior Director of Business Development for Angeles Link and SoCalGas, and he's going to make a presentation first on the project options and alternatives.

YURI FREEDMAN: Thank you, Chester, and good morning. Once again, thank you. As Chester laid out, there will be two presentations I'll make today. They

are related to each other but they're separate. The first one that we are going to go through right now is the review of projects, options, and alternatives. It is going to describe how we went about analyzing in various ways to deliver hydrogen to Los Angeles Basin, as well as the alternative's mission on hydrogen.

And then the economic analysis is going to dig significantly deeper into the cost-effectiveness and comparison of costs of delivering hydrogen as well as the -- all the alternatives of providing the same service.

So project options and alternatives, the first slide -- next slide, please.

It's me whose gonna drive that.

(No response.)

YURI FREEDMAN: So okay. I'm talking to myself. I do it a lot.

CHESTER BRITT: Want me to do it?

YURI FREEDMAN: No, I'm good.

So the project options or alternatives evaluates portfolio of hydrogen delivery alternatives as well as non-hydrogen alternatives, which importantly includes electrification and a localized hydrogen hub.

It's important to step back and to talk a little bit about how this study relates to several others, and the three I would like to focus on for now are pipeline, routing -- well, size and design, high-level economic analysis and cost-effectiveness, and environmental analysis and environmental social justice plan.

The first of the three is reasonably intuitive, because the outputs of the study of pipeline size and design ultimately can be translated into costs. Those costs are, obviously, an element of analysis of economics and cost competitors. So that's how the outputs of pipeline size and design study are serving as inputs into the cost -- into the economics and cost-effectiveness.

Now you can see that the economics and cost-effectiveness, among other factors of course, is going to take the conclusions of this study -- which we're talking about right now -- project options and alternatives. And we will explain a little bit later how we narrowed down the list of options that we examined from the economic standpoint.

And last, but not the least, that the alternatives that meet the criteria established in the project options or alternative study will be carried forward to analyze from the environmental standpoint as well as from environmental social justice standpoint. This is a -- maybe a very brief description of relationship between this study and others, not the only relationship, but, again, between the 16 studies who are performing there are multiple links and interrelationships.

Let us, again, recap the 6-step process that we went through. That process starts from the identification of the alternatives, including localized hub, as we directed to do by the CPDC Decision. We then evaluated those alternatives against identified criteria, which we derived from the purpose and need of the project.

The alternatives which were not adequately meeting this criteria were dismissed as step three. And step four is, we then carried forward the alternatives that were meeting the criteria for further analysis. Step 5 is what we've described before, which is the cost-effectiveness, environmental studies, and environmental social justice analysis and stand the step.

Six ultimately is the incorporate findings and -- into the studies and to the -- excuse me -- to evaluate the alternative fulfillment of purpose needed a

project.

(Off the record discussion.)

YURI FREEDMAN: Sorry. I may be too far from the mic. Thank you.

The next slide is listing the alternatives that we have assessed. And on your left you see the hydrogen delivery alternatives. It's important to recall that all these alternatives are examining delivery of hydrogen -- of hydrogen from California to California.

So they're all looking only to the in-state delivery. And they include here localized hub, power transmission distribution, which, with basically in-basin hydrogen production, as well as the various forms of trucking, hydrogen could be delivered by trucks as a gas or as a liquid. Shipping, hydrogen can be shipped by the waterborne pathways.

We also examine methanol shipping as well as ammonia. And we also looked at the compressed truck and liquid train shipping. That's the combined delivery or maybe intermodal delivery. Importantly, on the right you can see the non-hydrogen alternatives. And they include electrification, carbon capture, and storage. There's a list of alternatives which we evaluated for

specific use cases, but not included into the alternative analysis and they, as you can see here, There's a list of alternatives which we evaluated for specific use cases, but not included into the alternate analysis. And they, as you can see here, include renewable natural gas, energy efficiency, nuclear, hydro, geothermal, plug-in hybrid, biofuels, and ethanol.

The next slide lists, the criteria against which we evaluated our alternatives and those criteria are effectively the columns on the chart they are we'll go into them a little bit more detail. For now the purpose of this slide is to indicate that the analysis of high digital alternatives had slightly different set of criteria. As you can see, the check boxes indicate which alternatives we've used. So you can see that for the hydrogen alternatives we've used state policy, range, reliability and resiliency, ease of implementation and scalability.

For non-hydrogen alternatives we examined state policy but also the technological maturity as it relates to the use cases. We did not look at range, but we examined, as you can see, for non-hydrogen alternatives, reliability and resiliency, ease of implementation and user requirements, which is quite important, and

scalability.

So with that, let us go to the next slide, which gives you a made -- maybe the first impression of how the various alternatives which are listed here as the rows in the table on the right screen up against various criteria.

Before that, again, let's review the criteria once again. State policy is effectively alignment of a certain alternative with California's environmental law and public policies. Range is the ability to effectively deliver hydrogen to support needs of specific category of users or reliability and resiliency is support of those important parameters.

Ease of implementation is whether or not alternative can be implemented using existing infrastructure, or considering that. And scalability is quite important, too, because to meet the State's carbon, neutrality goals the alternatives have to work at scale and therefore scale and potential to meet expected future need is an important factor in assessing those.

So moving from that to the right hand side, you can see that the color gamma that we use to rank these alternatives against the criteria ranges from dark blue, which is the best fit, to pink, which is the lowest fit.

And we will go into that into more detail on some of the following slides.

But now let's focus on the alternatives, and that's a bit of a recap. The alternatives which we carried forward for the granular analysis includes on the right gases and liquid hydrogen trucking, liquid hydrogen shipping, methanol shipping, in-basin production of hydrogen using electric transmission distribution, and localized hub.

We also examined non-hydrogen alternatives, electrification carbon capture and sequestration as they relate to the use cases, and we'll talk a little bit more about that.

Let's go over the alternatives in a little bit more detail. Gaseous trucking -- again, it sounds fairly self-intuitive but to be sure we're all on the same page -- it's hydrogen being produced at the defined production point and then being compressed and loaded at production facilities and transported by a truck in a -- as a compressed hydrogen to the endpoint where it's going to be used.

Liquid hydrogen is different in that we are liquifying hydrogen at the production point, and then we're loading this into the trucks which are going to deliver it as liquid where it's going to give -- be used

either as liquid or as gas depending upon the use case needs. Liquid hydrogen shipping follows that this is the specialized vessels which transport liquid cryogenic hydrogen to Los Angeles area to be transferred into storage spheres, and then, if need be, regasified.

Methanol shipping is using the methanol as if -- as a hydrogen carrier. Effectively vessels can transport methanol like, for example, from Northern California to Los Angeles area, and then being transferred to a conversion facility where it's going to be converted back into hydrogen.

In-basin production, using electrical transmission distribution, again, it is almost self-explanatory. It's the question of whether or not we could, instead of delivering molecules to the L.A. Basin, deliver electrons and produce hydrogen close to the demand sites.

And last but not the least, localized hub as part of phase one, we were directed by the Commission, and that's what we did. Studied the feasibility of localized, clean, renewable hydrogen hub located in the Los Angeles basin with hydrogen production being relatively close to hydrogen use. The next slide recaps very briefly the two non-hydrogen regional alternatives. And the first one is electrification, which relates here

to the combination of a system level transformation and use-case level technology changes, including the grid infrastructure required to support growing electric load. It's important -- and we make references to here in the footnotes. But it's important to mention here that we, within this phase, conducted the analysis only as it relates to the use case, because, as I know we've discussed before, the analysis of the grid level, notification is going to involve very substantial amount of modeling, which we look forward to doing the future phases, but now the analysis was limited to the use case level.

Carbon capture and sequestration refers to the capture of carbon dioxide and sequestration technologies, which is the process of storing this in underground geological formations. Now, let us go and take a closer look at the various color, you know, Gamma, if you will, rankings of those alternatives, again, with some commentaries on the right.

The Angeles Link appears to be a very good fit. In fact, the higher, the -- the best fit on multiple criteria, as you can see, dark blue all across the row. The one, which is the light blue, is the ease of implementation because of complexity, which we -- I think we all understand of designing, developing, and

building large-scale infrastructure.

Liquid hydrogen shipping, in contrast, is a aligned with the State policy, but to a lesser extent. And, as you can see, it addresses reliability and resiliency, ease of implementation and scalability to, again, lesser extent. Just by virtue of the fact that The pipe lines are more reliable ways of delivering energy as indicated by the -- what we know today about natural gas pipelines.

So I think what I will not be going -- what I will not be doing is to go over each and every box. I can hit a point to sound a specific boxes here, which relate to different criteria. For example, in-basin production of -- with Power T&D -- with power delivered to the basin, it is aligned with a state policy.

The challenge with that is scalability. As we'll talk later, there's a limited amount of power that you can bring to L.A. Basin in the moment of need. And there's also equally, if not more, limited amount of land for production of hydrogen in the vicinity to the end users.

We can see that if you go to, for example, the gaseous trucking. It's something which is being used today. Technology exists, is mature. That's why ease of implementation is colored dark blue. However, again, scalability as well as cost-effectiveness, which we will show in the next study, I hear significantly lower than for other alternatives, specifically for Angeles link.

And last, but not the least localized hub is clearly aligned with the State policy. The issue, of course, becomes again, scalability, cost-effectiveness as well as range. Ultimately the question is: How much hydrogen can be produced within localized hub concept? And the answer is: Rather little and at rather high cost.

With that, let us move to the analysis of the non-hydrogen alternatives. And the -- again, note that this has been done by the -- what we call use-case level. So if you look at the second column from the left you see those use cases which we analyze here, their power, mobility, industrial heat, and cement. You see on the left for each of those we compared and Angeles Link and electrification. The slide after that is going to compare the - they -- kind of do the same for carbon capture and sequestration.

But for now, comparing Angeles Link with the notification, we can see that, for example, comparing this for power, both Angeles Link and the electrification are in alignment with the State policy. The issue with electrification, as we will see, is going

to be significantly higher cost for the end use effectively. For this use case, we're asking the question: Is it better to bring clean, renewable hydrogen to the power plant and use it to generate power when you need that? Or is it better to put the batteries and provide the same service with batteries? And economics suggests that it is significantly more cost effective to do it with hydrogen.

Moving down to mobility again, both battery -- well, in mobility, we're comparing fuel cell electric vehicles and battery electric vehicles, which, by the way, are both, of course, electric vehicles. So they're all in alignment with the State policy. The Angeles Link is going to be superior because of the reliability that pipelines are going to provide, to deliver hydrogen to the point of use.

It's also is going to fit well end-user requirements, specifically as it relates to the long haul, heavy duty sector, which is the sector where, due to the high payload due to focus on high utilization the fuel cell eclectic vehicles are technology of choice.

This is the mobility overview. The -- the industrial heat, as you can see, the cost-effectiveness there is going to be an issue for direct electrification. Industrial is very a broad term.

We're describing some of the specific applications where you need high heat and where molecular heat is going to be called for.

And again, last, but not the least, cement. Cement is something which is going to be significantly more cost-effective then electrified just because of the nature of the process.

The next slide is going to provide you the recap of thematic comments, the -- that was given -- provided by various stakeholders on their support. And one comment that was provided to us is that it's important for us to demystify hydrogen for the average consumer.

Along with providing this detailed technical analysis, it's really important to make sure that communication to the average. The general public to the average consumer is going to be important, especially in the context of the DOE Award and partnership of SoCalGas with ARCHES.

We agree with that, and we are going to continue using PAG as well as CBOSG Engagement to help expand education around hydrogen's role in helping the State achieve its decarbonization goals: Reducing emissions, improving air quality and enhancing our ability and resiliency. The comment -- another comment

which was provided to us is not to include methane fossil fuel enabled alternatives and focus on electrification. Our approach in line with the decision of CPC is to analyze alternatives that support California decarbonization goals.

We did analyze the authentication as directed by the final decision as requested by the stakeholders. Another comment that we received was to include localized hub electrification of end uses, trucking and marine shipping, and behind the meter green hydrogen production and use of electrolyzers powered by on-site renewables or grid delivered renewable electricity.

The options listed here are being addressed as part of project options on alternative study and the production plan and assessment study will analyze production of electrolytic hydrogen powered by on-site renewables as well as curtailed renewables when feasible.

This concludes my presentation of the project options and alternatives Analysis.

Chester, over to you.

CHESTER BRITT: All right, thank you, Yuri.

So as we get into the member discussion, just a couple of quick reminders. If you're here in person, we've kind of developed a little standard where you just tip your name card on its end, and then I can know that you would like to speak, and we'll call on you. If you're online, you'll need to raise your hand. You can also chat a comment as well, and then we'll call on you as we see that.

For the member discussion, I just want to remind you to please announce your name and speak directly into the microphone so our court reporter can document who's speaking. Make sure you name your organization as well. Be concise and focus on the discussion topics, if you might. That would help us keep our discussions focused on the topic at hand.

We will, as you know, have more meetings. This isn't on our last meeting. And so if there are other things that you'd like to talk about, you can always talk about them with staff during the breaks, in between meetings and other things; but for today, please, let's keep our discussion on the topics at hand.

The verbal comments are not your only way to provide input, so if you'd like to submit an e-mail or a letter or make a phone call to Emily or others between meetings, again, we're documenting everything as you're providing it to us, and we are accepting written input after the meeting, as I mentioned.

So with that, I see a few people in person.

We're going to go to those first.

And Norm, I'm gonna go to you to begin. If you could just announce yourself.

Get the microphone over to Norm and then start the process.

NORMAN PETERSON: Thank you for that run through, Yuri.

Norman Peterson for Southern California, Generation Coalition.

I'd just like to catch up to where we are here. In Slide 11, you introduced the project options and alternative study. In the June 11th review of the schedule that you circulated to the list for this -- this activity for the PAG you showed the draft findings is being released on June 4, and I don't recall them being released.

Could you help me catch up on -- are you going over on what we're doing here? Are you going over something that we have seen released or are you giving us a preview?

CHESTER BRITT: Yeah. So just to be clear, we did have all the preliminary findings released for all the 16 work studies. And we gave you -- I think it was 2 -- two to three weeks to provide comments. Today's meeting in the presentation is a preview of the draft

study that's going to be released. As Frank mentioned, following these meetings, we're going to start releasing the draft study. So today is just a preview of that.

NORMAN PETERSON: Okay. So the June 11th shareholder input, due date schedule that we had circulated to us shows project options and alternatives, Draft findings, June 4. Actually, we didn't get those on June 4, we're looking forward to getting those, you're saying, Chester? Is that right?

SHIRLEY ARAZI: Let me clarify if it helps. So we issued the preliminary findings, which is like those deck formats earlier that you may have seen already, but the actual draft report, which is the more extensive report with all the details, that has not been issued yet. This is a preview of that. So you'll see that full, kind of, draft report in the coming weeks.

It hasn't been issued yet. But you saw preliminary findings already in that, like, kind of, deck format.

FRANK LOPEZ: Yeah. And if I can just add to that too, Norm, so she mentioned that this is a preview of the draft study, but the draft study itself will not be presented in this format -- right -- this is just a summary for presentation. The draft study itself will be a Word document with -- it'll be a lot more detailed,

become more of a traditional study that you would expect.

NORMAN PETERSON: Okay, so we didn't get the draft findings on June 4 --

FRANK LOPEZ: We did.

NORMAN PETERSON: -- I went back and I thought, 'Did I get June draft findings on June 4?' I didn't find draft findings from -- on June 4, so we're looking forward to getting the draft study -- a pro's presentation of what Yuri just gave us in slide deck format.

YURI FREEDMAN: Yeah, I think, maybe, if I can help, I think there's distinction between the draft findings, which you did receive; right? And the draft study of the draft final report. This is the condensed summary of what you will see in the draft final report. You have not received that yet. What you did receive before, is a draft findings. So that's two separate steps in this process. So we got now --

NORMAN PETERSON: Well before June 4?

CHESTER BRITT: Yeah. June 4, was the actual due date for your comments, I believe.

EMILY GRANT: Yeah, we have the due dates listed on the matrix --

NORMAN PETERSON: Oh, okay.

EMILY GRANT: Not when you receive it. Thank you.

NORMAN PETERSON: Okay. Okay.

CHESTER BRITT: So the good news is, you haven't missed anything.

(Simultaneous talking.)

NORMAN PETERSON: Yeah, that's why --

CHESTER BRITT: And you still have an opportunity to comment.

(Simultaneous talking.)

NORMAN PETERSON: That's what I was trying to figure out, Chester. You hit the nail on the head. Thank you very much.

CHESTER BRITT: No worries. All right, thank you.

Jay. Yeah, you have to turn it on. And once you do that, please make sure you announce yourself.

JAY PARPALI: Hi, Jay Parpali, Legal Fellow, CBE. Thanks for the presentation, Yuri. I would like to kind of ask -- and I'll highlight and conflate one

point that I think that it's an inaccurate assessment on Slide 15 that hydrogen is not a technically mature option compared to what the non-hydrogen options -- electrification being a more advanced technology and proven technology.

I am kind of concerned, though, with all of these charts, with blues to -- to pinks, from high to low, what steps are taken to make sure that this is actually, like, an objective analysis that Angeles Link gives it a dark blue, high ranking thing on every criteria?

I mean, I'd like to say that electrification is a high blue on everything and Angeles Link is a pink on most things. What are the steps taken? Because these are not just promotional and persuasive, but rather, objective metrics that are being used and analyzed here.

YURI FREEDMAN: Thank you for the question. And to begin with, the -- the criteria that was selected was selected in order to address -- to compare the alternatives with Angeles Link from the standpoint of purpose in need of the project. That's where the State policy arrangement, reliability -- excuse me -- and resilience and others, this is the criteria that was selected for that purpose. The comparison of Angeles Link with these alternatives was made based on the

information. It's available -- us -- in the public domain by and large, specifically. And, you know, if we are looking at reliability and resiliency, we can go to the data on reliability of gas systems versus the alternatives. And this data is available. We're happy to provide that.

I think it's objective information that the failure rates on gas pipelines are significantly lower than on, pretty much, all the alternatives listed here, which is why, as you can see, and the reliability -- I'm just picking this one to talk it through -- which is why you can see that the Angeles Link is screened here dark blue.

It is not screened here dark blue, because it's a -- promotional material. And The screen based on the fact that reliability of gas systems has been historically over decades shown to be quantitatively superior to these alternatives, that effectively is the way we approach that.

Another way to think about this cost-effectiveness is the one that is non-transparent here, because there's a degree of -- called circularity here. You will see cost-effectiveness in the next study. So here you have to take it for now, and faith that this is a decent summary of what you will see in

the slide that we'll go through after lunch. That's how it's built out. But that's fundamentally how I went about this.

FRANK LOPEZ: Can I add to that, too? I want to mention that one way we can ensure that this is an objective study is -- is by doing this, right? Is by holding this PAG meeting and making sure that we have diverse representation from stakeholders who have a wide range of expertise and deep expertise in this field and putting that material out for comment, right?

So we -- we put it out in draft form. We put out information around the scope and approach, the actual preliminary findings, the draft study itself, providing folks opportunities to comment all along the way and give us opportunity to scrutinize that information before it makes it final.

CHESTER BRITT: All right. I'm going to go, now, online. I'll come back to you, Joon, in a second.

We have Julia Dowell, who -- I don't believe you introduced yourself when we did the roll call, but if you could unmute yourself, we should be able to hear you and welcome your comment.

JULIA DOWELL: Hi, yes. Thank you very much. I jumped on after the intros. So hi, everyone. I'm Julia Dowell. I'm with Sierra Club. I work on our

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electric sector work throughout California. I have two questions for you. So thank you, again, for this presentation.

Can you speak to how Angeles Link complies with (SB) 100 State policy of 100 percent clean energy by 2045 if you are not planning to use 100 percent green hydrogen in this project? That's my first question.

YURI FREEDMAN: Thank you for your question. Hydrogen Angeles Link is intended to be green, renewable hydrogen transportation pipeline, therefore, it is going to be in compliance with (SB) 100.

JULIA DOWELL: Okay, that's great to know. So you are planning on using all renewable sources to generate this hydrogen?

YURI FREEDMAN: Angeles Link is intended to be clean, renewable hygiene, transportation, pipeline, yes.

JULIA DOWELL: Okay, thank you. My second question is: Can you speak to what assumptions were used in determining that the Angeles Link is less expensive than electrification?

YURI FREEDMAN: Excellent question. And I think I'll have to, maybe, double down on what I mentioned to Jay. I would ask for patience in waiting for the answer, which will come through in the cost-effectiveness study. This is the -- the next study

which we're going to review is where we're going to go through the numbers which form the basis for the ranking that we present here.

JULIA DOWELL: Okay.

FRANK LOPEZ: Yuri, a clarifying question, too. Electrification. Can you just clarify what is in electrification? Right? We're not -- like, are you including, like, electrification of residential buildings? Is that part of electrification, or only hard to electrify sectors?

YURI FREEDMAN: It's the latter.

Thank you, Frank.

And again, to be -- maybe Slides 16 -- Slide 21, I believe, is going to be a good depiction of that. Again, I -- let me draw attention to the second column from the left. We analyze the comparison with the electrification based on the use case, and specifically, we focus quite heavily on power and mobility.

So the comparison is different for these two cases. For power sector, the alternative to bringing hydrogen to power plant and using it in the turbines is to put batteries. And that's what we compared for the cost-effectiveness as well for other -- from other criteria standpoint. Formability, it's a different comparison. It's comparison of battery, electric

vehicles with fuel cell electric vehicles in the various classes of transportation.

So I'm hoping that provides enough answer to the question, but I acknowledge that the information on the numbers is not in this study, it will come through in the cost-effectiveness study, which is to follow this one.

CHESTER BRITT: All right.

Julia, does that satisfy your question, or would you like any follow up?

JULIA DOWELL: That's good for now. Thank you.

CHESTER BRITT: Thank you. I'm gonna switch now to Joon. You could announce yourself.

JOON HUN SEONG: Hi, Joon Seong, Environmental Defense Fund. Thank you for the presentation. I had a one quick comment, and -- I'll start with a question first, and then a comment. So for the question, going back to Slide 16, you mentioned various scoring criterias for the different alternatives.

I was wondering if the report would provide some sort of a combined matrix. Since -- I assume the criteria are individually weighted differently, there are probably certain criterias that matter more or matter less, and the different ranges of the colors provided here are probably -- indicate some sort of

different ranges of liability or realistic possibilities.

I was wondering if the report would have some sort of a weighted metric or weighted average applied to these different criterias so we can get a sense of how the alternative stack up to each other. Now that's my first question. And I guess my comment was in Slide 21 on the use case alternatives. I was wondering if the report would have some sort of more granularity, because there seems to be a lot of caveats.

For example, when we're talking about mobility and comparing alternatives for mobility; and it seems to be, for example, hydrogen have advantages for specific classes of mobility. I was wondering if that would be spelled out more clearly in the draft report.

And also it would take into account additional various cost factors and logistical factors, for example, we're talking about mobility, would have to take into account last mile problem of getting the hydrogen from whatever hydrogen storage facility Angeles Link next to the actual refueling facilities. And I think, obviously, you can't think about the -- the alternatives of hydrogen, the mobility sector, without taking into account these other additional factors. So I was wondering if the report would kind of spell out that level of detail and granularity. Thank you.

YURI FREEDMAN: Thank you on the first question, we are providing quantitative data on the cost-effectiveness. Again, as you will see very soon in the -- in the presentation, and the following report is going to go into fair amount of detail on that. We are not developing all the metrics in quantitative fashion, but we are providing detailed discussion, why we rank them the way we do. On the second one, the assumptions about the physical, if you will, configuration of the assets that underpin our economic analysis will be provided in the report.

CHESTER BRITT: Alright, I'm gonna switch now to Sophia. You can announce yourself.

SOPHIA DUBROVICH: Sophia Dubrovich, Local 13, International, Longshore, and Warehouse Union. I just wanted to make a quick comment. So as someone who will be on the forefront of, you know, the error and all of that and someone who will be an end user of the hydrogen, or who would like to be an end user of the hydrogen, I would like to add that, as I'm speaking to these terminal operators who will be purchasing the hydrogen and using the hydrogen for their equipment and so forth, they've actually shared their concern. And one of the things that they've said is that they do

believe that hydrogen is a more attractive option to -- for hard to electrify sectors, such as the port itself.

It doesn't mean that there isn't a place for electrification at the port, because we have little pickup trucks that we're able to use, or little buses that we use to get to and from the ship, which would be perfect for that. But as far as using heavy equipment and heavy operations that do go on at the port, it's just not feasible.

And this is just information that I'm getting from talking to terminal operators who will be making these big purchases. And one of the things that he did mention that stuck with me was that, you know, he's ready for using hydrogen, he just needs a delivery method.

And trucking -- getting the hydrogen to him by truck isn't -- isn't cost-effective. So I just wanted to add that real quick that the terminal operators are seeing hydrogen as a more attractive option.

CHESTER BRITT: Thank you so much for your comment.

Janice.

You could hand the microphone, Sophia, to Janice.

JANICE LYNN: Thank you. I -- Janice Lynn,

from the Green Hydrogen Coalition. I wanted to build on that comment because we actually conducted a system-wide study of what's possible here in Southern California for a scaled green hydrogen economy.

And our first instinct was, you know, can we bring the renewable electrons in via the existing transmission and distribution system, and just make it here? Because, obviously, there are no pipelines today, so let's just use the existing infrastructure.

We hired a consultant who's very familiar with the LADWP system, like, power flow models, the whole thing, and found that even with the planned transmission capacity enhancements that are underway, there's just not enough for the amount of renewable electricity that would be needed to go after the opportunity at hand; that opportunity being all that Diesel use here at the port, all the Diesel use on the trucks.

So we also looked at the cost and found that even if there was sufficient transmission capacity, it would be much more expensive than pipeline transport, just the energy, density, and pipelines is so much higher. And then, on the electrification question for the different applications, we came up with a scenario for mobility, and it was based on what had the lowest total cost of ownership and some mobility applications

would certainly remain battery electric, but there were quite a few where the total cost of ownership was much less with a fuel cell and hydrogen solution, particularly because of payload duty cycle, and, you know, other factors.

So I think it's really interesting the findings that are shown here because it's quite consistent with what we found through our independent analysis a few years ago.

I have one question, too. Just -- I'm -- I'm wondering if you could just explain the difference between the localized hub and the in-basin production. I just want to make sure I understand those two scenarios.

Thanks.

YURI FREEDMAN: Thank you, Janice, and thank you for comments.

In-basin productions effectively bring in this -- as close to the end use as you can, which is to say, literally, making hydrogen at the point of use. From mobility, for example, build a hydrogen refueling station, bring the wires into it, make hydrogen there on the spot, and then distribute that. Same goes for the power plant. Can we make hydrogen pretty much inside or across the fans from power plant? A localized hub is a more inclusive concept in that it -- it examines the question of relative proximity to Los Angeles. Let's just call it 10 miles 20 miles without going all the way into the desert, s there enough land to make enough hydrogen that -- to satisfy the need that we identified? And is it cost effective?

So it is definitely something that we have taken very close look at. And, again, we can talk about the conclusions of that, but the short of it is that localized hub is taking the broader look, not just at the immediate point of use production possibility, but also in the vicinity of Los Angeles metropolitan area.

CHESTER BRITT: All right.

Janice, is that good?

All right, if you could pass the mic to Mike, we'll just keep going around.

Ernie, I'm going to come to you eventually.

MIKE GALVIN: Yeah. I just wanted to add to what --

CHESTER BRITT: Mike, could you introduce yourself.

MIKE GALVIN: I'm sorry. Mike Galvin, the Port of Los Angeles. I just wanted to add to what Sophia and Janice said in regards to the heavy duty. So we have in between the two ports 3,300 pieces of equipment, and

we've heard that they're not all heavy-duty pieces of equipment. So there are several pieces of equipment, smaller, light, medium duty, that make a lot of sense to go battery electric.

But in the heaviest emissions emitters which are top handlers, reptile gantry cranes and UTRS, the duty cycle on those pieces of equipment can go 18 to 22 hours, and they need to run consistently that whole time. And they could be doing a variety of different work cycles, and some of which could be lower durability need, and -- and some of which could be much higher.

And so you need something that's reliable all the time that doesn't require an operator to decide "I'm gonna use that one or that one," but that just will work in any type of job that it has in any day for that whole shift, because you will only be able to refuel at the end of the shift.

If you replicate the current system, and that's the important part that I wanna highlight, the resiliency of the port, It's extremely important. The way that -- that labor works today, works really well. We've had some hiccups throughout the COVID process, but we worked our way through that relatively quickly, and these ports are extremely efficient, and the labor force is extremely efficient. But disrupting that whole

system is not a way to maintain that resiliency. And disrupting, meaning that using battery electric for every single job out there, first, there's the capacity issue that Janice mentioned. There's just not enough electrons to -- to do that. There's a durability issue that Sophia sort of mentioned that there -- it's just not is durable. We can't rely on it, and we're seeing with hydrogen fuel cell technology that is being tested in our facilities today that it can be that durable.

But the resiliency is really important. And that's a resiliency of the system that works today, the infrastructure that's on the ground, and how boxes are managed, and how the system gets a significant amount of cargo in and out on a daily basis. But it's also the workforce and making sure that as we transition to zero emissions that we don't leave people behind, and that the workforce can adapt, and hydrogen does provide that drop in fuel that works just like Diesel, and that the workforce can adapt to relatively easily, continue to do their job in a very, very successful and efficient way. And so I think that's really important as we look towards this big move towards zero emissions, which is extremely expensive for all of our terminal operators. They wanna make sure that the system continues to work the way that it does today. And we wanna make sure that

the people that are working out there can continue to do their jobs in -- in a very similar fashion to the way they do them today to maintain the resiliency of the port.

So those things are important. And that's why we see a hydrogen as -- as an alternative in -- in certain heavy-duty scenarios that works really well.

CHESTER BRITT: Thanks for your comment, Mike. Pass the microphone to Ernie.

And, by the way, before Ernie, you speak, Ian, I see your hand. We're going to come to you. We're just going to clean up the people in the room first.

ERNIE SHAW: All right. Now I'm good. Ernie Shaw, president of Local 4330, Workers Transition and Storage. Still can't get used to this. Put my hair back, man, just... It's hard to get used to.

So just a couple points and comments kind of want to, you know, kind of extrapolate on here. Understanding, you know, Slide 16, looking at that, and the blue boxes, like Mr. Parbelli [sic] was -- Parpali was saying, so the way that I kind of interpret that, you know, so -- objectiveness and all -- everything is reading each little line item, like, State policy, range, reliability, implementation, scalability. So currently just to put it in -- I guess -- I guess, people, numbers, right? As it is right now, my Local runs and operates and delivers and cleans and stores gas, you know, throughout the Southern California territories and everywhere from Needles, Arizona -- you know, Needles, Blythe, Central, all the way to Taft, and everything right in between, except for some areas.

So as it is, you know, we've been doing that time and time again, just -- just only with a handful of a membership, right? Right now we're about a 350, you know, give or take. So just on that alone, I think that's maybe part where some of the objectiveness comes from where -- I think. You know, we're not huge. We're not massive, right? So maybe that's where some of the high costs could come in, but because we're such low numbers and we're still able to safely deliver, you know, clean, store, monitor our pipelines every day, make sure we're safe, you know, take pieces out, weld pieces in, I think that's where some of the reliability resiliency comes in to -- to be able to make that objectiveness, to say, like, "Hey. Maybe this is why, Angeles Link could operate efficience -- efficiently as opposed to some of these other examples. That's not to say, though, there isn't room to be flexible for all these other pathways to be, you know, implemented. There's plenty of room. There's plenty of work, with

plenty of jobs for all of us to share, all my brothers and sisters, or non brothers and sisters to take part and sift the darn (inaudible) together, without fighting over the same, you know, t-bone steak. We can all have a t-bone steak each.

So that's one thing to kind of, like, consider. And then I like what that lady over there, Mrs. Sophia, was saying about -- and Mike -- about the reliability with the equipment, and needing, you know, that -- that sustainability to carry that through, because right now to kind of compare some of my members who are operators, they work 12-hour shifts consistently. So one guy goes off, another guy comes up and relieves him to make sure that our storage facilities and our commercial stations are able to operate safely and efficiently without fail.

So to -- to have that, you know, that -- that larger energy source be consistent to -- to you know, kind of power these, you know, this heavy equipment instead of like, "Oh, man. This is done, or we, you know, batteries, we're not relying on that. We gotta change it out," now, there's a disruption in that production and capability, I think so... I guess what I'm trying to get at is, like I said, it's just either way, being flexible with either transmission and distribution of electrical, you know, like, electrical

-- electrification or, you know, shipping, or what any of these options, I think, could be feasible, we all work together and put it together so nobody can be left out.

Thank you.

CHESTER BRITT: Thank you, Ernie.

We're gonna switch now to you, Jay. You have a microphone, if you turn it on. Announce yourself. Yeah, Ian will be -- you're -- you're next.

JAY PARPALI: Yeah. Jay Parpali, CBE. I'll try to make it quick. It was just a bit of a responsive point. Yeah, it's -- I mean, it's interesting to hear the -- the port workers' -- kind of preferences. I know that my communities that I represent in Wilmington are both interested in, but also concerned about how much port activity is going to be going on for the Pure Wind Project.

If the ports don't need electricity, then why are we going to be dredging up hundreds of acres of waterfront right now to make a sandbar to put wind turbine nasals and blades out to sea? I had a been under the impression that the Port of Long Beach and the Port of LA are interested in offshore wind to expand electrical capacity and transmission. Our frustration is that CCS -- that hydrogen when it's not fully

green -- and the phrase about intending for a pipeline to have green hydrogen doesn't guarantee that produced hydrogen that is blue or gray from steam, methane -- steam, methane reformation, which is highly greenhouse gas intensive, and is largely the way that hydrogen is made, very little of it is made from electrolysis, which is powered by renewable energy, most of it is dirty, so my -- the guarantee, I'm not sure that it's there, and maybe it's not even part of what the State requires or what SoCalGas will be providing; it might just be intending to be a green pipeline that ends up transporting a bunch of blue and gray hydrogen.

But I would see that alternative maritime power onshore, our systems that could be emissions lists, I don't know about heavy equipment. I know that batteries are heavy. I don't see why an AMP system for all these container ships that get discussed during the pandemic and otherwise of supply chain issues couldn't be supplied by clean electricity from offshore wind that is, being stationed and housed at the Port of Long Beach. So, I mean, perhaps it's not an either/or, maybe it's a and/both. But we need to ensure that green hydrogen is really green hydrogen, not just green washing. Thank you.

CHESTER BRITT: Thank you. I'm gonna switch now to Ian. If you could unmute yourself, we should be able to hear you.

IAIN FISHER: Hi, there. Thank you. Iain Fisher, Public Advocates Office. I'm glad we're on this slide. This actually kind of points to one of the questions I want to have -- ask Yuri.

Yuri, with your in-basin in production, with Power and T&D delivery, what were your assumptions in regard of the type of transmission you were thinking about?

YURI FREEDMAN: Iain, thank you for the question. So your question with regards to -- I mean, in -- in a very high-level, the -- the assumption, of course, is that we're going to use existing transmission lines to bring power in and then make hydrogen at the point of use, if you will, I have to go back to review our assumptions, which we will provide in all detail to see whether or not we assume additional transmission being built, even though, as I'm sure you know, and we all know, transmission is extremely difficult, not to mention costly to build.

IAIN FISHER: Okay. So just in response to that, we're talking about -- with the pipeline and with transmission, we're talking about point-to-point movement of energy here, one way or another. If you're

doing point-to-point -- so you're going from wherever the solar and the production is in -- in San Joaquin Valley and you're coming into downtown LA or into the ports -- you don't need to build AC. You're not -- you don't necessarily have other off takers.

If you're building in-basin, you can use high voltage DC. And high voltage DC gets around a lot of your issues with transmission sighting and planning. You can put it underground safely; it doesn't overheat; you can run immense amounts of power through it.

And so I'd like to know what -- what assumptions you're making, as far as that's concerned, and whether you've cost it -- I'd -- I'd like you to cost that out as the alternative for in-basin power if that's possible.

(Simultaneous talking.)

YURI FREEDMAN: Yeah, yeah. I think -- Sorry. Go ahead.

IAIN FISHER: If you -- and if you need kind of an indicator of how that's been done, you just need to look at the actual HVDC that runs power, 400 megawatts of power directly into San Francisco that run -- you know the -- the -- the -- that comes across the -- the

Bay. That we have -- we've -- we've done this. We can do this. And that -- I mean, what you would be talking about is, obviously, a longer line, but it -- that's that's Mari- -- that's under the Bay, but you can run HVDC underground in the same ways you run a pipeline underground.

So it has about as much distur- -- it has less disturbance than a pipeline and I would say, it is substantially safer.

YURI FREEDMAN: Yeah, Ian, let -- let us come back to you with a detailed summary of the assumption, which, again, is going to be provided in the draft report. I think there's probably very basic level of answering question, which probably is not going to answer it is that, as I think we all know, the transmission of power by wires per unit -- or transmission of energy on -- by wires is a significant, less cost effective than transmission by pipelines that, I think, has been well documented.

But with regards to whether we assume the HVDC or A/C, Let's come back to with more granular answer and just provide you all the inputs and assumptions.

IAIN FISHER: Okay. Yeah. I mean, if you've not actually looked at that, that's one of those things I would actually consider, right, because we're talking

point-to-point. You're not -- you're not necessarily delivering from free -- so you don't have to run an A/C system.

YURI FREEDMAN: Well, I think that our -- I'll just say that our -- one of our foundational assumptions here is the 500 KV a -- a -- A/C line. If if you're talking about whether or not we examined HVDC lines, if I understand the question correctly, let us come back to with that. Again --

IAIN FISHER: Yeah.

YURI FREEDMAN: -- HVDC lines are -- definitely are part of a solution and people have been developing them. I don't know that there's been a lot of them built, but it's something which is definitely worth looking at.

IAIN FISHER: And then I do have a second question about the scalability assumptions, but are those -- are the assumptions around scalability going to be in the draft report? Will they be able to -- will it be able to respond to those? The reason I ask is because the scalability curve for a pipeline looks different to the scalability curve for, say, trucking. And I just want to understand how you how you took that into account.

YURI FREEDMAN: Yeah. Well, one of the ways --

I mean, the -- the really granular way, Iain, that we broke it down, actually, is when we look at localized hub, because then in conjunction with the production work, we have an assessment of how much hydrogen can be produced within localized hub and the localized hub assumptions as well as the -- what costs of that hydrogen is going to be.

So that work actually has been done bottom up with a substantial degree of granularity. I think with regards to Angeles Link, we can assess the scalability because we can compare the costs and the cost-effectiveness of various scenarios of the -- throughout the pipeline.

With regards to, let's say, trucking, there's no question that it has a role. And, in fact, as I think we all know, hydrogens being tracked today to the refueling stations. I think scalability of this is limited by just virtue of the -- you know, difficulty of running, you know, not dozens, but hundreds and ultimately thousands of trucks through environments, including urban environments. So it creates logistical constraints, whether it's liquid or gas, so to speak. So it's basically going over the -- pathway by pathway and discussing that. And we are going to provide more granularity around that in the report. This, obviously,

is just a PowerPoint slide summary.

IAIN FISHER: Okay. Thank you.

CHESTER BRITT: Thank you, Iain.

Mike, did you wanna follow up?

MIKE GALVIN: Okay, that's working.

So Mike Galvin Port of Los Angeles. I just wanted to respond to what Jay said. Electricity is really important to the ports because we do see pathways to get to zero emissions with electricity. Everything that we do with alternative marine power and plugging in ships is extremely important to reduce emissions. Ships are the biggest emission producers in the port and ramping up usage of alternative marine power or ships beyond the container ships is happening in this next year in -- in 2025, and we'll continue to push into all ship classes to get at all those emissions.

To do that, you need a lot of electricity, and there really is no alternative to doing that beyond treating the emissions at the stack, which there are machines out there right now that -- that are doing that, but they're in very limited quantities. So -- so the most likely scenario, for most everything except for tankers, is going to be alternate marine power. So we have to focus our electrical needs on that, because that is the biggest profile of emissions that is coming out

of the ports right now, first.

Second, in regards to the development of Port of Long Beach, I'm not from the Port of Long Beach, but we also have developers looking at different opportunities to put together wind turbines in the Port of LA as they're talking about with the Port of Long Beach.

But that's not to produce wind here necessarily. That's going into the larger energy grid. It's going to produce wind in Central California and Humboldt Bay off offshore, but it's not necessarily to produce wind right here, but it is going to bolster the entire energy grid in California, which is important, because the Port, like, I said, does rely significantly on electricity and resilient electricity, and that's why we want to use that for where we know we need to use that whether there is not an application for hydrogen, but have alternatives, and we accept all alternatives to get to zero emissions and really want to not leave anything on the chopping block because we're going to have failures along the way. And we need as many pathways as possible to get there. But I just wanted to explain that we are very focused on making sure the electrical grid is resilient; that we can rely on it; and we're putting in -- I believe it's about a $300

million project right now to bring more electricity onto Terminal Island, as well as to our outer harbor through Wilmington and San Pedro because we are currently tapped out right now and need more electricity in the system to get to where we minimally know we need to be with electrification of various pieces of equipment, including alternative brain power for our vessel.

So we see both pathways are very important. I just don't want to -- anybody to take away from my comments previously that we're focused on one or the other.

CHESTER BRITT: Thank you for that, Mike.

Ernie.

ERNIE SHAW: Ernie Shaw, president of Local 43 W8, Transmissions and Storage. So thank you for that as well, Jay. You know that's a good perspective. You know, something to think about. Give you, as well, some on that side of things, the -- as far as reliability and being flexible, like, I was saying earlier with, you know, electricity and all that stuff. So currently in our storage -- or at least (inaudible) and I should say, you know, we do have an electric driven compressor or EDC that we, you know, rely heavily on to, you know, operate efficiency from the, you know, from the grid. And then, you know, we -- we have a -- you know, automated valves that we were putting in, you know, changing out the old ones and getting, you know, working those efficiently, you know, and driven from, like, our SCADA boxes and stuff like that, I mean.

So just like what Mike was saying in -- in -- kind of, like, feed into the room here, not just focused one thing, you know. Like I was saying earlier, we -- just being flexible with different other, you know, sources for energy is kind of what makes everything go around. So makes sense. So yeah, definitely wanted to thank you for that.

CHESTER BRITT: All right. Thank you, Ernie. Sophia.

SOPHIA DUBROVICH: Okay. Now it's green.

So I just wanted to make a quick comment on everything that we've been discussing. I wanted to mention that, you know, I express your concern as far as, you know, you wanting it to just be 100 percent green hydrogen, which is what everybody wants, ultimately, but we also need to do everything possible to get there. And if we need some sort of bridge fuel to get there to help us achieve that, then, by all means, let's do it. And I also wanted to touch on that hydrogen equipment is on the rise and the demand for it is growing. And this Angeles Link Project will help

solve a lot of our concerns that we do have, as far as getting it to the Port.

FRANK LOPEZ: And can I add a clarification? You reminded me. I wanted to just remind folks, too, that we're not proposing to produce -- we don't -- we don't intend to produce clean, renewable hydrogen. Right? We're just mainly transporting it. And we are on the record, both in our application for the memorandum account and all the studies committed to clean renewable hydrogen. Thank you.

CHESTER BRITT: Yeah, thanks, Frank, for that, Janice.

JANICE LYNN: Thanks. I really appreciate the comment that we need to make sure that when we implement our green hydrogen economy, that it really is green and it's not greenwashing. So thank you for that, Jay.

I wanted to share that, you know, the reason why we started the green hydrogen coalition was to achieve that objective. And, you know, my personal background is in the solar industry. It's in renewable electricity. And as I was, over the years, watching more and more renewable electricity be deployed, it always bothered me that we were using natural gas at the margin to ensure reliability. And it -- at some point, we realized that to achieve that goal of a hundred

percent, unless there was some sort of clean, firm, dispatchable power that could run for many hours, even days -- and battery storage will get you there for short durations -- we were always going to rely on fossil fuels. And so you know the -- I want to come back to the why of green hydrogen, and so we can move away from fossil fuels.

And you know my starting point was in the power sector, and we said, wow, you know, we could actually do this, convert abundant renewables into a stored energy carrier and then convert that back to electricity to really achieve a hundred percent. And if we could do that at scale, then why not go after maritime shipping? Aviation? Heavy duty trucking?

And that -- and my background's in the power sector. And once we started looking at those sectors, what was so humbling was the scale and scope of that fossil fuel use today, and that we were going to need to produce really large quantities of this alternative fuel, even under a massive electrification effort. I think it was Bloomberg that came up with a forecast that in the future, like by 2050, even with massive electrification and also load growth in the electric sector, like from data centers, 55 percent of our energy demand as humans is still going to be in the form of

molecules and fuels. And at that time we looked into it, and every pathway to provide an alternative solution for these molecules, for these fossil fuels, involved hydrogen as an energy carrier.

And so that's -- I just wanted to share that's the why we started the green hydrogen coalition. But it has to be -- has to be green and no greenwashing. But the scale and scope, there's a lot of questions about transmission lines. The volume of hydrogen that's needed to even make a dent in this fossil fuel use is so large. And if we relied only on the electric system to move the molecules, there's a time factor in building all of this -- all of this infrastructure. And so, you know, the way we see it is, the quicker we can develop the infrastructure, whether it's electric infrastructure, gas infrastructure, so we can have availability and cost competitive solutions, so that end users at the Port and industrial companies can switch.

That's when we're going to move away from the status quo problem, which is fossil fuel use.

CHESTER BRITT: Thank you, Janice. Just doing a quick time check. We're almost right at time. For this discussion. But I do wanna take, Tyson, your comment online. And then, Joon, we're gonna take yours. A lot of this discussion is gonna be also carried forward into the next presentation, which is, gonna be on cost-effectiveness.

So I do wanna allow for the 2 comments, and then we will transition, probably to lunch if they serve lunch on time, and then we'll come back to Yuri and his second presentation.

So, Tyson, if you could unmute yourself, you're up.

TYSON SIEGELE: Hello, my name is Tyson Siegel. I am here on behalf of the Utility Consumers Action Network. When there has been discussion so far in -- in past planning advisory group meetings on what the basis for the hydrogen is going to be, whether or not it's going to be clean hydrogen or not, one of the things that SoCalGas has made clear in past meetings is that it does not intend to restrict transportation of the hydrogen to just hydrogen that is produced using the three pillars of clean hydrogen, which means that it opens the door to other less clean hydrogen opportunities, and it opens the door to using credits to produce hydrogen in such a way that you're actually increasing emissions, even though on paper, because of the -- the crediting system, it could appear to be clean. And so that's a real concern that The Utility Consumers Action Network has regarding the -- the claims

about the -- you know, how clean this hydrogen is going to be.

I -- I would love to hear if that position has changed. Ha- -- is -- is SoCalGas intending at this point to use the three pillars of clean hydrogen, or is it sticking with its previous position?

YURI FREEDMAN: Tyson, this is Yuri. I thank you for the question. And I will say that, as I'm sure you are very well aware, the discuss -- I assume you are referring to three pillars, as they're going to be factored into the treasury incentives for production of hydrogen. And, as I'm sure you're aware this discussion is actively underway right now. I believe that the Department of Energy received north of 29,000 comments. So the stakeholder process there is very, very active and real.

We are looking forward to that taking final shape, and as I'm sure many of the industry participants are, I will reiterate that we, as Socal guests, are not looking to be a hydrogen producer, and we obviously are at the same time going to be intensely focused on helping the State meet its decarbonization goal in full compliance with the state requirements and also with local requirements. As I think you know, City of Los Angeles is very keen on having the hydrogen green, and

we respect that. That is why we intend the hydrogen transported to Los Angeles to be green. Again, I'll repeat that we are firmly focused on complying with the -- all the environmental objectives of the State or the Federal environment, as well as the local authorities.

TYSON SIEGELE: So if I understand what you said, you still do not support the three pillars of clean hydrogen?

YURI FREEDMAN: I am not sure that we, as an infrastructure company, are in a position to support or not support something which is now a subject of the active and live discussion at the Federal level. And I think we all are waiting with a great degree of impatience for the that process to conclude, and for the Federal Government to determine their position on these attributes.

Clearly, as of now, this position has not yet been settled, as I'm sure you are well aware and just --

FRANK LOPEZ: I just want to clarify and say, I don't think it's accurate to say that we don't support 45E. The Gas Company does not have a position on 45E, but we do support efforts to, you know, transport as much clean, renewable hydrogen as possible. We're aware of the 45E comment letter, but we're also aware of the EJ Equity Principles Comment letter that was provided to

us with some of our members expressing support for 45E.

We're in receipt of those, I think, ultimately, it will just be up to the POC to determine what the hydrogen injection standard is, and we'll support clean -- transportation of clean, renewable hydrogen as part of that.

TYSON SIEGELE: I see. So what you're saying is, if the Public Utilities Commission said that only three pillars hydrogen could be transported through potential hydrogen infrastructure projects in the State of California, you would support that.

FRANK LOPEZ: We comply with CPUC requirements.

TYSON SIEGELE: I see. So would you also support the three pillars in the work that is upcoming both in Phase 2, as well as the Phase 2 application, and request that the Public Utilities Commission require only three pillars hydrogen to be transported through any sort of PUC regulated pipeline.

YURI FREEDMAN: I think maybe, at the risk of repeating ourselves, we, as an infrastructure company, Tyson, do not take position on production credits. It is not our business. It is not going to be our business. We are going to be in the business of transporting clean, renewable hydrogen as determined by the State, federal, and local authorities.

TYSON SIEGELE: I see. Okay. I -- I -- I think that -- that at this point, there are numerous advocacy groups, both environmental and consumer advocacy groups, within the State of California that are requesting that the three pillars be the exclusive way that clean hydrogen is -- is determined. I -- I hope that at some point in the future so-called gas will -- will join us in supporting the three pillars for clean hydrogen.

CHESTER BRITT: All right. Thank you, Tyson. We've noted that. And I think you've made yourself clear. So we're documenting all the comments.

I'm gonna switch now to Jack Brouwer, who might have something to say about those comments, or maybe not. But, Jack, go ahead.

JACK BROUWER: Thank you, Chester. I was not going to talk about three pillars, but I was gonna talk, rather, about -- just to add to Janice Lynn's comments because not only did GHC understand the magnitude of contribution that clean molecules must make, and clean hydrogen being the most important of it, because clean hydrogen is how you start with all of the other derivatives, the sustainable aviation fuels, and all of these -- sustainable ammonia, sustainable steel, and all these other things so... But -- but the additional

comment that I wanted to make is that for it to become cost effective, it needs a system to move it around in society like that with which we have been moving gaseous molecules previously so... And -- and GHC analyses, UCI analyses, analyses by NREL, analyses by so many entities around the globe, have found that it's couple of orders magnitude cheaper to move hydrogen around in society through pipes than it is any other way, and that's also a lot cheaper than moving energy around in other forms, like, moving energy around as electrons in the electric system.

So -- so -- but let me but let me just add that, I was really happy to hear so many people talking about electrification plus hydrogen. I heard Mike Galvin speak about it. I heard others. I'm sorry I'm not going to remember everyone who spoke about this, but it's essential for all of us in California, a State which has some of the very best energy and environmental policies anywhere around the world -- and which we can be very proud of -- as having introduced more than 50 percent of our energy on the electric grid today as renewable zero emissions and some days, 80 percent, some hours 100 percent zero emissions. Okay? So we are doing a great job, right? But if we want to go all the way to decarbonize and depollute everything, we are

falling woefully short, especially in addressing those particular applications for which hydrogen, I think, is agreed by all to play some sort of formal role.

We need a lightweight fuel for aviation. We need a chemical for ammonia and steel. We need lightweight fuel for heavy-duty trucking and ships. We need it for that. And in the end WIT will also make a contribution to tons of additional renewables on the grid because we can do long duration storage.

Okay, so... But -- but again, remember, pipes are super important for this additional vector that will that will increase the rate at which we can adopt sun and wind power. Okay. Let me -- let me make one final comment because you asked me to comment on 45E. Okay.

I am a very strong supporter for all three pillars to be applied to all of our energy conversion technologies increasingly over time by date certain. That's how we should do it with hydrogen. That's how we should do it with every additional renewable zero emissions technology that we adopt. We have to do additional solar and wind power. That's what hydrogen will allow us to do. We have to do regional production so that we can actually deliver it via some mode, wires, pipes. That's why we're talking about the hybrid case where we have wires going through it and then making

hydrogen there. That's why we're talking about some of it being made over here and delivered in pipes. Okay?

And if we have any market based mechanisms, we eventually have to have, I think, even more than hourly accounting of that renewable energy credit. Sometimes we need 15 min accounting. The CPUC has a 10 min accounting, for example, for the peaker plants. When it calls on a peaker plant, it needs it in 10 minutes. Okay.

So this must be done in our zero emissions future. How do we get there from here? I don't know, but it should be done with every technology subjected to those same requirements, three pillars for everything over time. That's the only way we really get to zero emissions.

CHESTER BRITT: Thank you, Jack.

Joon.

JOON HUN SEONG: Yeah. Hi, Joon Seong, EDF. I just had a quick question in reference to a lot of the points I think Janice made, Sophia made, I think Mike, from Port of LA made it. I think we all have an understanding here that the ports are going to be a huge uptaker of hydrogen if -- if management gets built. I was wondering if SoCalGas could provide kind of a cut across that line. Like, what percentage of the demand do we expect to come from port and port related sources? How do the different alternatives that we're evaluating today stack up in terms of that specific use case because that would be very helpful, since they are such a huge component of the discussions around the viability of Angeles Link.

YURI FREEDMAN: Yeah, great question, June. Thank you. So the information that was provided within the demand assessment that's what we've done, I think what's important to realize and not to speak on behalf of the Port of Los Angeles, but the transport -- the ground transportation out of the Port, those 20,000 trucks that are today hauling containers from that is a very big element of that. And that links up with the conversation about mobility.

So a lot of mobility needs are related to the Port. So we aren't talking just about what Mike Galvin talked about, which is the ground equipment, gantry cranes, but also the -- the heavy duty transportation to hold those containers, but the numbers are in the demand report. We happy to go over them at your convenience to take you through this in detail, because there's a lot of granularity there. It goes -- is -- is based -- a lot of it is based on work which was done at University of California, UC Davis, and I believe I believe

Professor Fulton is on the phone today and thank you for joining us, Professor.

And so definitely happy to walk you through the inputs assumptions as well as how we got to those numbers.

CHESTER BRITT: All right.

Mike, I see that you raised your hand. I'm gonna -- it's quarter to 12. We were supposed to have lunch delivered at 11:30, but we were told that it got stuck behind a train of all things. So it's not here yet. We are running now a little bit behind schedule, though, so I would like to just take a break.

Mike, we can come back to you, I think, as part of the cost-effectiveness, and I see that -- actually, lunch is being delivered right now. Speak of the devil.

So what we're gonna do then, is we're gonna go ahead and take our lunch. How would you guys like to do lunch? We had 30 minutes in the agenda. We're 15 minutes behind schedule, so why don't we just grab lunch and bring it back to our seats, and then we can kind of go into the next presentation and kind of work through lunch, if you don't mind, to stay on track. If you're online, please again take a break, grab something to eat. We should get started around 12-ish, maybe 12:05 and then we'll pick up this discussion as part of the

cost-effectiveness. Yuri will make another presentation. And this has been a terrific discussion. So thank you very much.

(Whereupon, a lunch recess was taken.)

CHESTER BRITT: All right. Well, we're gonna get, go ahead and get started. And Yuri is up again. As I -- we mentioned coming out of the last session, we're going to transition now to high-level economic analysis and cost-effectiveness, which Yuri is going to make a presentation, and then we'll jump back into dialogue again.

YURI FREEDMAN: Thank you, Chester. The study, which we are going to review right now is the high-level economic analysis and cost-effectiveness. The first slide is to level set us to -- as to the objective of the study and the way we approached it. The study is measuring cost-effectiveness of various hydrogen and non-hydrogen alternatives by performing an economic analysis to determine the potential levelized cost. The cost is going to be a levelized cost of clean hydrogen for hydrogen alternatives and there's going to be different metric for non-hydrogen alternatives which we are going to go into deeper detail further on.

This slide is intended to do what we've done in the past for the project options on alternatives, which is to say, to describe the relationship of this study with others. The previous review that we just conducted before lunch, Project Options and Alternatives, is inputs into this study. As is the pipeline size and design where we costs of the pipelines and compression will be used to compare Angeles Link and alternatives.

Production is another input into the cost effective and study, because all these elements of producing, transporting, and storing hydrogen are ultimately flowing to the levelized cost as well as the water, of course.

The alternatives, as we discussed in the previous conversation, are grouped into two categories: One is the hydrogen delivery that uses what we call LCOH, which is levelized cost of hydrogen. The other one is non-hydrogen, and there we are using the parameters which are specific to the use case. For power sector, we're using the levelized cost of electricity, LCOE; mobility Sector, we're using total cost of ownership, TCO; and for industrial sector, we are using the use-case dependent parameters it may be for; for co-generation, which is production power inside defense of industrials facilities, we use LCE electricity; for refining where hydrogen is being used as an -- a feedstock, we're using LCOH as a cost of hydrogen.

Let us spend some time talking about the assumptions, and this slide summarizes the assumptions. The sources of the inputs and assumptions for hydrogen alternatives. You see on the left hand side the list of, if you will, a value chain, production, storage, and midstream transportation.

The in the third column from the left is the data source. And as you can see, the production study serves as data source for production and sounding storage needs. The CAPEX and OPEX on the storage was taken by International Journal Hydrogen. And after the midstream, the Pipeline Sizing and Design Study served as a basis for the numbers that went into the calculations and CAPEX estimates are made by so-called gas and -- as well as the OPEX. So the last column on the right summarizes the data source for alternatives.

And going over to the next slide. The next slide recaps the source of information for -- that were used for non-hydrogen alternatives. For example, vulnerability where the alternative to the batteries is fuel cell electric vehicles. The TCO, the total cost of ownership is the metric and the source are the models

which were supplemented by National Laboratory and California, specifically, the Institute for Transportation Study at University of California, Davis.

They study as their search and assumptions for power. The comparison, as we described before, was between hydrogen power plant and battery storage. Again, the metric to look at is level as cost of electricity and the economic models and power service models is what we use to determine that.

And industry is a, obviously, very broad term. It becomes specific to the sector; for example, for that, as you can see, the cement here is hydrogen kiln and electric kiln. So we look at the total fuel cost, and we also use the modeling, which was supplemented by California based specific assumptions.

Now this was a preamble to, really, the slide. That is the summary of the information contained in the study. So this is by far the most important slide in this presentation. This is the summary, a very high-level summary, of all the quantitative work that was done to assess the total costs of hydrogen delivered to the user by various hydrogen alternatives. And, as you can see, the several segments that comprise -- issue, this category are, some of them are the same, some of them vary. The segment that repeats itself is,

of course, production. And that, as you can see, is the highest cost element almost in all the stacks, maybe, with some exceptions.

You can also see that that cost of production is fairly comparable for the four columns on the left -- five columns, in fact, on the left. It is significantly higher for a localized hub. And that's because the facilities in the localized hub scenario are going to have to be small because of land constraints.

And these -- the smaller projects have the -- what we would call the -- you know, this economy of scale where the small project has the low higher cost per unit because the fixed cost of the projects are going to have to be spread, or fewer -- fewer units of production, that's why the cost of production in this scenario is so high. For others, it's relatively comparable.

You can see that the storage is a very meaningful element of that. And I know that there have been comments and the CALPA submitted letter that pointed out the importance of the subject. We completely agree with that. That's something to look into in more detail down the line. You can see that storage is a fairly significant cost component where it has to be above ground. And then many of those scenario

storage would have to be above ground.

You can also see that transmission becomes a really significant element in some permutations, but not all them. Specifically, gaseous trucking and liquid trucking, which is the last column on the right, and the third from the right, that blue color there is so prominent because the trucking is effective for shorter distances, but not really very economic for long distances.

So transportation of hydrogen by truck and scale becomes a problem. Recall, that's why the scalability was assessed the way it was in the previous study. So again, there are lots of numbers here. Pipeline transportation by Angeles Link ends up being significantly economically superior, which is to say, lower cost than other options we have examined.

We definitely would be happy to provide. In fact, we will provide information on the granular analysis of each and every alternative here in our report. That is, the attempts to give you all the preview of how the results are looking like, and that's going to be, again, on -- double clicked in the report with significantly greater granularity. Let me go to the next slide and give you a little bit more specifics on various use-case sectors, as you can see on the power, specifically -- we -- well, let me back up for a second.

This slide is focused on non-hydrogen alternatives. And, as you remember, we are looking at them on what we call the use-case basis. Specifically in the upper left quadrant, you see the comparison of the hydrogen power plant supplied by Angeles Link and batteries.

And batteries are ending up significantly more expensive. On the lower left, you can see the mobility comparison; and that's where it's becoming granular. And that -- like, granularity may be difficult to discern on the chart, but let's just say that for sleeper cabs and for the transit buses, the combination of the duty cycle, the fueling time versus charging time, and the range makes it significantly more economic to use the fuel cells rather than batteries.

And that's why I see that the dark blue is lower than the light blue or the TCO. That is not the case for drayage, which travel shorter distances, and that's not the case -- the case for day cabs. So as you can appreciate that comparison of economics was made at a fairly granular level. And again, we look forward to sharing with you the details of this analysis in the report itself. And last, but not the least, for

industry, we took food and beverages one sector; again, to assess the economics of the cost of delivered fuel, and that's where the Angeles Link pathway seems to provide significantly lower cost to the user.

So take away of that is that Angeles Link is more economical to serve several key sectors, including power generation, mobility as far as the sleeper cabs and transit buses, and some other sectors not shown here are concerned, as well as high heat industrial processes.

The next slide you may be familiar by now with the format. It brings together what we showed in the previous review, and the cost-effectiveness. You can see that the column of cost-effectiveness now has the comparative, maybe not numbers, but the indication of the relative costs.

And that's just to bring -- to bring it all together and to review the non-hydrogen alternatives. The -- specifically, this slide is focused on electrification. And going by the use case for power from the point of cost -- of standpoint, of cost-effectiveness, it is significantly lower cost to use hydrogen fired generation, then, to solve this with batteries as it is formability. Again, with regards to specific applications within the mobility sector,

specific sectors that we discussed.

It is also the case for food and beverage. That again, that's one example that we broke out here as well as for cement industry. The next slide is going to focus on another non-hydrogen alternative, which is carbon capture and sequestration, which is continue to use fossil fuel, but capturing carbon dioxide and sequestering this on the ground to make sure that this is emissions neutral, a pathway.

On this pathway, we assess that the Angeles Link numerically may not be as advantageous as the carbon capture sequestration, which is where you can see the cost-effectiveness. The Angeles Link is light blue versus CCS is dark blue all across. We wanted to show it to you in totality, because what matters, of course, is not just economics, but also the alignment of a -- of a pathway with the State policy.

And we believe that California, with its desire to limit and ultimately eliminate use of fossil fuels, Angeles Link is better aligned with this than CCS. Even though the State of California does have an interest in carbon capture and sequestration, this is the -- and maybe the follow-on slide is meant to capture the comments that we received and the comments -- thematic comments fall in several categories. The comment that

was made about hydrogen pipeline providing the lowest cost pathway to deliver clean, renewable hydrogen to LA, that is something which seems to be confirmed by the cost-effectiveness, and economic analysis that we just reviewed with you very -- on a very high-level, of course, in a very cursory fashion.

The next comment thematically that we received was that the cost-effectiveness study does not justify their fair investment. And the point we wanted to make is that direct pair investment analysis is out of scope for this Phase 1. This is the preliminary feasibility -- feasibility analysis, where we assess the various options and alternatives from the various standpoints, including the cost-effectiveness.

And one more comment we received was that -- where it relates to the high prices for renewable hydrogen and the importance of a reasonable cost estimates. We agree with cost estimates have to be reasonable, and we are very transparent with regards to cost estimate assumptions we are using. With regards to prices, prices are market-driven parameter. They're not an element of calculation of levelized costs of hydrogen or electricity or any other metric. That's the way we laid out our approach, and we believe it's appropriate for the feasibility and previewed analysis of this stage.

This concludes my presentation, the subjects. Let me stop here and turn over to Chester.

CHESTER BRITT: All right. Thank you, Yuri. Similar to the previous conversation, we want to just stay focused on the topic. We had a great discussion on options and alternatives. Now, we're focused on the High-Level Economic Analysis and Cost Effectiveness.

So if you would like to speak turn your card up, or if you would like to raise your hand online, we can call on you and then we can entertain comments.

All right. We have a couple online.

Tyson, You're up first. If you could unmute yourself, we should be able to hear you.

TYSON SIEGELE: Hello. My name is Tyson Siegel. Today I am speaking on behalf of the Utility Consumers Action Network. The -- so one of the real concerns about what has been presented both in this latest presentation, as well as the earlier presentation, is the -- the -- the lack of information. The -- the only real information came in this particular presentation, which was outputs from calculations. And we don't know what the inputs to the calculations were. We don't know what the calculations were. We don't know, you know, where any of the information came from

in order to reach those numbers that were presented.

And when I reached out to Emily prior to this meeting asking for that information so that you can -- could provide reasonable feedback at this particular meeting, I was told it was going to come later in the -- in the upcoming report.

That -- while, you know, I -- I look forward to receiving that information in the upcoming report. That is still a -- it -- what it does is it violates the Phase 1 decision for the Angeles Link. In the decision it says, that SoCalGas is prohibited from recording any public outreach costs in Phase one.

And this meeting -- these presentations are clearly public outreach. These are not designed to allow us -- the planning advisory group -- to make meaningful feedback on what SoCalGas has -- has -- has been presenting. If -- if we want to provide meaningful feedback -- and we do want to do that -- then we need to know: What are the inputs? What are the assumptions? What are the calculations that led to these outputs? Outputs can -- can be anything. And they are dictated by the calculations, they are dictated by the inputs. If you have false inputs and assumptions, then you're going to have false outputs.

The -- the -- then I also want to talk about

another concern I have, and that is with the -- the draft studies. I -- I think that they need to include more information as well. Even when we have the -- the draft of the end study, there are numerous inputs and assumptions that I have asked for.

I have asked for the calculations that SoCalGas did. I've asked for work papers that SoCalGas used to produce that demand study. And I was told that the Planning Advisory Group will not be receiving those. If that's the same thing that we're going to be told with these studies that are presented today, you know, it's -- it's going to be very difficult to provide meaningful feedback.

And so one of the things that I want to do is to, you know -- and go -- go through some of the -- the concerns that I have about what -- what SoCalGas has done in the previous studies so that we can talk about, you know, what needs to be done in terms of sharing information with the -- the Planning Advisory Group.

For instance, in the Demand Study, what we were told is that there were numerous assumptions made that -- that were based really, solely, on SoCalGas' opinion and that is -- that's unacceptable in terms of being a reasonable basis for a, you know, possibly a $100 billion project. The -- the idea that, you know, I -- I

-- I see that there are representatives here today from a variety of possible end users, City of Burbank, LADWP, these are sophisticated organizations that can provide feedback, but they need to have the information from which they can make that feedback.

They need to also be able to have the information to be able to analyze whether or not they simply wanna purchase hydrogen to begin with. When you are taking a look at what SoCalGas has presented and then, also, knowing that SoCalGas will not commit to the three pillars of clean hydrogen, it's -- it, in all likelihood, will lead to LADWP, Burbank, and others to conclude that SoCalGas is ultimately going to be producing hydrogen from renewable natural gas, charging very high prices for hydrogen, and definitely, far more than the cost of renewable natural gas. And so it would be -- I -- I mean, it would be silly for LADWP, Burbank, or others to say, "Yes, we're going to purchase the hydrogen," when it is simply being created with a much less expensive fuel that we have access to already. And so there, there's a lot of information that the planning advisory group needs. It has not been provided with that information. And, as I -- as I mentioned earlier, these presentations are promotional materials; they are advocacy efforts; and they are in violation of the final

decision for the Angeles Link.
And so I -- I want to provide that -- that feedback. Hopefully, what this leads to is SoCalGas providing the -- the types of information that allow for Utility Consumer Action Network, as well as others, to actually complete an analysis that will -- let's -- let us know, let others know whether or not hydrogen is -- is reasonable, whether or not hydrogen should be used for any given end use.
You know, the -- one of the issues that I see coming up in this presentation --
CHESTER BRITT: Can I interrupt you for a second, Tyson? You covered a lot of ground there. I want to give Yuri and Frank an opportunity to respond. And then, if you have a question specific to that economic analysis, I'd love to hear that.
TYSON SIEGELE: Great.
YURI FREEDMAN: So, Tyson, thank you for your feedback. And I'm actually glad that you brought up the demand report, even though it's outside the scope of this conversation, but as I hope you remember, having presented the Summary of the Demand Report, we offered -- you took us up on that offer to have a conversation where we walk you through the details of that. That conversation took place. We, I think, tried

to answer questions to a full satisfaction, and we, in fact, offered you to have follow-on conversation.
I'm sorry to hear that it may not have answered all the questions. If it didn't, I wasn't aware of that. I'm happy to do the same here. I also will say that the inputs and assumptions are going to be absolutely transparent. And the intent of the slides here was to list those inputs and assumptions as opposed to provide the detailed information. This information will be provided in the report.
So I wanted to be clear about the fact that we are going to be transparent. And we are going to present the numbers upon which the calculations were conducted. As far as the calculations themselves, I'm sure that you know levelized cost of electricity, hydrogen, or any other commodity is the arith- -- arithmetic of that is well known to anyone who deals with numerical assessments of this parameter. So the -- having in hand the assumptions of the upstream, midstream, and storage cost should present no difficulty for anybody to calculate the LCU or the LCOH.
But again, I'll finish where I probably started. To the extent you have questions that you feel you need more information, we're happy to get with you or with anybody else on the phone and spend time to make

sure we answer this question to the full satisfaction.
FRANK LOPEZ: Yeah. And I just wanna add to that and say that Emily did forward me your e-mail, Tyson. I did review it, and I know you were asking for some of the underlying data. When we released the preliminary findings, that data wasn't available at the time, but we didn't want to wait until the draft study to release the data, we wanted to issue the preliminary findings so you could see directionally we -- were -- where we -- we were headed.
But the draft study is, I believe, gonna come out soon. It will include a lot more detailed information -- perhaps -- I hope most of the information that you're looking for, so I would just ask please take a look at that draft study first, and if you still feel that you don't have all the data that you need to respond to comments, please reach out to us and send us a comment. We're happy to schedule a meeting to see what information we can provide you. So I would just say, hold off until you get the draft study, and then let us know at that time, please.
TYSON SIEGELE: I -- I -- you know, I -- I definitely appreciate, your willingness to have meetings. The the problem is that the -- the data is what the Utility Consumers Action Network needs. When

we asked for it with The Demand Study, we were told that the -- the calculations, the spreadsheets, would not be available to -- to UCAN.
When we asked for that -- when the -- had a meeting with SoCalGas representative regarding the -- the NOx emissions, again, we were told that the spreadsheet calculations would not be provided to UCAN. When we are -- when we're asking for these -- these basic pieces of information to see exactly what the inputs are, what exactly -- what the calculations are, we're told those things are not going to be made available to the Planning Advisory Group.
That sort of secrecy, does it not lead the Utility Consumers Action Network to have faith that these calculations are reasonable? One of the other pieces that we're very concerned about is that, again, in -- in this particular analysis, what Yuri presented was that in the power sector, hydrogen is more cost effective than electrification than -- than batteries than renewable energy. And that is, that is absolutely not the -- the conclusion of the Public Utility Commission modeling in the integrated resource plan proceeding; it's not the conclusions of the California Air Resources Board in the scoping plan; It is not the conclusion of the -- of the (SB) 100 study.

And so when -- I'm taking a look at these analyses, I'm taking a look at The Demand Study analyses, and they are not matching up with the -- the largest energy agencies of the State of California. And it's not -- not by just a little bit -- it is -- they are not matching up at all with what.

CEC, CPU, and CARB are presenting, and -- and that is -- is very concerning. The -- the other piece that goes back to, you know, is SoCalGas sa reliable source of information, a reliable source of data on this particular project, specifically, when SoCalGas stands to make billions of dollars if the Angeles Link is built.

And I -- I -- you know, the Utility Consumers Action Network is more inclined to believe the CEC, The California Public Utilities Commission, and the -- and CARB, when it comes to the analysis of whether or not hydrogen is -- is a cost-effective solution. And so you know, I -- I know that those are, again, provided a bunch of comments. I hope that SoCalGas will -- will take these to heart. And I also -- you know, I dropped in this chat a -- a -- a -- an advocacy letter that is signed by several organizations that are -- are part of The Planning Advisory Group related to the three pillars. I -- I know that SoCalGas makes policy

recommendations to The Public Utilities Commission on a weekly basis, if not a daily basis.

So I -- I don't understand why SoCalGas cannot make a policy recommendation on the three pillars, why SoCalGas cannot support the three pillars. And so that, that's the -- the end of my, my remarks. I -- I really hope that SoCalGas will take them to heart.

CHESTER BRITT: Thank you, Tyson, for your remarks.

Yuri, did you want to follow up?

YURI FREEDMAN: I would just say -- maybe -- there's a lot in what you, said Tyson. And then maybe I'll focus on one part to reiterate that we are going. When you refer to the data, data is inputs and assumptions. We are going to make those inputs and assumptions available to the public in our report. I just want to be very clear about that.

With regards to the methodology, I'm sure that any consultant, including yourself, should be perfectly capable of using those inputs and assumptions and calculating, which is not very complicated calculation, the level as cost of hydrogen or electricity, or total cost of ownership as we have walked you through in great detail in our last conversation, happy to do it again.

CHESTER BRITT: All right. Did you want to say

anything, Frank? Okay, we're good. All right. We have a few other people online. So I want to make sure we get to them. Pete Budden, I believe you had your hand up next, and I want to give you an opportunity to introduce yourself and make your comment.

PETE BUDDEN: Hi. Thanks very much. My name's Pete Budden. I'm with the Natural Resources Defense Council. My apologies. I -- I missed the first part of the meeting, but I happily caught all of -- all of this presentation. Just quickly, first, I want to uplift the letter that Tyson shared in the chat and our DC signed that letter and fully support the three pillars. And yeah, we completely agree with Tyson, and UCAN on -- on that point.

With relation to this analysis that's been presented, I -- I -- well, obviously, we all need to see the -- the input assumptions data that's been discussed already. It's it's hard to make any conclusions without seeing that. But I do have a couple of specific questions. The first of which is: Do the levelized cost of hydrogen include that -- the -- like -- obtaining the 45V tax credits, which are obviously only a temporary 10-year tax credit? So that makes hydrogen look a lot cheaper for that 10 years. And the pipeline will -- would operate for much longer than that. So I'm

curious how you price those kind of incentives in that are time limited.

And then also I noted on one slide for the food and beverage industry, you said -- the slide said that hydrogen was more cost effective due to the high electricity rates in California, but you need more electricity to make hydrogen to deliver the same amount of heat than you do if you're using electricity directly.

So if there's high electricity rates as a problem, then -- then surely that flows through -- that should flow through to the hydrogen prices as well because you're using more electricity to convert into hydrogen and then make heat rather than directly making heat with electricity.

So that's just a couple of comments. And I look forward to seeing the full report with -- with more detail.

YURI FREEDMAN: Thank you for questions. On the first one, I'd have to get back to you with the exact answer. We do assume the production tax credits, so they are included in the economics. I have to take a look to make sure that my answer to you is correct with regards to whether we assume their extension or not after 10 years. So let us come back to you with that.

On the second front, even though I don't think I said it but it must have been in the slide what you mentioned, the point about electricity rates, perhaps that's where I took it from. I would say that the analysis in that sector includes the -- not just the rate, the price of commodity that you're going to receive as an end user, but also the cost to incur in changing your equipment to use that commodity, so it's a calculation which includes more than just assessment of the power versus hydrogen price. That's part of the answer. But again, I would be happy to spend more time offline to walk you through the math over there.

PETE BUDDEN: Thank you. It's just a final closing point, I it would be great if the reports, when they're shared, would have enough information that we can recreate the -- the outcomes ourselves, and -- and not need to have extra meetings to be walked through. I -- I think it's a reasonable expectation that there should be enough detail in the input assumptions data that someone can recreate the -- the answers that -- that SoCalGas has come to. Thank you.

CHESTER BRITT: Thank you. We're gonna transition now to in the room. I'm gonna go to Jay.

JAY PARPALI: Thanks. Jay Parapali, Communities For a Better Environment. Thanks for this

presentation.

I'm gonna read just a paragraph out of our Feedback letter submitted on June 4th for my colleague Lauren Gallagher on the economic analysis and cost-effectiveness, largely because we're not always seeing that our feedback is incorporated in any meaningful way and that the record keeping at times from SoCalGas has been incorrect.

One point being, in our Quarterly Report for Q1, it was stated that my organization, Communities for a Better Environment, did not take a one-on-one meeting with SoCalGas. That's incorrect. I met with Theo Credo [sic], my legal attorney fellow with Frank and Emily from SoCalGas in March of 2024.

That is Q1. Here's the quote, "The economic presentation only examines production, storage, transmission, regasification, liquefaction, distribution once the Angeles Link pipeline is in place. The economic presentation fails to account entirely for the significant economic cost of building out pipeline infrastructure. In fact, the presentation does not provide any estimates regarding the cost of the project or potential funding and support of the project. Information regarding the complete estimated cost of the project must be made available before any further action

on the project can be taken."

And so I assume that that factors into the levelized cost of hydrogen, in which case some of these bars showing that electrification and CCS are inferior to Angeles Link are possibly incorrect or there's an emission in what kinds of inputs are going into these calculations.

I was once a scientist. The scientific method doesn't let you present outputs and assumptions without, at the same time, in the same report, providing the inputs that got you to that conclusion. The whole model of these meetings, of the preliminary feedback, decks with promises of inputs and assumptions and calculations to come later is promotional material.

You're telling us to buy into a project on the assurances that "we did the fair math," and "you will see the math and the calculations in coming months." But this is marketing. If you show me a bunch of graphs that show that Angeles Link is more cost effective without the underlying assumptions that get to that conclusion, you are trying to sway this group and the CBOSG and others into support of a project prior to us having real data and numbers and nitty gritty to -- to -- to delve into. And the final point I'll make is that on the kind of waffling about SoCalGas doesn't have a

position on 45V, I mean, if there's one thing we can all agree on on what occurs in Washington and Sacramento is that lobbyists have an incredible amount of power and influence.

And we would all be -- I mean, none of us were born yesterday to think that SoCalGas does not have lobbyists in Sacramento and Washington, DC advocating on a certain position. I don't know which one it is, necessarily. But I -- I think it's disingenuous to say that you don't have a position on 45V or the three pillars of -- of clean hydrogen. Somebody in your organization does. It may not be disclosed to us in the Angeles Link forum.

That's not a character attack. It's simply laying out the fact that Democrats and Republicans and Independents all involve lobbyists and advocacy in both centers of government. So again, this is an inadequate presentation to not include inputs and assumptions and to just give us the assurance of, like, "Believe us, we'll give you some documents and a couple of months of feedback" on when we're asked to be involved in this process throughout. And that process and our involvement in it should be recorded accurately in quarterly meeting reports as well. Thanks.

FRANK LOPEZ: I'll respond to the first part of your comments about accurately capturing the meetings that we had. I was in the meeting. I do recall the meeting that we had with you. Also provided the response on the Quarterly Report.

And I don't recall listing out the organizations who did -- who declined to meeting with us. We did include a list of all of the meetings that we did have in that quarter. I believe CBE was on it. If it was, then that was just an incorrect admission, and we'll make sure to correct that and reissue the report to accurately reflect that.

Yuri, you want to tackle the second part?

YURI FREEDMAN: Yes, thanks, Frank. I will go, maybe to the last point one -- maybe one before the last point you made. What we are trying to do in these meetings is to present you with an overview of our approach. We're trying to walk us through the logic.

I'm sorry to hear that does not seem to satisfy the -- the interest. And our intent here is not to cover the effort exhaustively because we cannot, within the confines of this conversation, do that. It is our belief that giving you an overview of our philosophy, approach, and methodology is actually a reasonable step towards having you be able to better understand the work in its entirety, which we're going to present to you in

a draft report.

That is an important distinction. And I -- again, I would think that a lot of reasonable people would agree that understanding of the key approach is the logical step before digging to work in more detail. I just want to make that clear because that -- we are not expecting any decisions or any opinions to be formed based on that. That is something which we are going to try to help you with. I was -- I am not going to get into the debate on whether it is or is not disingenuous.

You know, what I will say is that on top of repeating that we're an infrastructure company and we are going to be focused on what we do, what we do best, I just think that what you -- the way framed it is a character statement because I don't know that -- the same basis to the statements that at least I have. If there was a basis there to the statements, I have not heard that, but I'm happy to discuss it more, and now maybe conclude by saying that any questions with regards to methodology and any questions with regards to where we got the inputs and assumptions, all of this is going to be entirely transparent as it was in the past.

We're happy to have conversations with anyone who has questions to answer this to their full satisfaction.

FRANK LOPEZ: Yeah, can I add just one more comment too? You know, what -- we're not saying "trust us, we're gonna release a bunch of documents in a few months." I mean, we've been trying to be as transparent as we can every step of the way, right? So we've shared information on project on -- on this, on the scope of the study, we've shared and received feedback on -- on the scope, right? We release information on approach, took feedback on approach, make sure we're heading the right direction. We released preliminary findings as soon as those available so that folks don't have to wait until the draft studies is -- is released to provide feedback, and then at the very end we will release the draft study with all of the underlying information and detailed information, the appendices, and folks will still get an opportunity to comment.

So now, this process isn't over. We are doing the best that we can to incorporate feedback through these meetings, through written form, through one-on-one meetings. And and we're not saying, just take our word for it. We're -- we're being transparent and seeking input from folks, including individuals and organizations who oppose the project from the beginning.

And that's fine.

CHESTER BRITT: All right, we're gonna move to

Joon.

JOON HUN SEONG: Thank you for the presentation. Joon Seong with Environmental Defense Fund. First, before I get to my question, I'd like to echo what Jay just said and Tyson and, of course, Pete, about the importance of getting transparent assumptions and -- and figures from you guys. We're looking forward to that.

Had a quick question. Someone's told me there's no such thing as stupid questions, only inquisitive idiots. So, at the risk of being an inquisitive idiot, let me just ask you a question about the LCOH figures. Does that depend on the assumptions of hydrogen supply through each of these supply methods? And if so, would those different LCOH figures, depending on the volume of hydrogen, be provided as part of the report so we can get understanding of what the LCOH costs would look like depending on the level of demand and supply through Angeles Link and other alternative means? Thank you.

YURI FREEDMAN: Thank you. So I think if I understand the question correctly, the -- the assumption -- the LCOH, obviously, production cost, as you saw, is the largest cost component for majority of the pathways, not for all of them, but for the majority, hydrogen trucking. We are going to be very transparent about we arrive to that. There clearly was an assumption. I'm just engineering it back right now, but there clearly was an assumption about the size of the project that went into that.

That, in fact, is why the localized hub costs are higher because the size of the project is lower, and the fees costs are accordingly -- have a burden. So yeah, we're going to release all that. The -- maybe the -- going -- going back to the previous conversations, the whole logic of Angeles Link is to bring the lower cost produced hydrogen.

And what we see here is that the -- in the utility scale project -- so, obviously, that cost level as cost of hydrogen is going to be significantly lower than if you were to go for low parcels, but we are going to disclose what specific assumptions with regards to the size of the parcels we used, if that's what you're asking, of course.

JOON HUN SEONG: Yeah. I think -- I think that basically gets the heart of my question, and I'm wondering if -- I guess, up front in the report, there would be explorations of how these different scenarios, depending on different levels of assumption would look like or was that something that we need to follow up

with you once the report is released?

YURI FREEDMAN: Yeah, I'm not sure it will be upfront. Assumptions usually wouldn't be the first page in the report. But we are going to have assumptions in the report, and we will make sure that they include the assumption about the size of a project that we based the LCOH calculation on. Sure.

CHESTER BRITT: All right, I'm gonna go to Norman.

NORMAN PETERSON: Norman Peterson for Southern California Generation Coalition. I had, basically, the same sort of question that Joon had. Obviously, the levelized cost of hydrogen is an important part of your cost effectiveness study -- proposed study. Could you just put some more color around what you see as being the levelized cost of hydrogen?

The levelized study usually results in cost being shifted to later generations from earlier generations. So could you talk some about how you calculated a levelized cost of hydrogen? Over what years? What are you seeing by way of volumes? You mentioned that in response to Joon? And then could you also tell us about how you would go about pricing the hydrogen pipeline? Is it going to be on the basis of a levelized rate? Are you going to do something

differently? And can you put some color around that, like, the duration?

YURI FREEDMAN: Yeah --

NORMAN PETERSON: 10 years, 40 years, 30 years.

YURI FREEDMAN: Yeah, no, thank you --

NORMAN PETERSON: Information about how you do your levelized study.

YURI FREEDMAN: Yep. So I think that's a fair question, Norm. I may or may not be able to give the exact numbers for the asset life right now or the accounting details behind that, but the philosophy of it is fairly straightforward.

As again, I'm sure many of you here know, the asset to be constructed has the capital investment on the front end of it. You need to spend money to build it. And then you're going to have certain number of years that's going to be in operations, is going to -- that's going to be in operations, is going to incur operating costs and then the asset comes to the end of its useful life. Whether it's 40 years or 20 years, that's the numbers I don't have for you exactly, but we can come back to with that.

So the question really becomes: What revenues do we need to collect on an annual basis? So that by the time the asset reaches the end of its useful life,

you are going to realize the return off capital and return on capital, accounting for the operating expenses, capital expenses, taxes, everything else will go to depreciation, monetization, everything else.

That's basically the math. It's pretty straightforward as the concept. Of course, it varies greatly for the renewable project as opposed to the pipeline as opposed for other assets. So that's where I have to go back and get to you with specific numbers, but the philosophy of it -- of it is very -- it's -- it's the same across, really, all the asset classes. It's the same approach. That's the first question.

The second question, the -- we, as a regulated utility, are pricing our transportation service in accordance with the CPC regulation. So it's ultimately that -- as we discussed Angeles Link, we envision this as an open access regulated pipeline. And that sound, which is going to be providing the service under the tariff, that will be set by the CPC. We haven't gone through this work, but fundamentally the regulated nature of this asset is going to make sure that the rates are just and reasonable as required by the regulation and entirely transparent, to say the obvious.

NORMAN PETERSON: Maybe just on that last point, are you going to propose a levelized rate structure?

YURI FREEDMAN: I don't know if we've gotten that far, frankly. And I think that -- that's -- the rate making is, as you know very well, the separate and significant efforts. We're looking forward to conducting this effort down the line.

CHESTER BRITT: Good. Okay, okay. We have to stay on track of our agenda and time. We're having -- we're gonna go through the three people that have got their hand raised. So we're going to start with Janice. Then we're going to go to Lewis and Matthew, and then we're going to move on to the next presentation. So go ahead, Janice.

JANICE LYNN: Janice Lynn from the Green Hydrogen Coalition. I just want to commend everybody. I think you're all and asking such great questions today. And I have to say that I would, likely, have many similar questions Had we not done a similar study a couple of years ago. And so the first thing I wanted to share is on the demand. It was kind of interesting the numbers that you guys shared because I think you said 2045 the demand would be something like 1.9 million metric tons to 5.9. And how we did our demand analysis is, we hired a consultant to interview and talk to off takers in different sectors, especially the hard to

abate ones. And by 2,040, which is 5 years before your forecast, we came up with 1.76 million metric tons. And that was qualified through interviews.

And what I thought was really amazing in talking to these off takers was that there was a tremendous willingness to switch. They want to switch. But again, there's these two barriers, which is, can you guarantee the supply? Like, where's my alternative Fuel coming from? And it has to be at least within spit and distance of what we're paying now for fossil fuels. There has to be some kind of value proposition to switch because there's a lot of other cost changing equipment.

And I shared earlier that initially we didn't -- We were hoping we wouldn't need a pipeline. We're just, like, load up every building in Los Angeles with solar panels and make the hydrogen. And unfortunately, we found that that just isn't feasible for the demand we're talking about.

And so that's -- that's how we arrived at. Yeah. Pipeline transport's going to be the most cost effective way. And I was, actually, surprised when we learned that a couple years ago as well. The other thing I wanted to comment, I think it was Tyson who made a comment that, you know, hey the agencies aren't looking at hydrogen. And we agree that actually we

should. It should be part of the toolkit. And that's why some years ago we worked with Senator Skinner to help get Senate Bill 1075 passed into law, which required their Resources Board to lead a study.

And they did their first joint agency kickoff workshop last fall. And what I love about this workshop is the context of it is, how do we get to carbon neutrality economy-wide by 2045? And it involved a 94 percent reduction in liquid petroleum and 86 percent reduction in total fossil fuels. And they identified -- you can check out this report online, you know, it's on the ARB [sic] website -- a whole bunch of solutions, battery electrics, more electric appliances, four times wind and solar.

And, interestingly, the wind and solar capacity also required hydrogen use and turbines, Remember the need for reliability and clean, firm dispatchable power. And they also cited a need for 1,700 times our current hydrogen supply. So this was a watershed moment, and I encourage everybody to take a look at this report, and there's going to be more coming. But it underscores renewable hydrogen's role in our ability collectively to move away from fossil fuels and achieve that carbon neutrality goal. Thanks.

CHESTER BRITT: Thank you, Janice. We're gonna

go online now to Lewis. If you could unmute your microphone, Lewis, and introduce yourself.

LEWIS FULTON: Yup. Hello, thank you. Lou Fulton with UC Davis leading our hydrogen program. I'm also the chair of the Transportation working group for ARCHES. And I appreciate the presentations. Thank you, Yuri and SoCalGas. And I personally have no problem with the way you did it. I agree that when it's limited time, it's good to show the high-level results. And I'm confident that when you guys provide the reports for inspection that we'll be able to, you know, figure things out, and I know you'll be available if there are questions. So no problem for me.

I had 2 specific questions that you might not have time to answer right now, but I just want to get them out there. One is that I noticed in the scalability metric you give the pipeline a very good score for scalability, and then you also give it a very good score for or levelized cost. And I -- and I'm wondering is that -- does that -- how does that -- how do they relate? Because, perhaps, early on you build the pipeline and you're not utilizing it that much because you want to have room to increase utilization, but that could hurt the short-term levelized cost, and then, as you scale, you eventually get to these very low per unit costs. So that's -- that's one thing. How do they relate?

The other was that, it looks like for trucking, we're going to be pretty much going with liquid hydrogen at the stations. It just -- that's what the truckers want, and I think it's what they're going to get. So if -- if I saw it correctly in -- in the comparison of -- of costs, they didn't all have liquefaction in there so -- and I know there's different end uses.

But it'd be interesting to see -- or -- and actually, the specific question is: If you're delivering to stations, and you need it to be a liquid at the stations, where is the liquefaction step, if you're moving it by pipeline? Because I doubt it's going to happen at stations.

So it seems to me you may need a version of this, where you have a terminal that you deliver the gas to by pipeline, the hydrogen, and then you liquefy, and then maybe the last mile is done with truck, something like that.

Curious any thoughts you have on those 2.

YURI FREEDMAN: No, thank you so much for the questions. So on the first one, the relationship between the scalability and cost-effectiveness, the way we think about it is that, you know, if you ask the

macrolevel question, you barely share the view that State led ARCHES has that there's going to be 17 million tons per year of hydrogen by mid-century in the State.

The question is: What pathways can reasonably deliver that amount to the end use? I think once you start doing the -- the just, the volumetric analysis, and doing the number of vehicles, frankly, that you need to put on the road, you quickly realize that the pipeline is the most scalable way to do this by far.

That's just -- that's not to say that we don't need to track it today, we do. That's how hydrogen gets delivered today and will be delivered for quite some time. But we believe that -- and just on the volumetric basis -- millions of tons per year are -- really can be delivered reliably and most safely by a pipeline.

That's the kind of philosophical assessment we, obviously, can get into the numbers and details behind that of just how many tracks it would take to deliver that million tons. But you know those numbers better than me, so I will not be presumptuous here.

I think, on the second one you're absolutely right, that the last mile question of the delivery needs to be better understood. I think you're right. The log of action clearly is not going to take place at the stations. There likely will be transportation of gas by

pipeline to liquefaction points where it's going to get liquefied and delivered from there. So it will be similar to the Hubble -- hub and spoke system, which again, you know very well.

But I think your overall direction is absolutely correct. And again, we'd be happy to go into more details with you at your convenience.

CHESTER BRITT: All right, thank you for that. We have one more and then we're gonna transition.

Matthew Taul, if you could unmute your microphone we should be able to hear you.

MATTHEW TAUL: Hi, there. Matthew Taul from the public advocates. If you could put up the slide with the levelized cost, that'd be useful for this comment. And I do thank you for commenting about the Kelpies [sic] letter on this particular issue. I'll do this really quick.

Not not this slide, the one with the -- yeah, the columns. I think it's one -- one more back.

YURI FREEDMAN: One up -- one back.

MATTHEW TAUL: Perfect. Thank you. So in a light blue for all of the options, both Angeles Link and hydrogen delivery, that is your levelized cost of storage and essentially three at the bottom of the page. SoCalGas is assuming that underground storage is

useful for the Angeles Link and trucking options, but it would have to be above ground storage for all the alternatives

Given in -- and this is the other report, the pipeline sizing report, did some review of the different undergrad storage location options, and SoCalGas' attempt to produce in three -- nominally three regions the San Joaquin Valley, the Lancaster, and Blithe. Only the San Joaquin Valley region has potential localized underground storage for hydrogen, that of which -- being depleted oil and gas, not salt cavern, which I think the science says is -- is better for a couple of reasons for hydrogen.

I guess my question for this levelized cost of assumption -- a hydrogen assumption is, is that true only for the SoCal or for the San Joaquin Valley case, the ability to utilize the underground storage? Ideally, when we're getting to a full report, it'd be interesting if for the three different production locations that assumption could be quantified. So is there enough underground in the San Joaquin Valley production region? How about Lancaster? And Blythe? Which don't seem to have much local storage at all, whether or not that brings up the levelized cost of storage for the Angeles Link and makes it more cost competitive.

And then one last comment, not necessarily a question, but also in the other document the pipeline is currently being designed between 0.5 million tenths per year to 1.5 million tenths per year with these three production locations. That's -- that's less than the 1.9 or the 1.76 that Janice brought up in -- in hers as well. So just leave that comment. Thank you.

YURI FREEDMAN: Oh, great -- great questions. Thank you for asking. Maybe I'll start from the end. The -- the -- the last question about the relationship between the pipeline throughput and the assessment of market demand, I don't think it's reasonable to expect that any single pipeline can capture the entirety of market demand. Therefore, we made assumptions about us, capturing a fraction of it. And that's the very high-level answer.

I think that we observe very similar dynamics in other commodity markets, whether it's oil, natural gas, or others. So I think our assumptions on the throughput are prudent because we think that we will capture some of the demand, but not all of it. I also would like to recall, and I know that that was subject to previous conversations that we are going to conduct in future phases the assessment of demand as a function

of price.

And demand, obviously, is going to be to a certain degree price sensitive. So we are going to have numbers, which are going to be more reflective of the decision making of the end users. So that's the answer to a second question.

On the -- on your first question, the benefit of an integrated pipeline system is that it can access storage in one location and then the benefits of that access accrue to the users across the system, which is to say, you know, just philosophical, you do not need to have storage in every single location where you have the end user nearby. It becomes a question of engineering hydraulics to be able to make sure that if you have storage available at Point A, then deliverability of that storage is sufficient to serve demand at points -- on B, C, and D, and that's the technical work which is underway.

The analysis, as I think we mentioned, that the storage, ultimately, is going to be developed by the third parties. And so we are looking forward to better understanding that topic in -- in the future phase of work. There is significant effort underway at the national level, Project SHASTA at the international level, in Europe especially, trying to understand

similar issues.

So we're looking forward to trying to better understand, assess, and quantify the -- this important element in the hydrogen delivery system. I'm hoping that answers the question. But again, to the extent does not, I'm happy to continue the conversation.

MATTHEW TAUL: Yeah. I guess a quick follow up then would be: Would SoCalGas be expecting to, let's say Lancaster is producing, send that gas somehow back to San Joaquin Valley, you know, in the direction? You know, is the hydraulic feasibility, allowing to have a back flow of fuel to a storage site that is further away from the basin?

YURI FREEDMAN: I think it's an entirely reasonable question. I don't think we have an answer for you right now, but I see our technical people nodding their heads here that we are going to work very hard to answer that because, again, this is what hydraulics of the system analysis is supposed to do. And ultimately that's how the pipeline will be developed. So thank you for asking that.

MATTHEW TAUL: Thank you.

CHESTER BRITT: Thank you, Matthew. And thank you, Yuri, for your presentation and taking so many questions today.

We are going to move -- yes. Okay, we'll take one more, Norm, and then we're gonna move on to keep on schedule. So if you could...

NORMAN PETERSON: Southern California Generation Coalition. This morning, you said that -- I thought, Yuri -- that storage was most likely going to be above ground. Didn't you say that this morning?

YURI FREEDMAN: I think I referred to some alternatives for which the underground storage is not an option for Angeles Link the assumption that it's going to be underground storage.

NORMAN PETERSON: What what is the feasibility of underground storage or hydrogen as opposed to what we are very familiar with, and that is for methane?

YURI FREEDMAN: I think the short answer is that that's a subject which is of, again, great importance as the previous, I think, person from the CALPA mentioned, and we're going to understand it better. The efforts to understand the suitability of underground formations for storing hydrogen are underway at the national level. The -- the DOE and Andrell [sic] are working on this, and you may be familiar with the Project SHASTA that is analyzing this with examples of Pennsylvania and Alaska. There are efforts to understand it better in the Netherlands and in Austria.

So there's a body of knowledge worldwide that's rapidly growing to try to better understand that. And we are looking forward to, you know, to -- to tapping into all this knowledge base and understanding is better for the needs of our project.

NORMAN PETERSON: Is CALGM doing anything?

YURI FREEDMAN: That, I can't speak to.

FRANK LOPEZ: Yeah. And I just wanna mention, too, that we're gonna be releasing information about storage in our production study, which is gonna come out soon as well. So there'll be additional information there. And I think that's one of the topics we might address at our July workshop.

So there'll be an -- another opportunity to tackle a lot of these storage questions then.

NORMAN PETERSON: And, Frank, when you come out with The Draft Final Study that you talked about -- that you said would be coming out fairly soon, you have a lot of discussion here about the levelized cost of hydrogen, the levelized cost of transportation, which we talked about a little while ago; are you going to have some numbers? Or is it just going to be discussing -- is the report going to just be discussing the -- the concepts of a levelized cost of hydrogen? Levelized cost electricity, et cetera?

FRANK LOPEZ: Yuri, I believe there's going to be calculations, right, on levelized cost of hydrating in the actual study themselves? So there'll be figures.

YURI FREEDMAN: Yes, yeah.

CHESTER BRITT: All right. Thank you for that. Good discussion on those two topics and more to come, as we heard from Frank. Their draft reports are going to be coming out, and you're going to get a chance to review those and provide detailed comments.

I'm going to switch now and introduce Jessica Foley, the regulatory strategy and financial controls manager for Angeles Link. And she's going to make a presentation on the preliminary findings for the environmental analysis.

JESSICA FOLEY: Thank you, Chester. Oh, perfect. And I've got the clicker.

So, as Chester mentioned, I just want to level set. We're talking about the preliminary findings for environmental -- environmental, social justice. They were released earlier this month, and the close of comment is June 25th, so if you have any input on them, we'd really welcome your feedback. One thing I also want to touch on -- and jump to our next slide, here -- the findings were released with the environmental analysis, which is more of the physical construction,

operation and maintenance impacts as well as the environmental social justice component, which is more focused on the social justice aspects of Angeles Link.

I do wanna note that based on stakeholder feedback, we've elected to move the ES and J conversation to our July workshop, so that we'll have more time to focus on that topic. We realize that's a very important topic, especially to our stakeholders here and especially with our CBOSG.

So I just want to flag that, that the findings are consolidated both with the environmental analysis and the ES and J plan. But we'll talk separately about the ES and J plan in July. We'll be focusing on the environmental analysis today.

So as you've heard from Yuri earlier, related to the key topics and study areas that we've looked at and the relationship of various pieces of our whole portfolio of studies for Angeles Link, the environmental analysis looks specifically at the construction, operation, and maintenance as well as potential alternatives to the project. You heard Yuri earlier today talk through those alternatives. And as I mentioned ES and J is going to be considered in its own plan. I do want to also level set that the analysis that we're performing as part of the environmental

analysis, I'm sure many of you in this room are familiar with the National Environmental Policy Actor, NEPA; and California Environmental Quality Actor, CEQA.

Those are the general guiding environmental laws and regulations that apply to analysis in California. And this at this stage of the game, with our feasibility level of information, this is not a full blown NEPA/CEQA analysis that will ultimately happen, and that will be down the line when we get further along with the project. But again, just wanna make sure everybody understands where we're at with this level of analysis for today.

Did want to talk also about our relationship to other studies. So this environmental analysis is based on the roughly 1,300 mile alignment that was presented as part of our preliminary routing and configuration findings. You may all be familiar with the -- I like to call it the Green map -- but it's the map available in a living library that shows the alignment at a conceptual level that is being considered as part of the routing and configuration analysis, and was the foundation for what we looked at in the environmental analysis. This is also heavily related to our project options and alternative study. As you heard Yuri talk about earlier today, the alternatives are considered from the environmental side in this analysis as well.

So as I mentioned, our analysis started with our study approach and assumptions looking at publicly available data sets and information. So you're probably familiar with CNDDB, California Natural Diversity Database.

Many of the GIs data layers as it relates to land use and planning, all those have been aggregated and we're the foundation for how we looked at the pipeline related to those constraints and information. We also assumed that the pipeline would be located underground and to the extent possible within previously disturbed areas. So roads, other types of rights of way.

The study did look at a potential impact that with -- within 100 feet of either side of a proposed pipeline corridor, and that was specific to certain resource areas which were specifically air quality, greenhouse gas emissions, biological resources, energy hazards, hazmat, hydrology, water quality, land use and planning, and as I mentioned, environmental justice, which we'll talk about later, and then also with cultural and tribal cultural resources. And I'll talk a little bit in a moment about those topic areas. We also assume that the construction could occur in stages.

And again, the assumption was that we started with the 1,300 mile universe of what potentially could be Angeles Link. So emphasizing that that is not ultimately what would be Angeles Link, that was the universe we started with, and ultimately would be refined into a preferred route in later stages.

So the environmental analysis and the findings, we've concluded that it could be constructed and operated in accordance with environmental laws and public policies. We do determine that there could be impacts -- and I'll -- I'll talk about that on the next slide -- related to the implementation and construction of the project.

We also look at the fact that this is not -- again, not a NEPA/CEQA level analysis at this point in time. Given what we know about the potential corridors, we've made some reasonable assumptions based on what we know about pipeline construction and operation and included that in the analysis and that we are undertaking this in alignment with both the State's climate goals and with SoCalGas' climate goals.

So, as I mentioned, this analysis, looks at Angeles Link as well as the eight alternatives that you heard articulated by Yuri earlier. And we look at certain specific topic areas that were based on CEQA,

Appendix G. So again, California Environmental Quality Act, appendix G, that is from the CEQA guidelines, that is, generally, the kind of gold standard, as far as how environmental analysis is performed in California.

And so we looked at topic areas that at this point in time we felt we knew enough and could make some reasonable assumptions about potential impacts to be able to analyze the pipeline and alternatives effectively. The one thing I just also want to note that the study is not making any conclusions about the level of impact, or whether or not the impact would be beneficial or not beneficial. We are simply able to conclude whether there is a potential impact or no impact based on what we have information on at this point in time.

And so we would anticipate again as part of a CEQA/NEPA process down the line, those conclusions would be made by the lead agency for review of the project. And so as you've heard on many of our studies, how we're incorporating feedback, I think what we consistently heard, as I mentioned, from our PAG and CBOSG members, is that the ESJ component of our analysis is really critical and important to our stakeholders. And as a result of that, we've pulled the ESMJ component out of the environmental analysis, and it will move forward as

its own separate plan. And that'll be discussed in July at the workshop. And that will provide, I think, a greater focus on the ESMJ concerns that many have and that the environmental analysis can focus more on the construction and operational environmental impacts that could occur from the project.

So that is that study at a very high-level. I went through that I'm more than happy to answer any questions that you may have in the audience, and I'll turn it over to Chester to address that.

CHESTER BRITT: All right. Thank you for that, Jessica.

Jay. Perfect timing.

JAY PARPALI: Thanks for the presentation, Jessica and Trustee for facilitating. I'm not sure if -- and I totally caveat, like, I understand most of this will come out and CEQA/NEPA and definitely not demanding, we're expecting that kind of detail analysis yet. I did have a question on this piece. Why is the distance from the proposed quarters limited to 100 feet, for things like air, quality, hydrology, hazards, and hazardous as materials? 100 feet is quite short. Like -- and I don't know how wide the corridor is being considered spatially, but 100 feet either side seems quite limited.

JESSICA FOLEY: Thank you for your question. That's a great question. And I think it comes to a couple different reasons. So starting with 1,300 miles, we needed to -- to set some parameters with that. I think, with a 200 foot wide corridor, it gave us the ability to -- especially if you're looking at biological resources, for example, you'd be able to see the intersect of that resource with the potential pipeline corridor -- I think that's something that we can certainly take back and look at for a future phase, as part of our analysis.

And I think, as the refined corridors become more -- if we narrow it down to preferred route or preferred routes, we would be able to do a more detailed analysis, and that quarter may actually expand to larger area. That answer your question?

JAY PARPALI: Yeah.

JESSICA FOLEY: Thank you.

CHESTER BRITT: Anyone else? Any comments online?

(No response.)

CHESTER BRITT: I was getting so used to you guys all wanting to chat. No comments. All right. Maybe all those cookies are setting in or something. Okay. Well, we're gonna go ahead -- and get keep going

again. This is not your only -- did we -- Oh, did people -- okay. We got a couple of last second. All right.

Lauren Gallagher.

(No response.)

CHESTER BRITT: Please introduce yourself, Lauren. It looks like she's off mute, but cannot hear you.

JESSICA FOLEY: We can't hear you here.

CHESTER BRITT: She's speaking, but we can't -- We cannot hear you.

Let's go to Iain. And we'll come back to you, Lauren and see if you can adjust your settings. But let's go to Iain Fisher. Go ahead, Iain.

IAIN FISHER: Yeah, this is more an observation of my concern about the routing, which I have discussed with you before. One of your primary routes from some -- virtually the only primary route from San Joaquin and from Lancaster is down the I5 corridor. You've drawn your routes very narrowly, and they go almost entirely through low income communities. There is no real alternative presented. So as it stands, because this analysis follows on from the routing analysis, I think

your corridors are too narrow and too restrictive, and don't take enough count of the ESJ issues. You don't give -- you don't give low income communities an alternative of not having the route through their communities.

And SoCalGas has pipes that go down other major corridors that are not through low income communities. So I just wanna point this out from the outset that while I appreciate what has been done in the environmental -- and I -- I -- in this environmental review and this -- this -- this -- this particular study and I think the methodology is fine -- I think the starting assumptions are actually erroneous. And I just wanna get that stated now because your routing is too narrow, your corridors -- your general North/South corridors are too narrow. And I'm not sure that would actually stand up ultimately when we get into CEQA Review where you've got to start looking for alternatives. Okay, thanks.

JESSICA FOLEY: Thank you. I appreciate that feedback. And I will definitely take that to our pipeline routing team and see where we can look at opportunities. But I do think that that -- as you point out in our CEQA/NEPA analysis, that'll definitely be something that would be considered as part of potential

alternative routes.

Ultimately, that'll be the discretion of the lead agency as to how they may look at proposing different routes or route alignments that we would need to consider. But thank you for that feedback.

FRANK LOPEZ: Yeah, I just want to add to that. We are going to be releasing additional information on our environmental social justice analysis fairly soon as well. I'm including our environmental Social justice plan. And then we also plan to address both issues of ESJ and routing at our July workshop.

CHESTER BRITT: All right. Thanks for that, Frank. Lauren decided to chat her comment because she was having technical difficulties. So I'm going to go ahead and read it says, "In line with Ian's question, how are the findings in the environmental study going to be incorporated into routing determinations?"

JESSICA FOLEY: Thank you, Lauren. That's a great question. I think, you know, any written feedback that you provide is related to our findings, and especially looking at corridor wits and those are things that we can definitely take input on, I think at this point in time, again, that at the level of analysis we have, we will be able to look at -- again, I'm using biological resources just because that's an easy one for me to think of as far as you can find something when you get into field survey work and you can adjust your alignment if you have, say, a habitat of some sort.

Similarly, when we look at an environmental justice issues -- which we'll, again, talk about more in July -- but in the event we find that there are certain constraints or opportunities to look at routing and looking at how the pipeline relates to those communities, we'll take that feedback into consideration at that point, and be able to -- to move forward with your suggestions or consider your suggestions.

Frank, did you have anything you wanted to add?

FRANK LOPEZ: No.

CHESTER BRITT: All right, any other comments or questions?

(No response.)

CHESTER BRITT: All right, I'm gonna turn it over to Emily now. She's going to talk about next steps.

EMILY GRANT: Thank you, Chester. Okay, so we have -- currently, you should have in your possession the environmental analysis. So that is the data that matches the presentation just given to you by Jessica.

And that's due this Tuesday, June 26th. You also have your hydrogen leakage assessment draft report feedback, which is due on Wednesday, June 26th. Hopefully, either later this afternoon or early Monday, you will have your Safety Draft Report that will be delivered to you, and that due date will be Friday, July 19th.

So that's just a little peak ahead at what's coming either later this afternoon or on Monday. As stated before, our summer workshop is going to be Wednesday, July 24th. We'll be back at the energy Resource Center in Downey from 10:00 to 2:00.

Our preliminary topics or what we think we'll be discussing are routing, permitting, pipeline sizing, and design, production, and the ESJ plan as well.

As usual, today's presentation and all of the post meeting materials would be uploaded to the living library probably early next week. And, as usual, if you have any questions, comments, concerns, I'm here to take them and thank you so much for your participation today. And I'll kick it back to --

FRANK LOPEZ: Hey, can I also take a moment just to thank the -- the tech team that arrives here really early to set up and allows us to have well executed hybrid meetings, which are not easy to do. I

think they do an amazing job. And I want to just acknowledge them. Thank you for that.

CHESTER BRITT: All right. Norm, I think you're the first one to have a comment on Emily's presentation. Give her the hard questions, Norm. Please use the microphone, though, if you can.

NORMAN PETERSON: When do you --

CHESTER BRITT: Yeah, you're on.

NORMAN PETERSON: -- expect that we'll be seeing your Phase 2 application at the Commission?

FRANK LOPEZ: I think Shirley wants to jump into this one.

SHIRLEY ARAZI: Thank you.

(Inaudible discussion.)

SHIRLEY ARAZI: That's a really good question. Thank you, Norman. So we are preparing to file our Phase 2 application a little bit later this year once we kind of conclude Phase 1 studies, so that will be forthcoming. I don't have a specific date yet. But we're working on putting our Phase 2 application together and it'll be issued sometime later this year.

FRANK LOPEZ: We have our hands full with Phase 1 still, Norm, to be honest with you. And we have

a lot of the draft studies are coming out and a lot of information is going to be released. So we're really just focusing on -- on making -- doing a really good job on Phase 1, right now, before we started thinking about Phase 2, all right.

CHESTER BRITT: Any other thoughts on -- Jay. It looks like --

JAY PARPALI: I thought we were gonna do a little bit the -- the ESJ deck and I will -- I'll raise the point because it's part of the feedback that's due June 25th, so I know that the answer is gonna be reserved in July. This is -- so on Slide 22 of the Environmental Analysis Deck -- Slide 22 of 24, we wouldn't have it here, but it's part of the things that are going to be -- yeah -- soliciting feedback due this Tuesday.

It's a critique of, like, what is being considered a finding. And and what's an objective statement of finding. So I'll give an example and give credit where it's due. The second last bullet point says, "On routing and ESJ, this study determines that the project may lead to potential impacts from construction and operation and maintenance activities and all resources analyzed in the study. That's true. And -- and I'm not gonna even make the argument about significant impacts, that'll come at and CEQA and NEPA. There will be significant impacts.

The second bullet point is not a finding. Angeles Link has the potential to reduce greenhouse gas emissions, improve air quality, create union jobs, grow small and diverse businesses, and generate millions of dollars and community benefits. While some of those things may ultimately prove to be true, They are not environmental social justice findings.

And I'm gonna keep hitting that point. We've hit it in many of our feedbacks. So far preliminary findings and analysis cannot be -- if I wrote that statement in the Law School Exam as an environmental attorney with no support for that statement, that would get an F, because that's just conclusory marketing.

Like, it is a promotional statement to say that this is going to improve air quality without any corroboration. So a statement like 'This could result in potential impacts of air quality and biological resources and hydrology' is accurate, the latter statement is not. And so I know we didn't get to ESJ today, and then it'll get more deeply covered in July. But that will also be part of our written feedback for June 25th that point, specifically. Thanks.

CHESTER BRITT: All right. Thank you for that.

All right, are we okay? Again, a very long meeting. I really wanna, you know, express my appreciation for the PAG. You guys have always been very good at, like, you know, sticking with it. These are long meetings. We cover a lot of detail. There's a lot of information.

And I know the process has been -- oh, do we have another person? Okay. Iain. Did you --

IAIN FISHER: It's always me. Sorry.

CHESTER BRITT: We have extra time. So you know what? Go ahead.

IAIN FISHER: This is more a question about being able to contact other stakeholders. And I can't -- maybe it's just I can't find it. Have we got a posted list of e-mails for other stakeholders? Am I just missing it?

EMILY GRANT: Hi, Iain. We don't have e-mails posted, but we do have the rosters.

IAIN FISHER: Yeah. And the roster dates from September -- September. And I can't see Jay on it. So, Jay, my apologies. I would love to have a conversation with you and this is the only way I'm going to be able to kind of flag that. The roster is out of date. The roster is out of date. There's no contact details. And I know I've asked this before, can we at least get e-mails so that we can at least have conversations

amongst ourselves? You know, there may be sidebar conversations we want to have and that would make things just a lot easier.

EMILY GRANT: Yes, so first, I can -- we'll make sure that the rosters are updated. Jay was newish covering for another colleague, so we had some folks swap out. So we'll take a second look at that, Iain. Thanks for flagging it.

Initially I believe the group decided that we didn't want to publicly share e-mails on the living library. We can take another look at that, if that's something you'd like to do. I'm also happy to connect you both over e-mail. So if there's -- you can do that through me, so if there's any member who wants to get in contact with another member, you can e-mail me, and I'd be happy to put you on an e-mail together.

IAIN FISHER: Okay, thank you. And yeah, I appreciate that. It would be better if we didn't -- if -- it would be easier if it wasn't mediated through SoCalGas, I've got to be honest. But that's just the way it's going to be. Okay. Thank you. Okay. Sorry about that. Folks.

CHESTER BRITT: No worries. So again, I just wanted to express my appreciation for everyone sticking to it. We're having more meetings, obviously, as you

heard in July, so that'll be another opportunity to -- for us to see each other and go through another set of studies.

As Frank mentioned numerous times, we have a lot of draft studies that are going to be coming your way. You have a four-week period to provide written comments. We would encourage you to take a look at those and provide those comments as we go through all the 16 work studies.

And I -- I just wanna reiterate something that we've kind of talked around the edges about, but, you know, I've been part of this process since the beginning and help facilitate this. And we said early on that this is going to be a challenge because we had 16 work studies and we were gonna, essentially, have four bites of the apple: You know, the scoping process, technical approach, preliminary findings, and draft studies. And so we're getting into the weeds now. And I -- I appreciate you guys paying attention. Giving us pointed comments. That's why we're here having a -- a robust conversation, not always agreeing with each other, but recognizing the importance of other -- other people's input. I really like, Jay, how you and Janice and others kind of communicated back your own opinions about things. That's -- that's what this is all about.

That's what's meant to do.

It's not meant to for us to just present information to you. It's meant for us to have a group to conversation about these very important topics. And again, we're very early on in the process. If we could all remember that these are preliminary studies, preliminary process that we're going through, and we have future phases in front of us if we get those approvals.

So thank you, again, very much. Have a safe drive home and have a great weekend.

ALMA MARQUEZ: And if you guys could, please, remember to leave your nametags, we believe in reuse, recycle, and repurpose; and then feel free to take some food home for your weekend and enjoy the outside view.

Thank you.

(Whereupon, the meeting adjourned.)

REPORTER'S CERTIFICATE

STATE OF CALIFORNIA)
) SS.
COUNTY OF LOS ANGELES)

I, Jakenya Jones, CSR No. 14304, in and for the State of California, do hereby certify:

That I was requested to transcribe from the live videoconference of this meeting;

That said meeting was taken down by me in shorthand, and thereafter reduced to typewriting under my direction, and the same is a true, correct, and complete transcript of said proceedings.

I further certify that I am not interested in the event of the action.

In witness whereof, I have subscribed my name, this 11th day of July, 2024.

Jakenya Jones

Jakenya Alicia Jones, CSR 14304
Certified Shorthand Reporter
For the State of California

Appendix 6 – CBOSG Meeting Materials

PAG AND CBOSG JOINT UPDATE

- Welcome PAG and CBOSG Members
- SoCalGas Opening Remarks
- Phase 1 Studies Review and Commenting Process
    - Member Discussion
- Phase 1 Remaining Stakeholder Calendar
    - Member Discussion
- CBOSG Compensation Plan
    - Member Discussion
- Next Steps and Upcoming Meetings

April 23, 2024
10:00 am

ANGELES LINK

Planning Advisory Group (PAG) & Community-Based Organization Stakeholder Group (CBOSG)

Angeles Link Update

Warm welcome to our participants!
We will be starting shortly after 10:00 am
to make sure everyone is present.

SoCalGas

WELCOME FROM OUR FACILITATOR

ANGELES LINK

CHESTER BRITT
Executive Vice President
Arellano Associates
PAG Lead

ALMA MARQUEZ
Vice President Gov. Relations
Lee Andrews Group
CBOSG Lead

SoCalGas

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- If you would like to speak, please use the "Raise Hand" button at the bottom of the Zoom screen
- In lieu of a formal roll call, please announce yourself in the chat and add your organization in your Zoom name

AGENDA OPTION

- Welcome PAG & CBOSG Joint Update
- SoCalGas Opening Remarks
- Phase 1 Studies Review and Commenting Process
  - Member Discussion
- Phase 1 Remaining Stakeholder Calendar
- CBOSG Compensation Plan
- Next Steps and Upcoming Meetings

ANGELES LINK

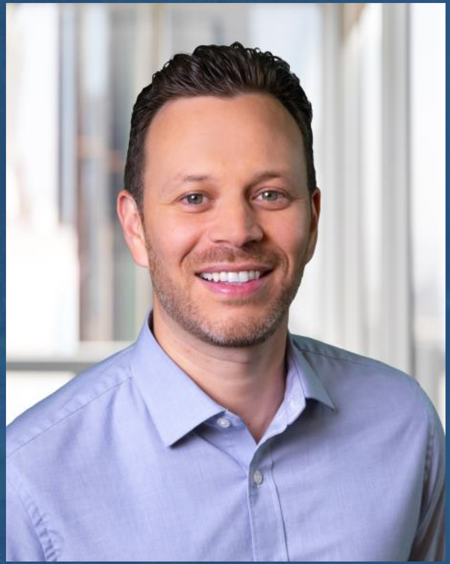
WELCOME PAG & CBOSG JOINT MEETING

PLEASE ADD YOUR ORGANIZATION TO YOUR SCREEN NAME AND WELCOME OTHERS IN THE CHAT

SoCalGas

SOCALGAS WELCOME

ANGELES LINK



FRANK LOPEZ
Director
Regional Public Affairs

PHASE 1 PROCESS IMPROVEMENTS

ANGELES LINK

JESSICA FOLEY
Regulatory Strategy & Financial Controls Manager
Angeles Link

STAKEHOLDER FEEDBACK: COMMENT PROCESS

- The materials provided are too dense and detailed, making it difficult for stakeholders to provide meaningful feedback
- Key takeaways and findings can be challenging to discern
- Stakeholders should be able to see participant comments that are submitted

PROPOSED PROCESS IMPROVEMENTS

- Simplified preliminary findings format to streamline review
  - Key findings in presentation format
  - 2 weeks to submit comments
- Detailed/comprehensive information will be included in draft Study Reports (available over a 3-week period for review and comment)
- Dedicated discussion at future stakeholder meetings to summarize stakeholder input that has been considered and, if applicable, incorporated
- Comment letters are posted to the Living Library at the close of the feedback window as well as in our quarterly reports
- Quarterly CPUC reports will continue to provide responses to submitted comments and the comment letter in original form
- Website for regulatory proceeding and final quarterly reports: [Angeles Link Project Memo Account | SoCalGas]

ANGELES LINK

PRELIMINARY DATA AND FINDINGS: WORKFORCE PLANNING & TRAINING EVALUATION

April 2024

SoCalGas

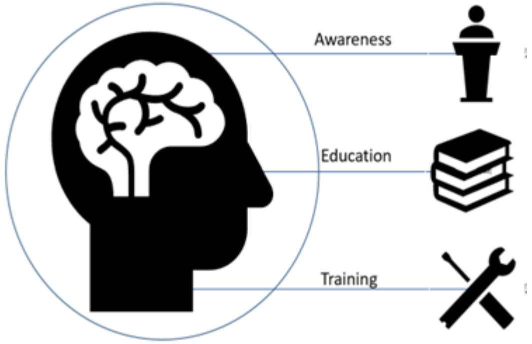
STUDY INTRODUCTION

- This study evaluates operations and maintenance protocols for utility workers regarding hydrogen infrastructure and workforce needs in terms of staging and growth for the Project
- Future workforce job estimates will be provided in draft study to be released later in 2024
- This study is being prepared as directed by CPUC Decision (D.22-12-055, OP 6 (e)) which requires SoCalGas to provide the findings and results from the Phase One feasibility studies

WORKFORCE STUDY CONSIDERATIONS

Sharing Knowledge

Collaborate with industry, government, unions, and local communities on workforce initiatives



Workforce Planning

Utilize resourcing data to plan for hydrogen industry workforce needs; new skilled and upskilled workers

Build Hydrogen Job Pathways

Support workforce centers, universities/trade schools, and skills/training programs

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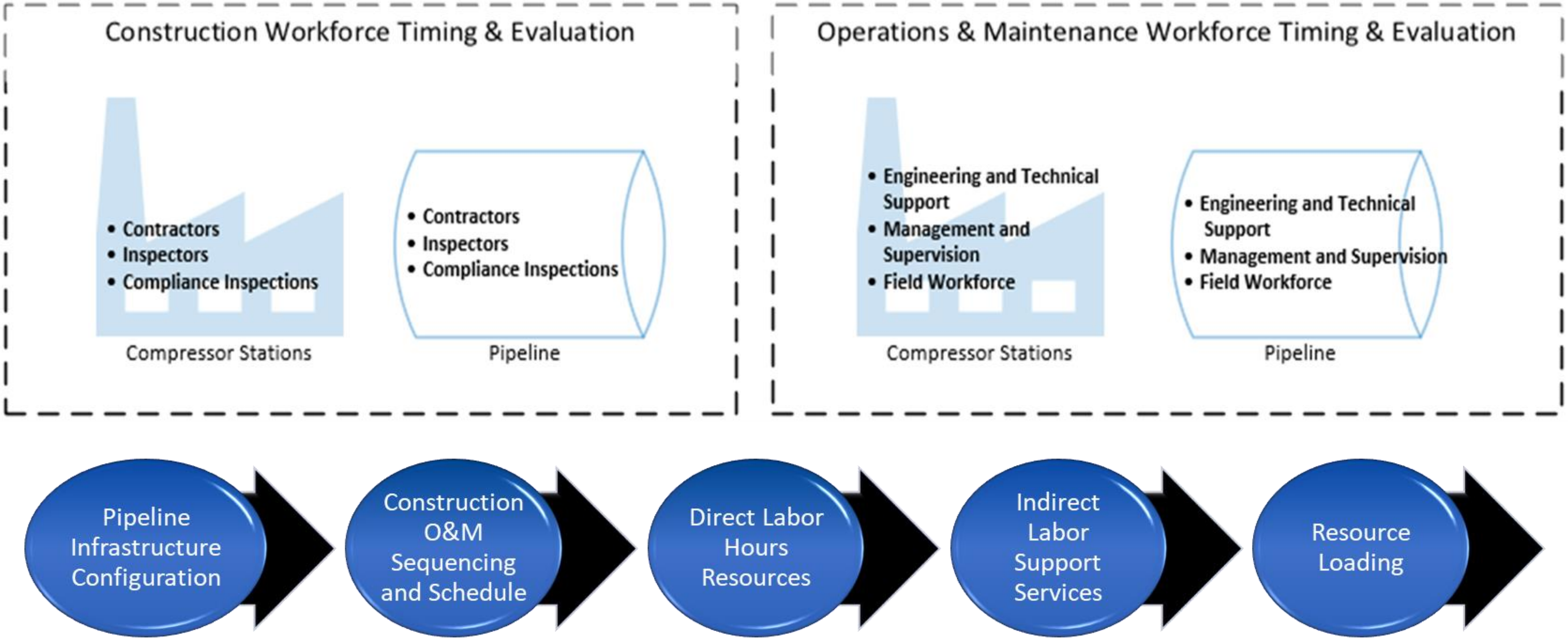
STUDY APPROACH/SCOPE

WORKFORCE METHODOLOGY/FORECASTING

Workforce Staging Timing & Evaluation



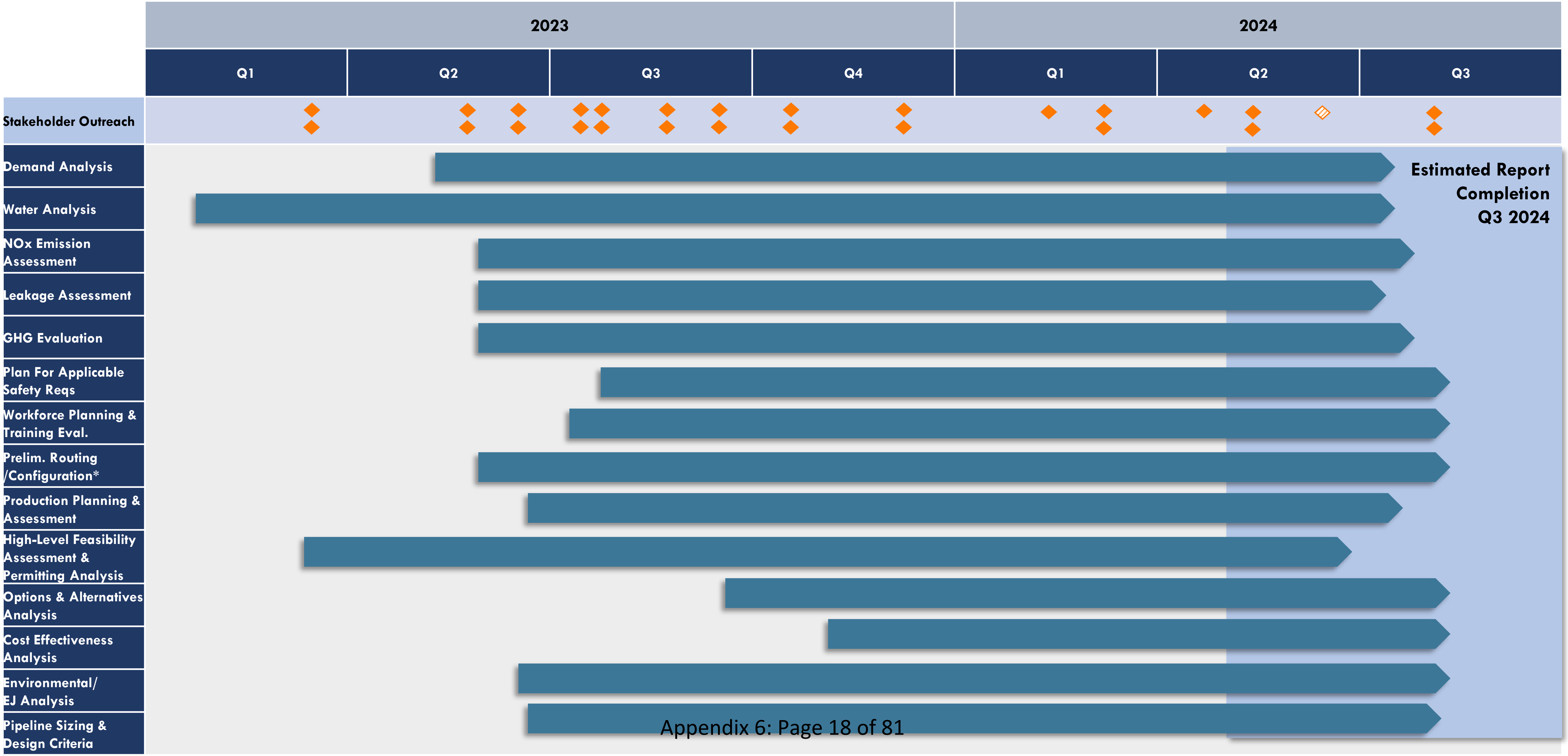
WORKFORCE PLANNING & TRAINING PRELIMINARY FINDINGS

- Identify skill requirements, specifically qualifications required for various roles involved in hydrogen pipeline construction and pipeline operations
- Workforce training for safety and regulatory compliance
- Identify gaps in the required skills within the existing workforce

- Determine workforce size to estimate the number of resources needed
- Continuous monitoring and adaptation for workforce management

- Education and training given to the project management and operations workforce for material and component selection
- Operator qualifications to provide appropriate training and awareness to operations personnel
- Training programs to enhance existing workforce skills and/or prepare new workforce for hydrogen related work

Estimated Preliminary ALP1 Study Schedule



*Includes Right-of-way and Franchise analyses

MEMBER DISCUSSION

ANGELES LINK

- Please announce your name and organization
- Be concise and focus on discussion topics
- Verbal comments are not the only way to provide input, feel free to type a chat
- We are accepting written input after this meeting if we run short on time, or you think of things later

JESSICA FOLEY
Regulatory Strategy &
Financial Controls Manager
Angeles Link

SHIRLEY ARAZI
Director
Regulatory & Policy
Angeles Link

FRANK LOPEZ
Director
Regional Public Affairs

AMY KITSON
Director
Engineering & Technology
Angeles Link

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PHASE 1 2024 STAKEHOLDER CALENDAR

ANGELES LINK

EMILY GRANT
Regional Public Affairs Manager
Angeles Link

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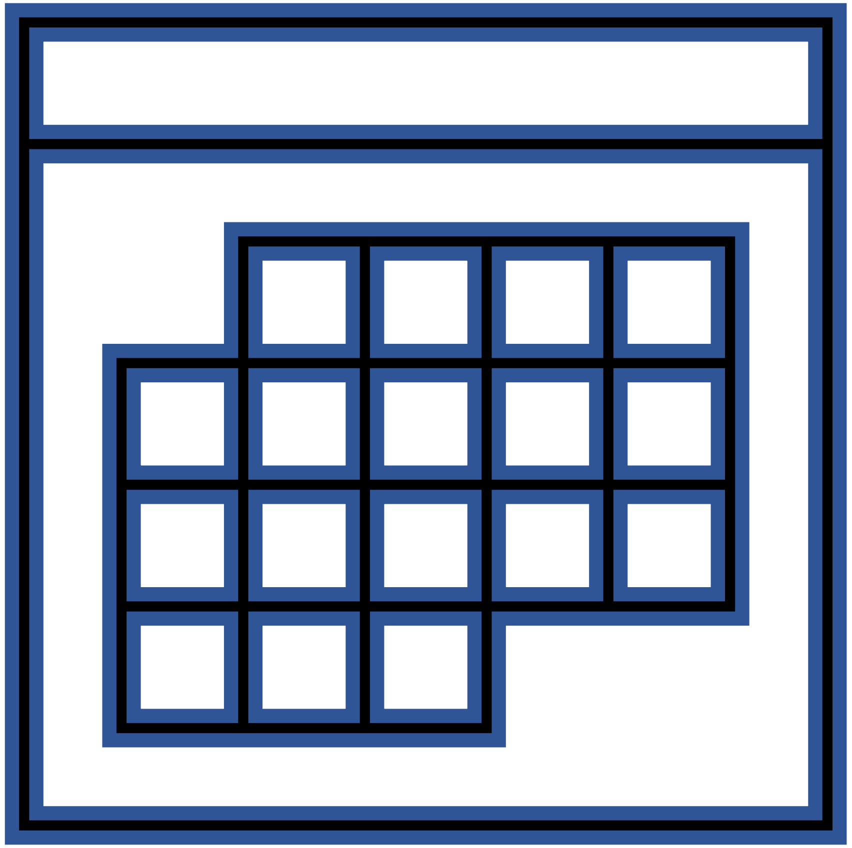
PHASE 1 2024 PROPOSED CALENDAR



- 4/23: Today's Update

- Tuesday, 6/18: CBOSG Q2 Quarterly Meeting
- Friday, 6/21: PAG Q2 Quarterly Meeting
  - Hybrid; in-person attendance encouraged
  - 10am – 2pm with continental breakfast and lunch
  - Port of LA's Banning's Landing Community Center: 100 E Water Street, Wilmington
  - Topics: Review of Draft Study Reports

- TBD July/August: Interim Workshop
  - Option: virtual workshop to review additional Draft Study Reports

- September: Q3 Quarterly Meeting
  - Wrap-up

UPDATE: CBOSG COMPENSATION PLAN

ANGELES LINK

ALMA MARQUEZ
Vice President Gov. Relations
Lee Andrews Group
CBOSG Lead

UPDATE: CBOSG COMPENSATION PLAN

Flat rate of $150/hour of any noticed meetings or workshop (quarterly meeting minimum $500)

Interim meeting format and frequency determined by SoCalGas and the CBOSG

Stakeholders can provide feedback until May 3

POLLING QUESTIONS

- Would you be interested in an Interim Workshop over the summer to review select draft study reports?
- Of the remaining studies, what are you most interested in?

NEXT STEPS

- Reminder: Feedback on Preliminary Findings is due Friday, May 3
  - Preliminary Routing/Configuration, Franchise, and Right-of-Way Analyses
  - Production Planning & Assessment
  - Plan for Applicable Safety Requirements
  - Workforce Planning & Training Evaluation
  - High-Level Feasibility Assessment & Permitting Analysis

- June Q2 Quarterly Meetings (Hybrid)
  - CBOSG Meeting: Tuesday, June 18, 2024; 10am - 2pm
  - PAG Meeting: Friday, June 21, 2024; 10am - 2pm
  - Both meetings will be held at the Port of LA's Banning's Landing Community Center: 100 E Water Street, Wilmington

- TBD: July/August Interim Workshop
  - Virtual meeting; high-level review of select draft studies
  - Please let us know your thoughts

- If you have questions or comments, please submit them in writing at your next convenience
  - PAG: ALP1_Study_PAG_Feedback@insigniaenv.com
  - CBOSG: ALP1_Study_CBO_Feedback@insigniaenv.com

ANGELES LINK

THANK YOU FOR YOUR PARTICIPATION

SoCalGas

CBOSG QUARTERLY MEETING AGENDA
10:00 AM – 2:00 PM

- Arrival and Continental Breakfast
- SoCalGas Safety Moment, Land Acknowledgement, & Roll Call
- SoCalGas Welcome
- Introduction to ARCHES from ARCHES Chief Community Officer
- Preview of Draft Reports: Project Options & Alternatives and Cost Effectiveness
  - Member Discussion
- Preliminary Findings: Environmental Analysis
  - Member Discussion
- LUNCH
- Panel: Best Practices and Case Studies: Community Benefits Planning
- Breakout Session: Best practices and Structure for Community Benefits Plan(s)
- Next Steps/Adjourn

June 18, 2024
10:00 a.m – 2:00 p.m.

ANGELES LINK

Community Based Organization Stakeholder Group (CBOSG)

June Q2 Quarterly Meeting

Warm welcome to our participants!
We will be starting shortly after 10:00 a.m.
to make sure everyone is present in-person and online.

SoCalGas

WELCOME FROM OUR FACILITATORS

ANGELES LINK

ALMA MARQUEZ
Vice President Gov. Relations
Lee Andrews Group
CBOSG Lead

CHESTER BRITT
Executive Vice President
Arellano Associates
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SoCalGas

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We encourage you to turn on your cameras so we can better engage with you

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Wireless microphones will be passed to those speakers attending in person

CBOSG AGENDA

- Arrival and Continental Breakfast
- SoCalGas Safety Moment, Land Acknowledgement & Roll Call
- SoCalGas Welcome
- Introduction to ARCHES from ARCHES Chief Community Officer
- Preview of Draft Reports: Project Options & Alternatives and Cost Effectiveness
  - Member Discussion
- Preliminary Findings: Environmental Analysis
  - Member Discussion
- Lunch
- Panel: Best Practices and Case Studies: Community Benefits Planning
- Breakout Session: Best practices and structure for Community Benefits Plan(s)
- Adjourn

SOCALGAS SAFETY MOMENT

ANGELES LINK

CHANICE ALLEN
Engineering Project Manager
SoCalGas

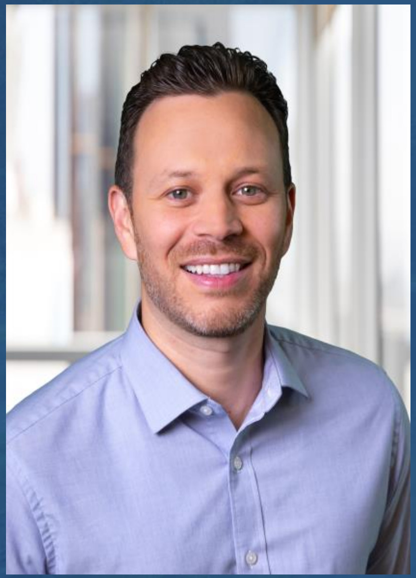
ANGELES LINK

LAND ACKNOWLEDGEMENT & ROLL CALL

SoCalGas

SOCALGAS WELCOME

ANGELES LINK



FRANK LOPEZ
Regional Public Affairs Director

SoCalGas

Draft Reports Release

1	Demand Study (Previously Released)
2	Hydrogen Leakage Assessment
3	Production Planning & Assessment
4	Plan for Applicable Safety Requirements
5	High Level Feasibility Assessment & Permitting Analysis
6	Pipeline Sizing & Design Criteria
7	Water Resources Evaluation
8	Greenhouse Gas (GHG) Evaluation
9	Preliminary Routing /Configuration Analysis with integrated Right-of-Way and Franchise Analysis
10	Workforce Planning & Training Evaluation
11	Nitrous Oxide (NOx) and Other Air Emissions Assessment
12	Environmental Analysis
13	Environmental Social Justice Plan
14	Project Options & Alternatives
15	High-Level Economic Analysis and Cost Effectiveness

Studies Released

Studies

to be Released

- Two Draft Reports have been released for member review and comment.
- The remaining draft reports are forthcoming.

**Given the relationship with the routing analysis, right-of-way and franchise information will be integrated within the Routing Study.*

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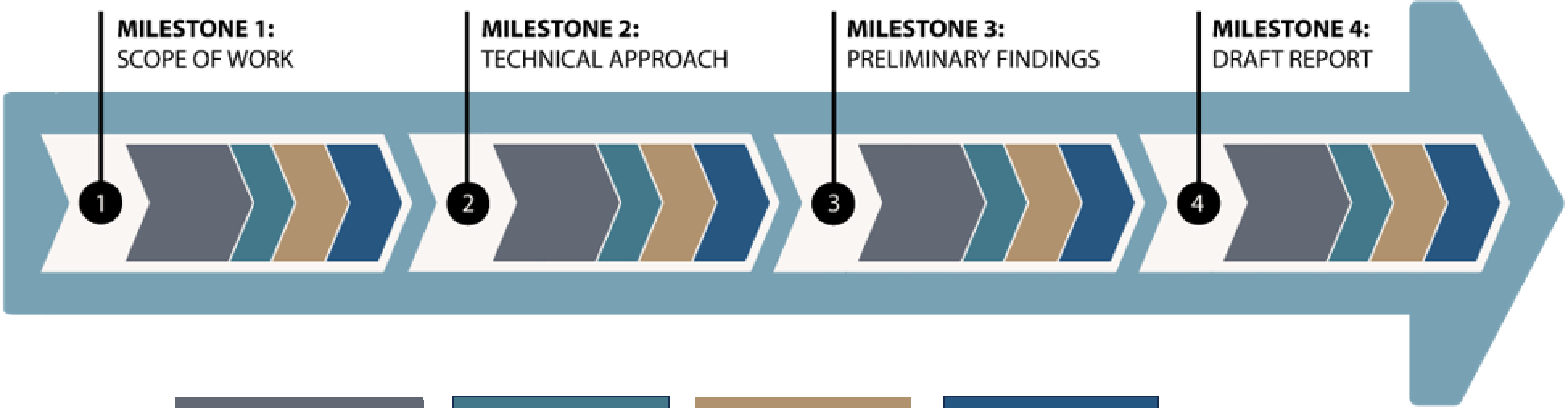
STAKEHOLDER COMMENT UPDATE



Stakeholder Meeting and Comment Period

Comments are Recorded

SoCalGas Drafts Response to Comments

Revisions incorporated in the final report

SoCalGas

INTRODUCTION TO ARCHES

ANGELES LINK

JOY LANGFORD
Chief Community Officer
ARCHES

SoCalGas

ARCHES: OVERVIEW

ARCHES is a public-private partnership created to facilitate California's transition to clean renewable zero emission hydrogen (H2) energy. Its goals are to display fossil fuels and decarbonize our economy with environmental and energy justice and equity, quality of life for our communities, and good green careers for our workers.

ANGELES LINK

ARCHES COMMUNITY BENEFITS PATHWAYS

Community Benefits Pathways

Join ARCHES
Community Benefits Meetings

PROJECT OPTIONS & ALTERNATIVES AND HIGH-LEVEL ECONOMIC ANALYSIS AND COST EFFECTIVENESS

PREVIEW OF DRAFT STUDIES

ANGELES LINK

YURI FREEDMAN
Senior Director
Business Development

SoCalGas

PROJECT OPTIONS & ALTERNATIVES STUDY

Evaluates portfolio of hydrogen delivery alternatives and non-hydrogen alternatives, including electrification and a localized hydrogen hub.

INTEGRATED ACROSS OTHER STUDIES

- **Pipeline Sizing & Design -** Preliminary results of the pipeline sizing and design analysis will help develop a high-level cost estimate for potential conceptual hydrogen pipeline configurations, which will be compared against hydrogen delivery alternatives (e.g., trucking and shipping) and non-hydrogen alternatives (e.g., electrification and renewable natural gas).

- **High-Level Economics and Cost-Effectiveness -** Alternatives that meet the criteria established in the Project Options and Alternatives study (e.g., electrification) will be carried forward to the High-Level Economics and Cost Effectiveness study

- **Environmental Analysis & Environmental Social Justice Plan -** Alternatives that meet the criteria established in the Project Options and Alternatives study will be carried forward to the Environmental Analysis study & Environmental Social Justice Plan

ANGELES LINK

COMPREHENSIVE ASSESSMENT THROUGH A 6-STEP EVALUATION PROCESS

Step 1

Identify potential alternatives including localized hub

Step 2

Evaluate potential alternatives against identified criteria

Step 3

Dismiss alternatives that fail to satisfy Step 2 Criteria

Step 4

Select alternatives to carry forward for further analysis

Step 5

Feed alternatives into cost effectiveness and environmental studies and the Environmental Social Justice Plan

Step 6

Incorporate findings from the Step 5 studies and evaluate alternatives' fulfillment of purpose and need.*

**The Scope of Work Descriptions for the Project Options and Alternatives study identified the underlying purpose and need for Angeles Link, including supporting the State's decarbonization goals.*

COMPREHESIVE SCREENING PORTFOLIO OF POTENTIAL ALTERNATIVES

Screening List

Step 1

Identify potential alternatives including localized hub

Hydrogen Delivery Alternatives

1. Localized hub
2. Power Transmission & Distribution (T&D) with in-basin hydrogen production
3. Liquid hydrogen trucking
4. Gaseous hydrogen trucking
5. Liquid hydrogen shipping
6. Methanol shipping
7. Ammonia shipping
8. Hybrid of compressed truck + liquid train

Non-Hydrogen Alternatives

1. Electrification
2. Carbon Capture & Storage (CCS)
3. Other clean fuels and technologies evaluated for specific use cases and not identified as a potential alternative include:
   - Renewable Natural Gas (RNG)
   - Energy efficiency
   - Nuclear
   - Hydro
   - Geothermal
   - Plug-in Hybrid
   - Biofuels, and
   - Ethanol

ANGELES LINK

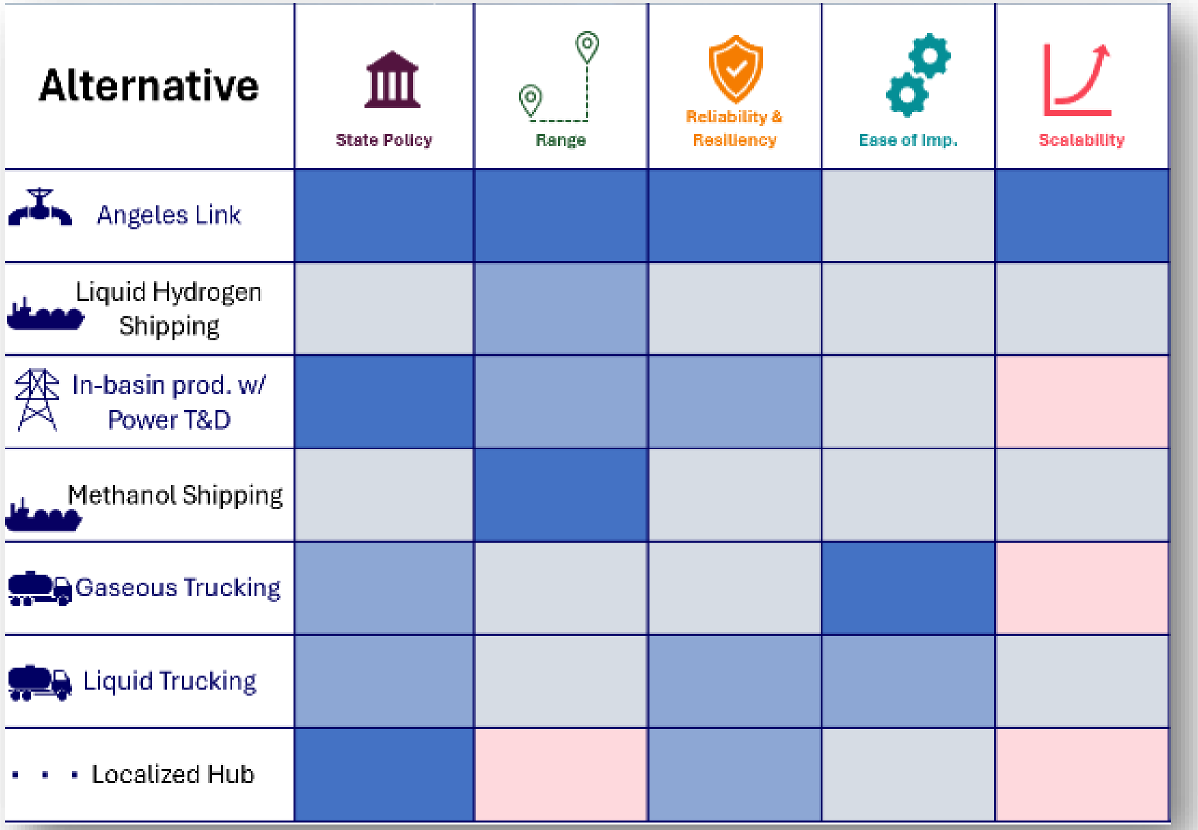
SCORING CRITERIA EVALUATION EXAMPLE (HYDROGEN DELIVERY ALTERNATIVES)

Step 2

Evaluate potential alternatives against identified criteria

In order to be further evaluated, alternatives must meet a set of criteria, including:

- **State Policy:** Alignment with California's environmental law and public policies
- **Range:** Ability to effectively deliver hydrogen to support needs
- **Reliability and Resiliency:** Support overall energy reliability and resiliency
- **Ease of Implementation:** Whether the alternative can be implemented considering existing infrastructure
- **Scalability:** Scaling potential to meet expected future needs



Illustrative scoring framework against identified criteria for hydrogen delivery alternatives

ALTERNATIVES CARRIED FORWARD

ANGELES LINK

The established criteria determined which alternatives would move forward for cost-effectiveness and environmental analyses & environmental social justice plan.

Step 3

Dismiss alternatives that fail to satisfy step 2 criteria

Step 4

Select alternatives to carry forward for further analysis

Step 5

Feed alternatives into cost effectiveness and environmental studies and the Environmental Social Justice Plan

Alternatives Carried Forward*

- **Hydrogen Delivery Alternatives**
  - Gaseous hydrogen trucking
  - Liquid hydrogen trucking
  - Liquid hydrogen shipping
  - Methanol shipping
  - In-basin production using transmission & distribution
  - Localized hub
- **Non-Hydrogen Alternatives**
  - Electrification
  - CCS

***Excluded Hydrogen Delivery Alternatives for purposes of delivering hydrogen to Central and Southern California, including the LA Basin:**

1. Train Delivery excluded due to long loading time challenges and schedules, inflexible routes and limited scale.
2. Ammonia Shipping excluded due to the Haber-Bosch process to convert hydrogen to ammonia which needs to be running 24/7 and is infeasible with solar power constraints.

HIGH-LEVEL ECONOMIC ANALYSIS & COST EFFECTIVENESS STUDY APPLIES A ROBUST ASSESSMENT METHODOLOGY

Measures cost effectiveness by:

- Reviewing cost estimates.
- Performing an economic analysis to determine the potential levelized cost of delivered clean renewable hydrogen (LCOH) to end users.
- Comparing Angeles Link against various project alternatives.

INTEGRATED ACROSS OTHER STUDIES

- **Project Options and Alternatives**[1] – Costs will be analyzed for Angeles Link and Alternatives, including:
  - Hydrogen Delivery Alternatives – Trucking; Shipping; in-Basin Production; Localized Hub
  - Non-Hydrogen Alternatives – Electrification; CCS
- **Pipeline Sizing and Design**[1] – Estimated costs for pipeline and compression will be used to compare Angeles Link to alternatives.
- **Production** – Estimated third-party hydrogen production costs will be used as an input to estimate the levelized cost of hydrogen.
- **Water** – Estimated water related costs will be used (as needed) as an input to estimate third-party hydrogen production costs.

[1] The scope of the hydrogen delivery alternatives is based on the Angeles Link project's potential design with respect to supply, storage and demand. The cost estimates were determined through modeling and using publicly available information.

COST EFFECTIVENESS METHODOLOGY ADOPTS STANDARD METRICS BASED ON ALTERNATIVES

The study compares estimated costs for the Project against selected alternatives using the following metrics

Hydrogen Delivery Alternatives	Non-Hydrogen Alternatives
▪ Comparison metric is Levelized Cost Of Hydrogen (LCOH)[1]	▪ Comparison metrics vary based on end-use: ▪ Power Sector - Levelized Cost of Electricity (LCOE)[2] ▪ Mobility Sector – Total Cost of Ownership (TCO)[3] ▪ Industrial Sector – LCOE and LCOH (metric is use case dependent (e.g., LCOE for co-generation, LCOH for refining))

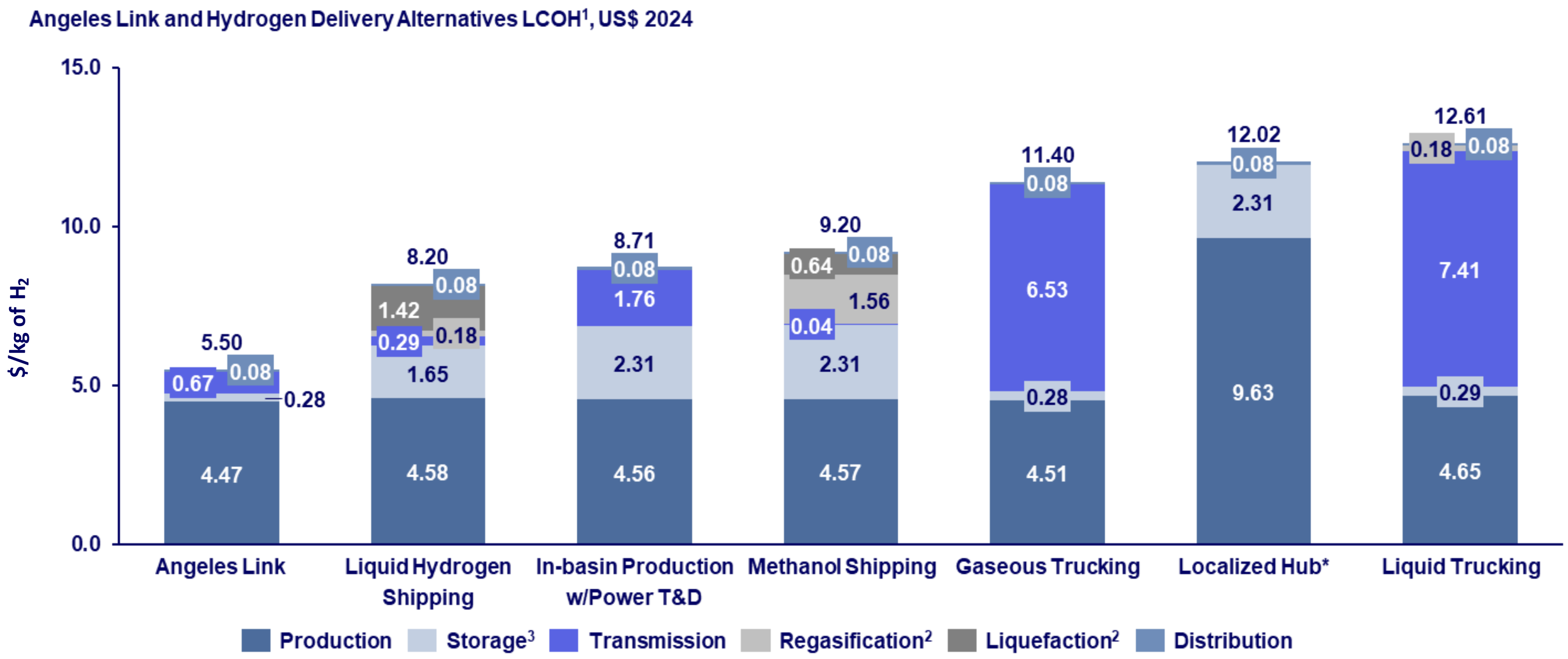
1. *The levelized cost of hydrogen is a common metric used to benchmark cost competitiveness of hydrogen taking into account the investments required to produce and deliver hydrogen to an end-user. This methodology enables different production and delivery routes to be compared on a similar basis.*
2. *The levelized cost of electricity is a common metric used to benchmark the cost competitiveness of producing electricity taking into account the investments required to produce and deliver electricity to an end-user. LCOE with hydrogen would use hydrogen to generate electricity; LCOE for electrification would use other, non-hydrogen renewables to generate electricity; LCOE with Carbon Capture would use natural gas with a carbon capture and sequestration investment.*
3. *Total cost of ownership is a common metric used to benchmark cost competitiveness when comparing different fuels in the mobility sector. TCO takes into account the vehicle's cost, operation and maintenance.*

STUDY INFORMED BY NATIONAL AND/OR CALIFORNIA BASED MODELING
Non-Hydrogen Alternatives

End-use	Angeles Link	Non-Hydrogen Alternatives		Metrics	Sources
		Electrification	CCS		
Mobility (HD trucks and transit buses)	Fuel cell electric vehicles	Battery electric vehicles	Not applicable to use case	TCO ($/mi)	Models supplemented by national lab and CA based assumptions
Power	Hydrogen power plant	Battery energy storage	Gas + CCS power plant	LCOE ($/MWh)	Power service and other economic models
Industry (varies by industry, example used Cement)	Hydrogen Kiln	Electric Kiln	Gas + CCS (Cogen) Blue Hydrogen (Refineries) Gas + CCS kiln (Cement)	Fuel cost ($/MMBtue)	Models supplemented by CA-based assumptions

COST EFFECTIVENESS: Hydrogen Delivery Alternatives

Angeles Link and Hydrogen Delivery Alternatives LCOH[1], US$ 2024



1) Assumes commencement of construction in 2028 and it includes ITC/PTC as well as tax shields
2) Liquefaction and regasification – also includes conversion to methanol and vice versa for the methanol shipping alternative
3) Due to accessibility, we assumed underground storage for Angeles Link and trucking options, and above ground storage for the rest of the alternatives

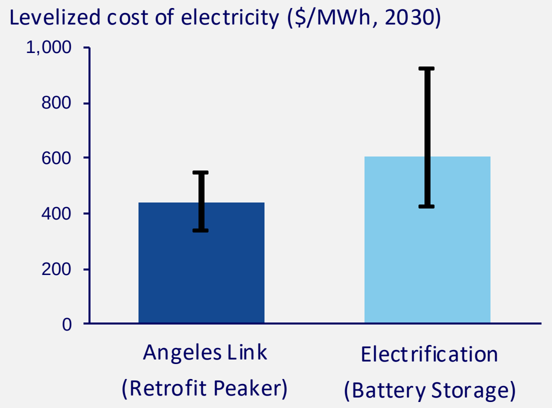
Key Takeaways

- Angeles Link is the most cost-effective hydrogen delivery method analyzed to bring hydrogen into Central and Southern CA, including the LA Basin
- Localized Hub feasibility is limited by renewable electricity supply constraints and high cost of in-basin production

NON-HYDROGEN ALTERNATIVES – ELECTRIFICATION*

ANGELES LINK

Power
(peaking/reliability: 12-hour duration)



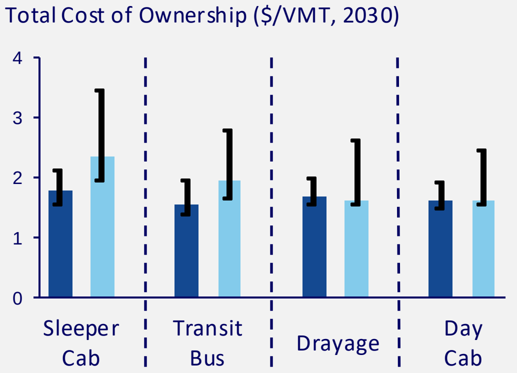
- High relative capital costs of oversized battery storage outweigh H2 fuel costs, making AL more cost-effective
- Maturation of other Long Duration Energy Storage (LDES) technologies like Compressed Air Energy Storage (CAES) and Vanadium Redox Flow Batteries (VRFB) will likely be needed to serve this role with electrification

Key Takeaways*

Angeles Link is more economical to serve several key sectors of the California economy including:

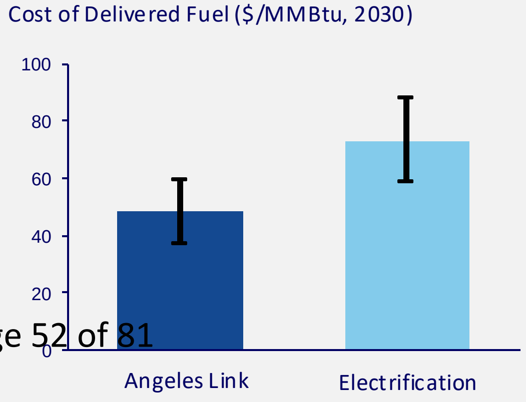
- Power
- Mobility
- High heat industrial processes

Mobility
(long-haul, heavy-duty)



- Fuel cell Electric Vehicles (FCEVs) are most cost-effective vs. Battery Electric Vehicles (BEVs) where faster refueling times offer operational cost savings
- Fuel/charging cost and operational patterns are largest drivers of sensitivity ranges
- FCEVs have technical advantages in applications with high duty cycles, long range requirements, and heavy payloads

Industry – Food & Beverage
(fuel switching)



- AL is cost-effective due to relatively high electricity tariffs in California
- Electrification of low-medium heat is more technically feasible

** Electrification refers to a combination of system level transformation and use-case level technology changes including the grid infrastructure required to support growing electric load. In our analysis we evaluated the cost effectiveness at the use case level.*

ANGELES LINK

HYDROGEN DELIVERY ALTERNATIVES*

Step 6
Incorporate findings from cost effectiveness & environmental studies and evaluate alternatives' fulfillment of purpose and need.

Alternative	State Policy	Range	Reliability & Resiliency	Ease of Imp.	Scalability	Env. Impact	Cost Effectiveness	Key Findings
Angeles Link						Refer to Environmental Analysis Preliminary Findings and Environmental Justice Plan		Appropriate for distance/scale.
Liquid Hydrogen Shipping								Efficient long-distance transportation of H2, requires specialized handling.
In-basin prod. w/ Power T&D								In-basin hydrogen production incurs additional electric T&D costs and is also limited by hard to resolve transmission constraints. Scalability limited by above ground storage need.
Methanol Shipping								Requires additional processing steps, specialized handling and storage facilities. Suitable for relatively long-distances.
Gaseous Trucking								Quickly deployable. Scalability of on-road transportation is limited.
Liquid Trucking								Quickly deployable. Scalability of on-road transportation is limited. Higher costs due to storage and loading costs.
Localized Hub								Limited scalability and higher costs.

Highest — Lowest

*The purpose of this slide is to illustrate the comparison between Angeles Link and the hydrogen delivery alternatives

NON-HYDROGEN ALTERNATIVES - ELECTRIFICATION*

Based on Use Case

Alternative	Use Case	State Policy	Reliability & Resiliency	Maturity	Scalability	End-User Requirements	Env. Impact	Cost Eff.	Key Findings
Angeles Link	Power						Refer to Environmental Analysis Preliminary Findings and Environmental Justice Plan		• Molecules are easier to store than electrons, supporting system reliability • While battery storage is mature and simpler to deploy at scale, it is cost-prohibitive to overbuild for longer duration system reliability needs without advances in other Long Duration Energy Storage (LDES) technologies
Electrification	Power								
Angeles Link	Mobility								• Molecule-based storage and refueling is more reliable and resilient • Fuels are better suited to serve the operational requirements of long-haul, high payload, high duty-cycle vehicles than batteries
Electrification	Mobility								
Angeles Link	Industrial Heat								• AL is more cost-effective for high heat applications. • Electrification is the more mature, scalable solution for low-medium heat applications
Electrification	Industrial Heat								
Angeles Link	Cement								• Molecules are easier to store than electrons, supporting system reliability • AL is more cost-effective than electrification.
Electrification	Cement								

The purpose of this slide is to illustrate the comparison between Angeles Link and the non-hydrogen delivery alternatives

Highest Score — Lowest Score

ANGELES LINK

SUMMARY OF INITIAL FEEDBACK

Key themes from stakeholder feedback are summarized below:

Thematic Comments	Plan to Incorporate/Address
As SoCalGas continues studying options and alternatives, demystifying hydrogen for the average consumer should also be considered, especially given the DOE award and partnership with ARCHES.	SoCalGas will continue using PAG/CBOSG engagement to help expand education around hydrogen's role in helping the state achieve its decarbonization goals, reducing emissions in disadvantaged communities, and enhancing reliability and resiliency.
A hydrogen pipeline would provide the lowest cost pathway to deliver clean renewable hydrogen to the LA Basin to meet demand expectations and be competitive.	The High-Level Economics and Cost Effectiveness Study concludes that Angeles Link is the lowest cost method to bring clean renewable Hydrogen to Central and Southern California, including the LA Basin.
The cost effectiveness study does not justify the ratepayer investment. The studies do not result in a demonstrated need for such a significant ratepayer investment in a major new hydrogen pipeline system	The High-Level Economics and Cost-Effectiveness Study estimates the levelized cost of delivered hydrogen for the Angeles Link Project and compares that to the various alternatives. The ratepayer investment analysis is currently out of scope as part of the Phase 1 preliminary feasibility analysis.
Because current information suggests that renewable hydrogen is expensive, it is important that reasonable cost estimates are included in the demand forecast calculations. Omitting or using unrealistic prices delivers unreliable demand projections.	SoCalGas is evaluating cost effectiveness for the Angeles Link project using the levelized cost of energy framework, which considers asset related costs across the hydrogen value chain over its lifetime, to determine the levelized cost of delivered clean renewable hydrogen (LCOH) and comparing it do other clean renewable hydrogen alternatives and non-hydrogen alternatives. This approach is appropriate for feasibility/pre-FEED analysis at this stage of the project.

1. All comments are available on the living library in the Comment Letters folder located on the Homepage: https://arellanoassociates.sharepoint.com/sites/SCGAngelesLink

MEMBER DISCUSSION:
PREVIEWS OF PROJECT OPTIONS & ALTERNATIVES AND HIGH-LEVEL ECONOMIC ANALYSIS & COST EFFECTIVENESS DRAFT REPORTS

- Please announce your name and speak directly into the microphone
- Be concise and focus on discussion topics
- Verbal comments are not the only way to provide input, feel free to type a chat
- We are accepting written input after this meeting if we run short on time, or you think of things later

ENVIRONMENTAL ANALYSIS

PRELIMINARY FINDINGS

ANGELES LINK

JESSICA FOLEY
Regulatory Strategy & Financial Controls Manager
Angeles Link

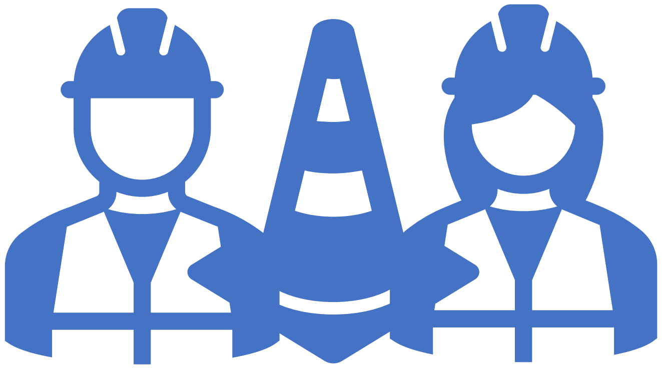
SoCalGas

ESJ PLAN (JULY WORKSHOP) & ENVIRONMENTAL ANALYSIS (TODAY)

ESJ PLAN

Addressing potential impacts and directing project benefits to **Disadvantaged Communities (DACs) and Environmental Social Justice (ESJ)** communities is a top priority for SoCalGas with the Angeles Link project.

+



ENVIRONMENTAL ANALYSIS

Studies environmental impacts associated with the **construction** and **operation**, and **maintenance**

SoCalGas

ANGELES LINK

ENVIRONMENTAL ANALYSIS PRELIMINARY FINDINGS

- High-level evaluation of potential impacts associated with the construction and operation and maintenance of Angeles Link, as well as other potential alternatives to the project.
- Plans for addressing and mitigating impacts and provide the findings from Phase 1 feasibility studies demonstrating the Project’s compliance with environmental law and public policies.

RELATIONSHIP TO OTHER STUDIES AND PROCEEDINGS

- Preliminary pipeline routes have been developed as part of the Preliminary Routing/Configuration Analysis and project alternatives as part of the Project Options and Alternatives study
    - Preliminary pipeline routes are subject to change and will be further refined, which will further inform the environmental analysis of the Project in future phases

STUDY APPROACH AND ASSUMPTIONS

- Results and impact analysis are based upon publicly available datasets and information
- Pipeline would be located underground and within previously disturbed areas to the extent feasible
- Study evaluated potential impacts that could occur within 100 feet of each side of the proposed pipeline corridors for certain topic areas (i.e., air quality, greenhouse gas emissions, biological resources, energy, hazards and hazardous materials, hydrology and water quality, land use and planning, and environmental justice), and within a 0.25 miles of the proposed pipeline corridors for cultural/tribal cultural resources
- Construction of the pipeline could be in stages

ENVIRONMENTAL ANALYSIS PRELIMINARY FINDINGS

- This preliminary evaluation indicates that Angeles Link can be constructed and operated in accordance with environmental laws and public policies.
- This study determines that the project may lead to potential impacts from construction and operation and maintenance (O&M) activities in all resources analyzed in this study.
- Potential environmental impacts will continue to be analyzed once preferred pipeline routes are identified at the conclusion of Phase 1. This additional analysis will be used to help refine the preferred routes in Phase 2 to avoid and minimize potential environmental impacts. The extent of potential impacts will not be known until the project is refined and engineering is developed.
- The project is expected to undergo review pursuant to the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA) at the conclusion of Phase 2, in compliance with applicable environmental laws.
- The project is being undertaken in furtherance of the State's climate goals.

ENVIRONMENTAL ANALYSIS PRELIMINARY FINDINGS

- Angeles Link and eight (8) alternatives evaluated according to environmental topic areas:
  - Air quality, cultural and tribal cultural resources, biological resources, energy, greenhouse gas emissions, hazards and hazardous materials, hydrology and water quality, land use and planning
- Study identifies “potential impact” or “no impact” in each topic area given the level of detail known about the project and alternatives at this time
- The high-level assessment uses applicable questions from the CEQA Guidelines Appendix G as a framework to evaluate potential impacts in selected resource areas.

Findings are preliminary and high level and therefore 1) do not represent if an impact is significant from the CEQA/NEPA perspective nor address the magnitude of the impact; 2) do not capture all impact areas that will be evaluated in a CEQA/NEPA document; and 3) do not account for the project’s or alternatives’ benefits, including those benefits from the use of the clean energy delivered by the project or alternative.

Hydrogen Delivery Alternatives

- Alt. 1: Gaseous Trucking
- Alt. 2: Liquid Trucking
- Alt. 3: Liquid Hydrogen Shipping
- Alt. 4: Methanol Shipping
- Alt. 5: In-basin hydrogen production using transmission and distribution (In-basin)
- Alt: 6: Localized Hub

Non-Hydrogen Alternatives

- Alt. 7: Electrification
- Alt. 8: Carbon Capture Utilization & Storage (CCS)

SUMMARY OF INITIAL FEEDBACK

Preliminary findings are currently available for comment. The close of the comment window is June 25, 2024.

Thematic Comments	Plan to Incorporate/Address
EJ/ESJ considerations are a priority and must encompass more than projected impacts forecasted with desktop tools.	SoCalGas separated the EJ/ESJ component from the Environmental Analysis to ESJ as a standalone consideration. The analysis will include a combination of desktop tools with feedback from impacted communities, via the CBOSG in Phase One and as regionally appropriate in subsequent phases.
	ESJ Plan developed in response to stakeholder feedback provided during July 2023 CBOSG workshop.

1. All comments are available on the living library in the Comment Letters folder located on the Homepage. https://arellanoassociates.sharepoint.com/sites/SCGAngelesLink

MEMBER DISCUSSION: ENVIRONMENTAL ANALYSIS

- Please announce your name and speak directly into the microphone
- Be concise and focus on discussion topics
- Verbal comments are not the only way to provide input, feel free to type a chat
- We are accepting written input after this meeting if we run short on time, or you think of things later

ANGELES LINK

LUNCH

SoCalGas

COMMUNITY BENEFITS: BEST PRACTICES, CASE STUDIES, AND STRUCTURE

PANEL DISCUSSION

ANGELES LINK

ROBERT SAINZ
President & Executive Dir.
New Ways to Work

VERONICA SOTO
Senior Advisor, Workforce Development & Economic Impact, Capital Improvement Program
Los Angeles World Airports

ANGELES LINK

WHAT IS A COMMUNITY BENEFITS PLAN (CBP)?

As defined by the U.S. Department of Energy, Community Benefits Plans are based on a set of four core policy priorities:

- Engaging communities and labor;
- Investing in America’s workers through quality jobs;
- Advancing diversity, equity, inclusion, and accessibility through recruitment and training; and
- Implementing Justice40, which directs 40% of the overall benefits of certain Federal investments to flow to disadvantaged communities.

COMMUNITY BENEFITS PLANS: BREAKOUT SESSION

ANGELES LINK

ALMA MARQUEZ
Vice President Gov. Relations
Lee Andrews Group
CBOSG Lead

EMILY GRANT
Angeles Link
Regional Public Affairs Manager
SoCalGas

BREAKOUT SESSION:
COMMUNITY BENEFITS PLANS

MEMBER DISCUSSION: COMMUNITY BENEFITS PLANS REPORT OUT

- Please announce your name and speak directly into the microphone
- Be concise and focus on discussion topics
- Verbal comments are not the only way to provide input, feel free to type a chat
- We are accepting written input after this meeting if we run short on time, or you think of things later

NEXT STEPS

- Feedback on Environmental Analysis Preliminary Findings due Tuesday, 6/25
- Feedback on Hydrogen Leakage Assessment Draft Report due Wednesday, 6/26
  - CBOSG Feedback: ALP1_Study_CBO_Feedback@insigniaenv.com
- Next Meeting date: Summer Workshops: Tuesday, July 23 at the SoCalGas Energy Resource Center in Downey
  - Please note we will be meeting in the Energy Solutions Auditorium
  - Topics and additional details to follow
- Today's presentation and meeting recording will be available soon on the living library
- If you have questions or comments, please submit them in writing at your next convenience

ANGELES LINK

THANK YOU FOR YOUR PARTICIPATION

SoCalGas

ROBERT SAINZ
New Ways to Work, President and Executive Director

Robert is the President and Executive Director of New Ways to Work, a nonprofit focusing on advocacy and technical assistance for the improvement of workforce and education programs and systems serving at risk young adults.

Robert recently concluded a 30-year public sector career in the City and County of Los Angeles. He established the City of Los Angeles YouthSource System and the Los Angeles Performance Partnership Pilot (LAP3), co-founded LA: RISE to serve homeless and re-entry populations, and created HIRE LA, one of the largest public-private youth employment initiatives in the nation.

Robert was previously the Executive Director of the Los Angeles Youth Opportunity Movement and worked as the Assistant and Interim Executive Director of the City of Los Angeles Commission for Children, Youth and Their Families.

As a national voice on workforce, Robert previously served as President and Trustee in the US Conference of Mayor's Workforce Development Council, and as an advisory member for the National Dropout Prevention Council. He is also a board member of School & Main; Alliance for a Better Community; and Co-founder of the Reconnecting LA's Youth (RELAY) Institute at California State University, Northridge.

Robert is married, a father of three children, and grandfather to four.

VERONICA SOTO

Los Angeles World Airports, Senior Advisor, Workforce Development & Economic Impact, Capital Improvement Program

Veronica Soto is the Senior Advisor for Workforce Development & Economic Impact for the Los Angeles World Airports $30 billion Capital Improvement Program.

Previously, she served as the Inclusivity & Workforce Development Administrator for the Landside Access Modernization Program. She possesses over 25 years of experience developing public agency economic and workforce development programs that promote diversity and economic inclusion based on high standards of equity, open competition, and transparency on capital programs with a combined value of over $60 billion.

Veronica developed nationally and locally recognized programs serving small and disadvantaged businesses for the $2.4B Alameda Corridor Project, $27B Los Angeles Unified School District School Construction Program, $6.2B Los Angeles Community College District Bond Program, and Los Angeles County $350M Martin Luther King Medical Center Project. She also served as the Los Angeles Director for Emerald Cities Collaborative and performed economic inclusion work in New Orleans post Katrina.

Veronica's commitment to creating connections between industry and youth is also long-standing. She led the effort to launch the HireLAX Youth Program for Angelenos ages 18 to 24 to help cultivate a skilled workforce and address high unemployment among youth of color. She also created the ACES Engineering Pathway Program to increase the diversity of students entering the design and construction industry by eliminating barriers to higher education and providing paid internship experience on major capital projects.

Veronica has served on a variety of boards, is a member of numerous industry organizations, and is a recipient of local, regional, and national awards for her work building the competitive capacity of small, diverse firms and creating pathways for local and disadvantaged workers. She most recently completed the Massachusetts Institute of Technology Mel King Fellowship on Transnational Economic Democracy that heightened her awareness of international comparative approaches to creating community wealth and empowerment.

Veronica collects teapots and supports animal conservation.

SUMMARY

This presentation examines alternative methods for transporting hydrogen as well as non-hydrogen alternatives, such as electrification.

KEY FINDINGS

Alternatives Carried Forward

Hydrogen Delivery Alternatives

- Hydrogen Delivery Alternatives
- Gaseous hydrogen trucking
- Liquid hydrogen trucking
- Liquid hydrogen shipping
- Methanol shipping
- In-basin production using transmission & distribution
- Localized hub

Non-Hydrogen Alternatives

- Electrification
- Carbon Capture and Storage (CCS)

KEY TAKEAWAYS

OPTIONS AND ALTERNATIVES EVALUATION PROCESS

- **Step 1**: Identify potential alternatives
  Step 2: Evaluate potential alternatives against identified criteria
- **Step 3:** Dismiss alternatives that fail to satisfy step 2 criteria
- **Step 4:** Select alternatives to carry forward for further analysis
- **Step 5:** Feed alternatives into cost effectiveness study and environmental & social justice studies
- **Step 6:** Incorporate findings from cost effectiveness & environmental studies and evaluate alternatives' fulfillment of purpose and need

SUMMARY

This study measures cost-effectiveness by collecting cost estimates, analyzing the levelized cost of delivering clean, renewable hydrogen (LCOH) to end users, and comparing Angeles Link to alternatives.

KEY FINDINGS

For **hydrogen** delivery alternatives:

- Studies find that a pipeline is the most cost-efficient way to bring hydrogen to the LA Basin on a large scale.
- Challenges with a localized hub include limited renewable electricity and the high cost of local production.
- Other methods, like trucking, shipping, and in-basin production with transmission and distribution, are at a higher cost than the Angeles Link project.

For **non-hydrogen** alternatives, Angeles Link is more economical to serve several key sectors of the California economy including:

- Power
- Mobility
- High-heat industrial processes

PREVIEW OF ENVIRONMENTAL ANALYSIS PRELIMINARY FINDINGS DRAFT REPORT

Q2 MEETING
JUNE 18, 2024

SUMMARY

This study evaluates potential environmental impacts of constructing, operating, and maintaining Angeles Link, as well as project alternatives.

KEY FINDINGS

- Preliminary assessment shows Angeles Link can be constructed and operated in compliance with environmental laws and policies.
- Construction, operation, and maintenance may impact various environmental resources.
- The extent of potential impact levels will not be known until after project refinement and based on detailed engineering.
- Further environmental analysis will occur after identifying preferred pipeline routes in Phase 1 and refining them in Phase 2.

KEY TAKEAWAYS

Angeles Link and eight (8) alternatives have been evaluated according to environmental topic areas:

- Air quality, cultural and tribal cultural resources, biological resources, energy, greenhouse gas emissions, hazards and hazardous materials, hydrology and water quality, land use and planning.

Appendix 7 – PAG Meeting Materials

PAG AND CBOSG JOINT UPDATE

- Welcome PAG and CBOSG Members
- SoCalGas Opening Remarks
- Phase 1 Studies Review and Commenting Process
    - Member Discussion
- Phase 1 Remaining Stakeholder Calendar
    - Member Discussion
- CBOSG Compensation Plan
    - Member Discussion
- Next Steps and Upcoming Meetings

April 23, 2024
10:00 am

ANGELES LINK

Planning Advisory Group (PAG) & Community-Based Organization Stakeholder Group (CBOSG)

Angeles Link Update

Warm welcome to our participants!
We will be starting shortly after 10:00 am
to make sure everyone is present.

SoCalGas

WELCOME FROM OUR FACILITATOR

ANGELES LINK

CHESTER BRITT
Executive Vice President
Arellano Associates
PAG Lead

ALMA MARQUEZ
Vice President Gov. Relations
Lee Andrews Group
CBOSG Lead

SoCalGas

HOUSEKEEPING:

This meeting will be recorded (video and audio), and a court reporter will be transcribing the meeting. Please announce yourself before you speak

Zoom microphones are muted by the host to eliminate background noise. You will need to unmute your microphone when called on to speak

We encourage you to turn on your cameras so we can better engage with you

Please feel free to use the Zoom chat to provide input and ask questions throughout the meeting

If you would like to speak, please use the "Raise Hand" button at the bottom of the Zoom screen

In lieu of a formal roll call, please announce yourself in the chat and add your organization in your Zoom name

AGENDA OPTION

- Welcome PAG & CBOSG Joint Update
- SoCalGas Opening Remarks
- Phase 1 Studies Review and Commenting Process
  - Member Discussion
- Phase 1 Remaining Stakeholder Calendar
- CBOSG Compensation Plan
- Next Steps and Upcoming Meetings

ANGELES LINK

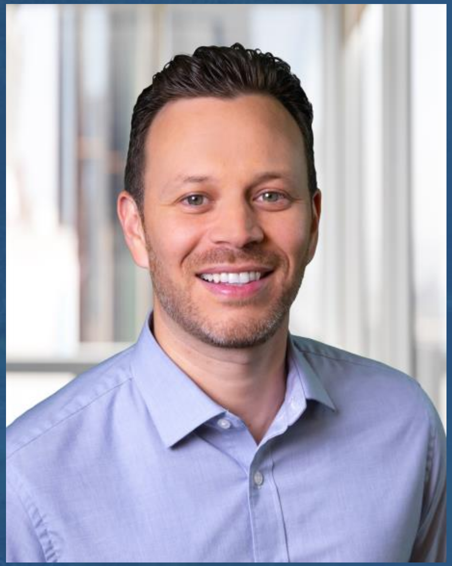
WELCOME PAG & CBOSG JOINT MEETING

PLEASE ADD YOUR ORGANIZATION TO YOUR SCREEN NAME AND WELCOME OTHERS IN THE CHAT

SoCalGas

SOCALGAS WELCOME

ANGELES LINK



FRANK LOPEZ
Director
Regional Public Affairs

SoCalGas

PHASE 1 PROCESS IMPROVEMENTS

ANGELES LINK

JESSICA FOLEY
Regulatory Strategy & Financial Controls Manager
Angeles Link

SoCalGas

STAKEHOLDER FEEDBACK: COMMENT PROCESS

- The materials provided are too dense and detailed, making it difficult for stakeholders to provide meaningful feedback
- Key takeaways and findings can be challenging to discern
- Stakeholders should be able to see participant comments that are submitted

SoCalGas

PROPOSED PROCESS IMPROVEMENTS

- Simplified preliminary findings format to streamline review
  - Key findings in presentation format
  - 2 weeks to submit comments
- Detailed/comprehensive information will be included in draft Study Reports (available over a 3-week period for review and comment)
- Dedicated discussion at future stakeholder meetings to summarize stakeholder input that has been considered and, if applicable, incorporated
- Comment letters are posted to the Living Library at the close of the feedback window as well as in our quarterly reports
- Quarterly CPUC reports will continue to provide responses to submitted comments and the comment letter in original form
- Website for regulatory proceeding and final quarterly reports: [Angeles Link Project Memo Account | SoCalGas]

PRELIMINARY DATA AND FINDINGS:
WORKFORCE PLANNING & TRAINING EVALUATION

April 2024

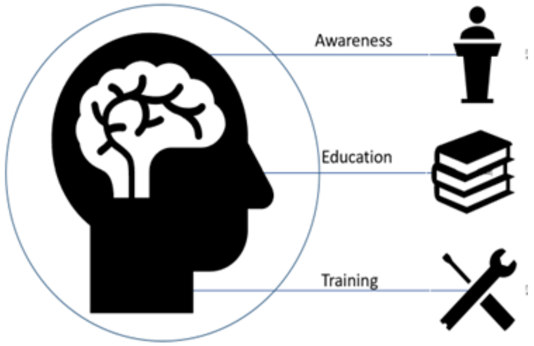
STUDY INTRODUCTION

- This study evaluates operations and maintenance protocols for utility workers regarding hydrogen infrastructure and workforce needs in terms of staging and growth for the Project
- Future workforce job estimates will be provided in draft study to be released later in 2024
- This study is being prepared as directed by CPUC Decision (D.22-12-055, OP 6 (e)) which requires SoCalGas to provide the findings and results from the Phase One feasibility studies

WORKFORCE STUDY CONSIDERATIONS

Sharing Knowledge

Collaborate with industry, government, unions, and local communities on workforce initiatives



Workforce Planning

Utilize resourcing data to plan for hydrogen industry workforce needs; new skilled and upskilled workers

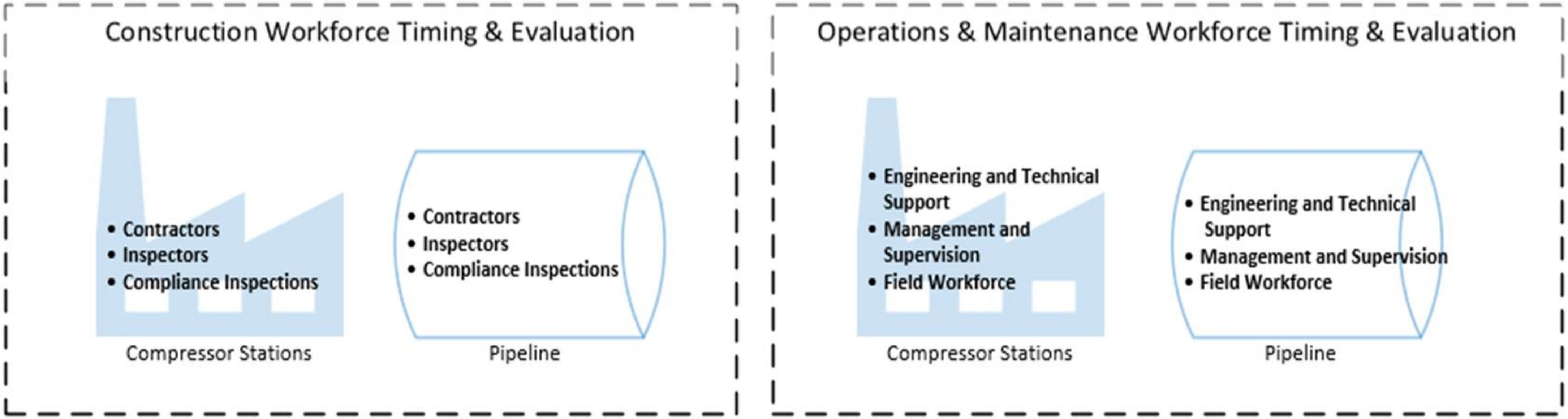
Build Hydrogen Job Pathways

Support workforce centers, universities/trade schools, and skills/training programs

STUDY APPROACH/SCOPE

WORKFORCE METHODOLOGY/FORECASTING

Workforce Staging Timing & Evaluation



WORKFORCE PLANNING & TRAINING PRELIMINARY FINDINGS

- Identify skill requirements, specifically qualifications required for various roles involved in hydrogen pipeline construction and pipeline operations
- Workforce training for safety and regulatory compliance
- Identify gaps in the required skills within the existing workforce

- Determine workforce size to estimate the number of resources needed
- Continuous monitoring and adaptation for workforce management

- Education and training given to the project management and operations workforce for material and component selection
- Operator qualifications to provide appropriate training and awareness to operations personnel
- Training programs to enhance existing workforce skills and/or prepare new workforce for hydrogen related work

ANGELES LINK

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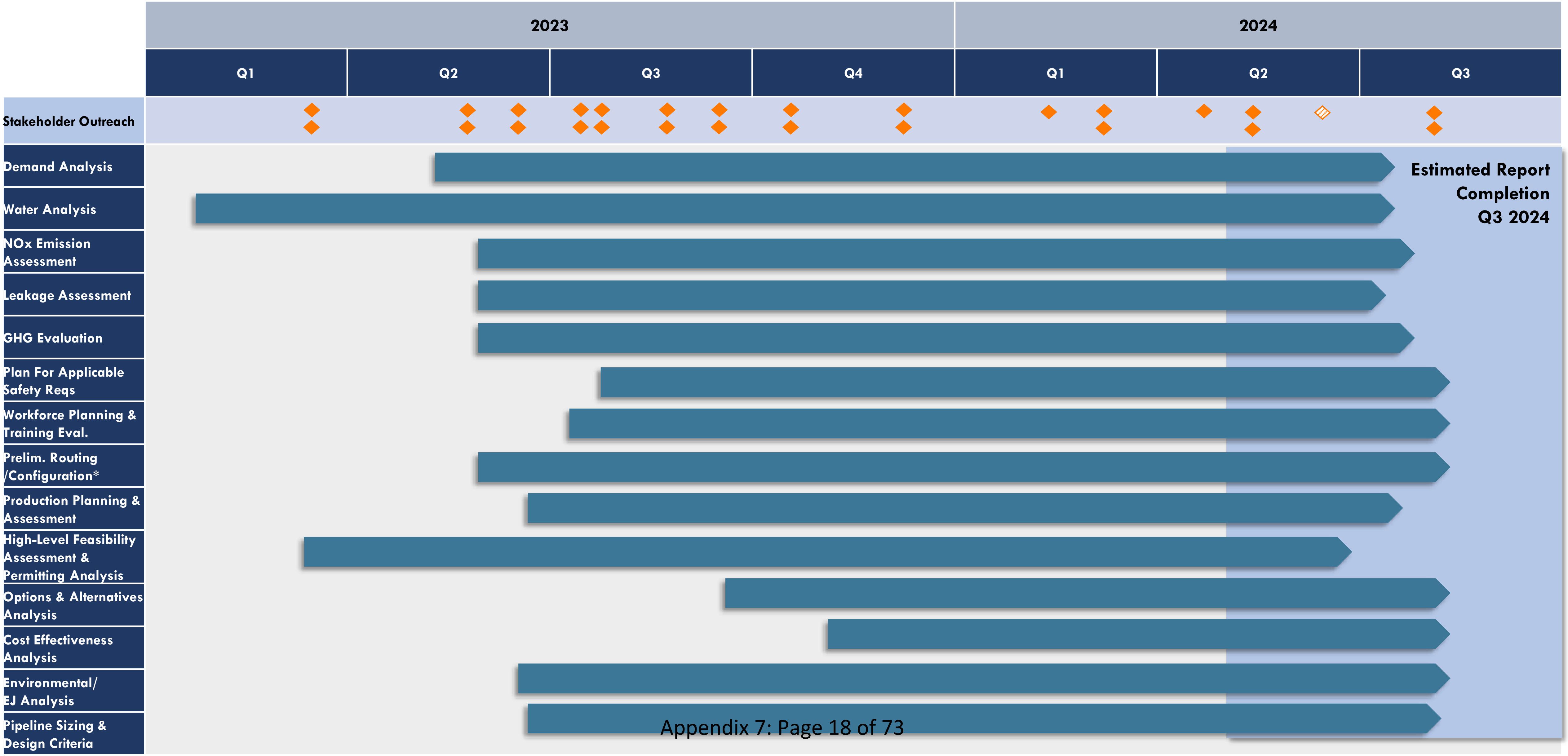
Estimated Preliminary ALP1 Study Schedule



*Includes Right-of-way and Franchise analyses

MEMBER DISCUSSION

ANGELES LINK

- Please announce your name and organization
- Be concise and focus on discussion topics
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- We are accepting written input after this meeting if we run short on time, or you think of things later

JESSICA FOLEY
Regulatory Strategy &
Financial Controls Manager
Angeles Link

SHIRLEY ARAZI
Director
Regulatory & Policy
Angeles Link

FRANK LOPEZ
Director
Regional Public Affairs

AMY KITSON
Director
Engineering & Technology
Angeles Link

SoCalGas

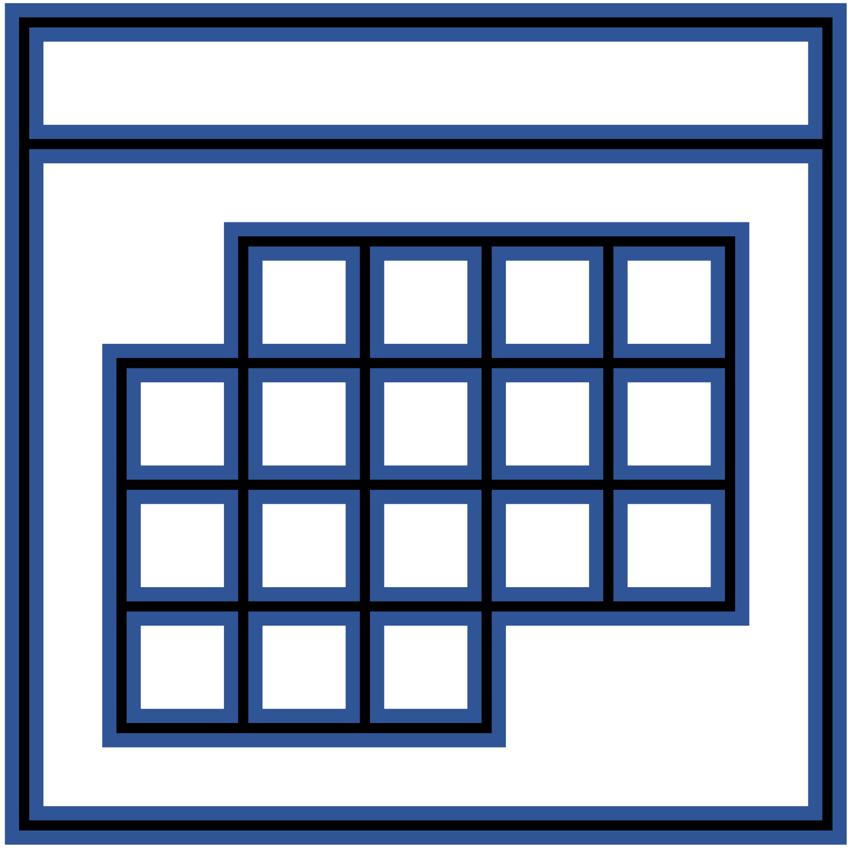
PHASE 1 2024 STAKEHOLDER CALENDAR

ANGELES
LINK

EMILY GRANT
Regional Public Affairs Manager
Angeles Link

SoCalGas

PHASE 1 2024 PROPOSED CALENDAR



- 4/23: Today's Update

- Tuesday, 6/18: CBOSG Q2 Quarterly Meeting
- Friday, 6/21: PAG Q2 Quarterly Meeting
  - Hybrid; in-person attendance encouraged
  - 10am – 2pm with continental breakfast and lunch
  - Port of LA's Banning's Landing Community Center: 100 E Water Street, Wilmington
  - Topics: Review of Draft Study Reports

- TBD July/August: Interim Workshop
  - Option: virtual workshop to review additional Draft Study Reports

- September: Q3 Quarterly Meeting
  - Wrap-up

UPDATE: CBOSG COMPENSATION PLAN

ANGELES LINK

ALMA MARQUEZ
Vice President Gov. Relations
Lee Andrews Group
CBOSG Lead

UPDATE: CBOSG COMPENSATION PLAN

Flat rate of $150/hour of any noticed meetings or workshop (quarterly meeting minimum $500)

Interim meeting format and frequency determined by SoCalGas and the CBOSG

Stakeholders can provide feedback until May 3

SoCalGas

POLLING QUESTIONS

- Would you be interested in an Interim Workshop over the summer to review select draft study reports?
- Of the remaining studies, what are you most interested in?

ANGELES LINK

NEXT STEPS

- Reminder: Feedback on Preliminary Findings is due Friday, May 3
  - Preliminary Routing/Configuration, Franchise, and Right-of-Way Analyses
  - Production Planning & Assessment
  - Plan for Applicable Safety Requirements
  - Workforce Planning & Training Evaluation
  - High-Level Feasibility Assessment & Permitting Analysis

- June Q2 Quarterly Meetings (Hybrid)
  - CBOSG Meeting: Tuesday, June 18, 2024; 10am - 2pm
  - PAG Meeting: Friday, June 21, 2024; 10am - 2pm
  - Both meetings will be held at the Port of LA's Banning's Landing Community Center: 100 E Water Street, Wilmington

- TBD: July/August Interim Workshop
  - Virtual meeting; high-level review of select draft studies
  - Please let us know your thoughts

- If you have questions or comments, please submit them in writing at your next convenience
  - PAG: ALP1_Study_PAG_Feedback@insigniaenv.com
  - CBOSG: ALP1_Study_CBO_Feedback@insigniaenv.com

SoCalGas

ANGELES LINK

THANK YOU FOR YOUR PARTICIPATION

SoCalGas

PAG QUARTERLY MEETING AGENDA
10:00 AM – 2:00 PM

- Arrival and Breakfast
- SoCalGas Safety Moment, Land Acknowledgement & Roll Call
- SoCalGas Welcome
- Preview of Draft Report: Project Options & Alternatives
  - Member Discussion
- LUNCH
- Preview of Draft Report: High-Level Economic Analysis & Cost Effectiveness
  - Member Discussion
- Preliminary Findings: Environmental Analysis
  - Member Discussion
- Next Steps/Adjourn

June 21, 2024
10:00 a.m. – 2:00 p.m.

ANGELES LINK

Planning Advisory Group (PAG)

June Q2 Quarterly Meeting

Warm welcome to our participants!
We will be starting at 10:00 a.m.
to make sure everyone is present.

WELCOME FROM OUR FACILITATORS

ANGELES LINK

CHESTER BRITT
Executive Vice President
Arellano Associates
PAG Lead

ALMA MARQUEZ
Vice President Gov. Relations
Lee Andrews Group
CBOSG Lead

SoCalGas

HOUSEKEEPING:

This meeting will be recorded (video and audio), and a court reporter will be transcribing the meeting. Please announce yourself before you speak

Zoom microphones are muted by the host to eliminate background noise. You will need to unmute your microphone when called on to speak. *For both in-person and on-line participants please speak directly into the microphone to ensure everyone can hear*

We encourage you to turn on your cameras so we can better engage with you

Please feel free to use the Zoom chat to provide input and ask questions throughout the meeting

If you would like to speak, please use the "Raise Hand" button at the bottom of the Zoom screen

Wireless microphones will be passed to those speakers attending in person

SoCalGas

PAG AGENDA

- Arrival and Continental Breakfast
- SoCalGas Safety Moment, Land Acknowledgement & Roll Call
- SoCalGas Welcome
- Preview of Draft Report: Project Options & Alternatives
  - Member Discussion
- Lunch
- Preview of Draft Report: High-Level Economic Analysis & Cost Effectiveness
  - Member Discussion
- Break (if needed)
- Preliminary Findings: Environmental Analysis
  - Member Discussion
- Adjourn

SOCALGAS SAFETY MOMENT

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CHANICE ALLEN
Engineering Project Manager
SoCalGas

LAND ACKNOWLEDGEMENT & ROLL CALL

SOCALGAS WELCOME

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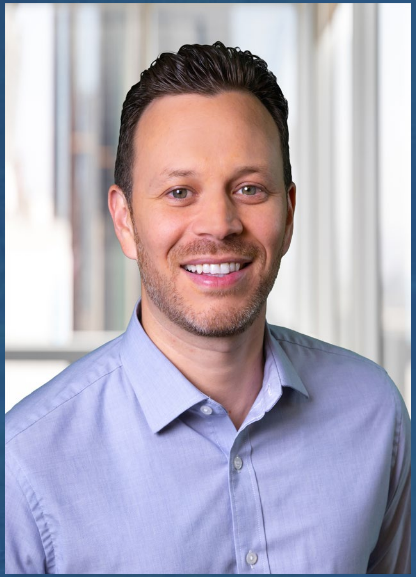

FRANK LOPEZ
Regional Public Affairs Director

SoCalGas

PROJECT OPTIONS & ALTERNATIVES

PREVIEW OF DRAFT STUDY

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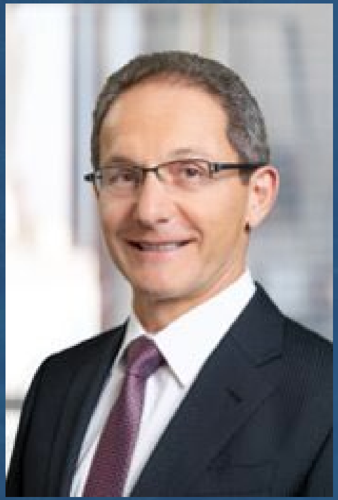

YURI FREEDMAN
Senior Director
Business Development

SoCalGas

PROJECT OPTIONS & ALTERNATIVES STUDY

Evaluates portfolio of hydrogen delivery alternatives and non-hydrogen alternatives, including electrification and a localized hydrogen hub.

INTEGRATED ACROSS OTHER STUDIES

- **Pipeline Sizing & Design -** Preliminary results of the pipeline sizing and design analysis will help develop a high-level cost estimate for potential conceptual hydrogen pipeline configurations, which will be compared against hydrogen delivery alternatives (e.g., trucking and shipping) and non-hydrogen alternatives (e.g., electrification and renewable natural gas).

- **High-Level Economics and Cost-Effectiveness -** Alternatives that meet the criteria established in the Project Options and Alternatives study (e.g., electrification) will be carried forward to the High-Level Economics and Cost Effectiveness study

- **Environmental Analysis & Environmental Social Justice Plan -** Alternatives that meet the criteria established in the Project Options and Alternatives study will be carried forward to the Environmental Analysis study & Environmental Social Justice Plan

COMPREHENSIVE ASSESSMENT THROUGH A 6-STEP EVALUATION PROCESS

Step 1

Identify potential alternatives including localized hub

Step 2

Evaluate potential alternatives against identified criteria

Step 3

Dismiss alternatives that fail to satisfy Step 2 Criteria

Step 4

Select alternatives to carry forward for further analysis

Step 5

Feed alternatives into cost effectiveness and environmental studies and the Environmental Social Justice Plan

Step 6

Incorporate findings from the Step 5 studies and evaluate alternatives' fulfillment of purpose and need.*

**The Scope of Work Descriptions for the Project Options and Alternatives study identified the underlying purpose and need for Angeles Link, including supporting the State's decarbonization goals.*

COMPREHESIVE SCREENING PORTFOLIO OF POTENTIAL ALTERNATIVES

Screening List

Step 1

Identify potential alternatives including localized hub

Hydrogen Delivery Alternatives

1. Localized hub
2. Power Transmission & Distribution (T&D) with in-basin hydrogen production
3. Liquid hydrogen trucking
4. Gaseous hydrogen trucking
5. Liquid hydrogen shipping
6. Methanol shipping
7. Ammonia shipping
8. Hybrid of compressed truck + liquid train

Non-Hydrogen Alternatives

1. Electrification
2. Carbon Capture & Storage (CCS)
3. Other clean fuels and technologies evaluated for specific use cases and not identified as a potential alternative include:
   - Renewable Natural Gas (RNG)
   - Energy efficiency
   - Nuclear
   - Hydro
   - Geothermal
   - Plug-in Hybrid
   - Biofuels, and
   - Ethanol

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MULTI VARIATE CRITERIA ASSESSMENT FOR SCORING ACROSS ALTERNATIVES

The appliable criteria for hydrogen and non-hydrogen delivery options were first identified

Step 2

Evaluate potential alternatives against identified criteria

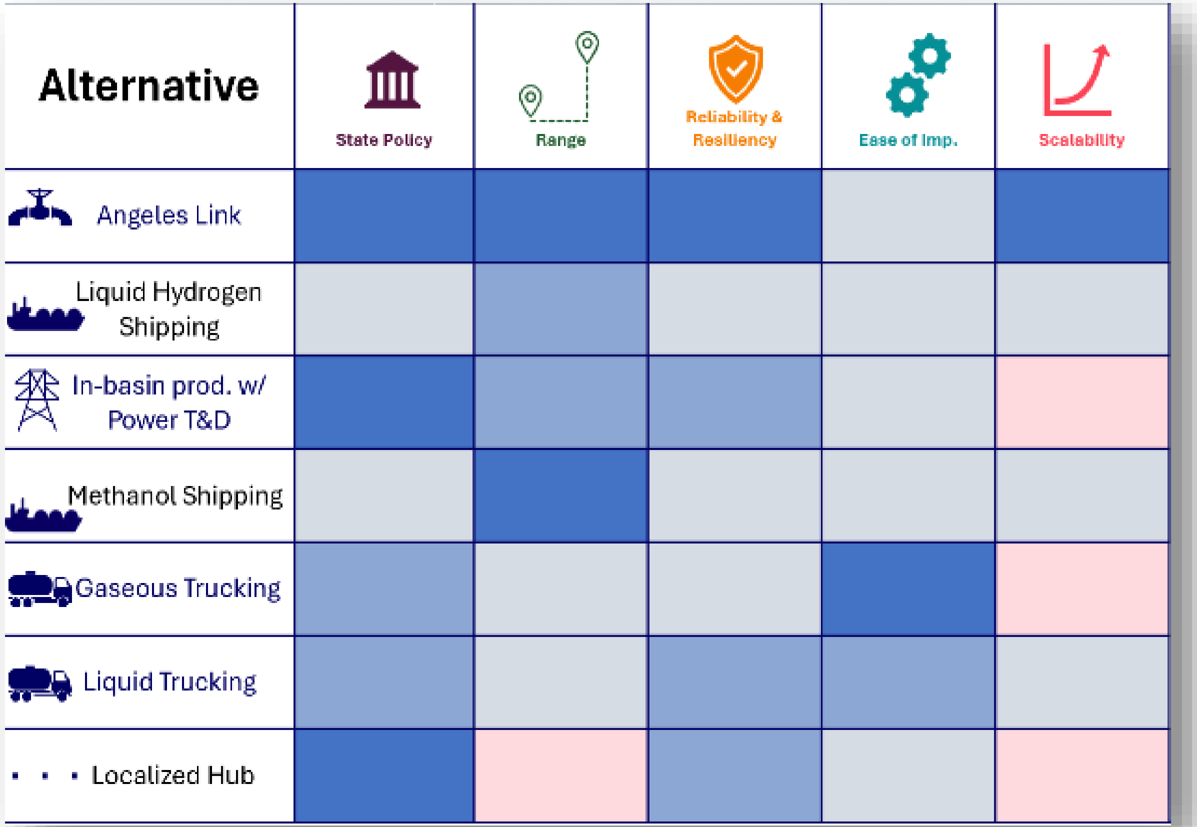
Delivery Alternatives		State Policy	Technological Maturity*	Range	Reliability & Resiliency	Ease of Implementation	End User Requirements*	Scalability
Hydrogen	1. Localized hub 2. Power Transmission & Distribution (T&D) with in-basin hydrogen production 3. Liquid hydrogen trucking 4. Gaseous hydrogen trucking 5. Liquid hydrogen shipping 6. Methanol shipping 7. Ammonia shipping 8. Hybrid of compressed truck + liquid train	☑		☑	☑	☑		☑
Non - Hydrogen	1. Electrification 2. CCS	☑	☑		☑	☑	☑	☑

*Technological Maturity and End user Requirements were not evaluated for as an evaluation criterion for hydrogen delivery alternatives.

SCORING CRITERIA EVALUATION EXAMPLE (HYDROGEN DELIVERY ALTERNATIVES)

In order to be further evaluated, alternatives must meet a set of criteria, including:

- **State Policy:** Alignment with California's environmental law and public policies
- **Range:** Ability to effectively deliver hydrogen to support needs
- **Reliability and Resiliency:** Support overall energy reliability and resiliency
- **Ease of Implementation:** Whether the alternative can be implemented considering existing infrastructure
- **Scalability:** Scaling potential to meet expected future needs



Illustrative scoring framework against identified criteria for hydrogen delivery alternatives

Highest Lowest

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ALTERNATIVES CARRIED FORWARD

The established criteria determined which alternatives would move forward for cost-effectiveness and environmental analyses & environmental social justice plan.

Step 3

Dismiss alternatives that fail to satisfy step 2 criteria

Step 4

Select alternatives to carry forward for further analysis

Step 5

Feed alternatives into cost effectiveness and environmental studies and the Environmental Social Justice Plan

Alternatives Carried Forward*

- **Hydrogen Delivery Alternatives**
  - Gaseous hydrogen trucking
  - Liquid hydrogen trucking
  - Liquid hydrogen shipping
  - Methanol shipping
  - In-basin production using transmission & distribution
  - Localized hub
- **Non-Hydrogen Alternatives**
  - Electrification
  - CCS

***Excluded Hydrogen Delivery Alternatives for purposes of delivering hydrogen to Central and Southern California, including the LA Basin:**

1. Train Delivery excluded due to long loading time challenges and schedules, inflexible routes and limited scale.
2. Ammonia Shipping excluded due to the Haber-Bosch process to convert hydrogen to ammonia which needs to be running 24/7 and is infeasible with solar power constraints.

HYDROGEN DELIVERY PATHWAYS DESCRIPTIONS*

Gaseous Trucking
Hydrogen produced at the defined production locations is compressed and loaded at production facilities, then transported to end users via compressed hydrogen trucks.

Liquid Trucking
Hydrogen produced at the defined production locations is liquefied and loaded at production site, then transported to end users via liquid hydrogen trucks.

Liquid Hydrogen Shipping
Specialized vessels that will transport liquid hydrogen to LA area, to be transferred into liquid storage spheres and then regasified.

Methanol Shipping
Vessels that will transport methanol from Northern CA to LA area. Methanol is then transferred into a methanol-to-hydrogen reconversion facility as liquid hydrogen before regasified at the terminal.

In-basin production using Transmission & Distribution
Transmit renewable energy as electrons through multiple high voltage lines to the LA Basin for hydrogen production in-basin.

Localized Hub
As part of Phase 1, SoCalGas must study the feasibility of a localized clean renewable hydrogen hub solution located in the LA Basin, with hydrogen generation and end users in close proximity.

** Delivery pathways are evaluated to transport clean renewable hydrogen from third-party production centers to the LA Basin. The pathways assume Angeles Link will serve end-users in Central and Southern California, including the LA Basin.*

NON - HYDROGEN ALTERNATIVES DESCRIPTIONS

Electrification

Electrification refers to a combination of **system level*** transformation and **use-case level**** technology changes including the grid infrastructure required to support growing electric load.

CCS

CCS refers to carbon capture and sequestration technology, which is the process of storing carbon dioxide in underground geologic formations.

**System level electrification includes the incremental electricity generation, storage, and supporting upstream grid infrastructure requirements to meet wide-scale end use electrification needs.*

***Use-case level electrification implies replacing technologies or processes that use fossil fuels, like internal combustion engines and gas boilers, with electrically-powered equivalents, such as electric vehicles or heat pumps.*

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HYDROGEN DELIVERY ALTERNATIVES*

Step 6
Incorporate findings from cost effectiveness & environmental studies and evaluate alternatives' fulfillment of purpose and need.

Alternative	State Policy	Range	Reliability & Resiliency	Ease of Imp.	Scalability	Cost Effectiveness	Key Findings
Angeles Link							Appropriate for distance/scale.
Liquid Hydrogen Shipping							Efficient long-distance transportation of H2, requires specialized handling.
In-basin prod. w/ Power T&D							In-basin hydrogen production incurs additional electric T&D costs and is also limited by hard to resolve transmission constraints. Scalability limited by above ground storage need.
Methanol Shipping							Requires additional processing steps, specialized handling and storage facilities. Suitable for relatively long-distances.
Gaseous Trucking							Quickly deployable. Scalability of on-road transportation is limited.
Liquid Trucking							Quickly deployable. Scalability of on-road transportation is limited. Higher costs due to storage and loading costs.
Localized Hub							Limited scalability and higher costs.

*The purpose of this slide is to illustrate the comparison between Angeles Link and the hydrogen delivery alternatives.

Highest — Lowest

NON-HYDROGEN ALTERNATIVES - ELECTRIFICATION*
Based on Use Case

Alternative	Use Case	State Policy	Reliability & Resiliency	Maturity	Scalability	End-User Requirements	Cost Eff.**	Key Findings
Angeles Link	Power							• Molecules are easier to store than electrons, supporting system reliability • While battery storage is mature and simpler to deploy at scale, it is cost-prohibitive to overbuild for longer duration system reliability needs without advances in other Long Duration Energy Storage (LDES) technologies
Electrification	Power							
Angeles Link	Mobility							• Molecule-based storage and refueling is more reliable and resilient • Fuels are better suited to serve the operational requirements of long-haul, high payload, high duty-cycle vehicles than batteries
Electrification	Mobility							
Angeles Link	Industrial Heat							• AL is more cost-effective for high heat applications. • Electrification is the more mature, scalable solution for low-medium heat applications
Electrification	Industrial Heat							
Angeles Link	Cement							• Molecules are easier to store than electrons, supporting system reliability • AL is more cost-effective than electrification.
Electrification	Cement							

The purpose of this slide is to illustrate the comparison between Angeles Link and electrification.

***Cost effectiveness reflects the cost of the alternative indexed to the cost of Angeles Link*

Highest Score — Lowest Score

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SUMMARY OF INITIAL FEEDBACK

Key themes from stakeholder feedback are summarized below:

Thematic Comments	Plan to Incorporate/Address
As SoCalGas continues studying options and alternatives, demystifying hydrogen for the average consumer should also be considered, especially given the DOE award and partnership with ARCHES.	SoCalGas will continue using PAG/CBOSG engagement to help expand education around hydrogen's role in helping the state achieve its decarbonization goals, reducing emissions in disadvantaged communities, and enhancing reliability and resiliency.
Do not include methane, fossil gas enabled alternatives. Electrification is a clean, safe, and affordable way to meet California and Los Angeles's climate goals.	Analysis will advance those alternatives that support California's decarbonization policies. SoCalGas analyzed electrification as directed by the Final Decision and as requested by stakeholders.
Include localized hub, electrification of end uses, trucking and marine shipping, and behind-the-meter green hydrogen production and use of electrolyzers powered by on-site renewables or grid-delivered renewable electricity.	Localized hub, electrification of end uses, trucking, and marine shipping are being addressed as part of the Project Options and Alternatives study. The Production Planning & Assessment Study will analyze production of electrolytic hydrogen powered by on-site renewables and curtailed renewables when feasible.

1. All comments are available on the living library in the Comment Letters folder located on the Homepage. https://arellanoassociates.sharepoint.com/sites/SCGAngelesLink

MEMBER DISCUSSION:
PREVIEW OF DRAFT REPORT:
PROJECT OPTIONS AND ALTERNATIVES

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- Please announce your name and speak directly into the microphone
- Be concise and focus on discussion topics
- Verbal comments are not the only way to provide input, feel free to type a chat
- We are accepting written input after this meeting if we run short on time, or you think of things later

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LUNCH

SoCalGas

HIGH-LEVEL ECONOMIC ANALYSIS AND COST EFFECTIVENESS

PREVIEW OF DRAFT STUDY

ANGELES LINK

YURI FREEDMAN

Senior Director

Business Development

SoCalGas

HIGH-LEVEL ECONOMIC ANALYSIS & COST EFFECTIVENESS STUDY APPLIES A ROBUST ASSESSMENT METHODOLOGY

Measures cost effectiveness by:

- Reviewing cost estimates.
- Performing an economic analysis to determine the potential levelized cost of delivered clean renewable hydrogen (LCOH) to end users.
- Comparing Angeles Link against various project alternatives.

INTEGRATED ACROSS OTHER STUDIES

- **Project Options and Alternatives**[1] – Costs will be analyzed for Angeles Link and Alternatives, including:
  - Hydrogen Delivery Alternatives – Trucking; Shipping; in-Basin Production; Localized Hub
  - Non-Hydrogen Alternatives – Electrification; CCS
- **Pipeline Sizing and Design**[1] – Estimated costs for pipeline and compression will be used to compare Angeles Link to alternatives.
- **Production** – Estimated third-party hydrogen production costs will be used as an input to estimate the levelized cost of hydrogen.
- **Water** – Estimated water related costs will be used (as needed) as an input to estimate third-party hydrogen production costs.

[1] *The scope of the hydrogen delivery alternatives is based on the Angeles Link project's potential design with respect to supply, storage and demand. The cost estimates were determined through modeling and using publicly available information.*

COST EFFECTIVENESS METHODOLOGY ADOPTS STANDARD METRICS BASED ON ALTERNATIVES

The study compares estimated costs for the Project against selected alternatives using the following metrics

Hydrogen Delivery Alternatives	Non-Hydrogen Alternatives
▪ Comparison metric is Levelized Cost Of Hydrogen (LCOH)[1]	▪ Comparison metrics vary based on end-use: ▪ Power Sector - Levelized Cost of Electricity (LCOE)[2] ▪ Mobility Sector – Total Cost of Ownership (TCO)[3] ▪ Industrial Sector – LCOE and LCOH (metric is use case dependent (e.g., LCOE for co-generation, LCOH for refining))

1. *The levelized cost of hydrogen is a common metric used to benchmark cost competitiveness of hydrogen taking into account the investments required to produce and deliver hydrogen to an end-user. This methodology enables different production and delivery routes to be compared on a similar basis.*
2. *The levelized cost of electricity is a common metric used to benchmark the cost competitiveness of producing electricity taking into account the investments required to produce and deliver electricity to an end-user. LCOE with hydrogen would use hydrogen to generate electricity; LCOE for electrification would use other, non-hydrogen renewables to generate electricity; LCOE with Carbon Capture would use natural gas with a carbon capture and sequestration investment.*
3. *Total cost of ownership is a common metric used to benchmark cost competitiveness when comparing different fuels in the mobility sector. TCO takes into account the vehicle's cost, operation and maintenance.*

KEY ASSUMPTIONS

Theme	Item	Data Source for Angeles Link	Data Source for Alternatives
Production	Scale, Capex, and Opex*	Production Study	Production Study
Storage	Storage needs	Production Study	Production Study
	Capex, Opex	Int'l Journal of Hydrogen - adjusted for project storage needs, Production Study for H2 purification costs	Third-party storage assumptions for alternatives are consistent with those for Angeles Link and sourced from publicly available literature for above ground storage and proprietary modeling**
Midstream	System Configuration	Pipeline Sizing and Design Criteria Analysis	Pipeline Sizing and Design Criteria Analysis
	Capex	SoCalGas	Public literature and proprietary modeling
	Opex	SoCalGas Inputs and proprietary modeling	

**Capex: capital expenditure, Opex: operations and maintenance expenses*

*** Due to accessibility limitations, underground storage is assumed for Angeles Link and trucking alternatives; above ground storage is assumed for the other Hydrogen Delivery Alternatives*

STUDY INFORMED BY NATIONAL AND/OR CALIFORNIA BASED MODELING
Non-Hydrogen Alternatives

End-use	Angeles Link	Non-Hydrogen Alternatives		Metrics	Sources
		Electrification	CCS		
Mobility (HD trucks and transit buses)	Fuel cell electric vehicles	Battery electric vehicles	Not applicable to use case	TCO ($/mi)	Models supplemented by national lab and CA based assumptions
Power	Hydrogen power plant	Battery energy storage	Gas + CCS power plant	LCOE ($/MWh)	Power service and other economic models
Industry (varies by industry, example used Cement)	Hydrogen Kiln	Electric Kiln	Gas + CCS (Cogen) Blue Hydrogen (Refineries) Gas + CCS kiln (Cement)	Fuel cost ($/MMBtue)	Models supplemented by CA-based assumptions

COST EFFECTIVENESS: Hydrogen Delivery Alternatives

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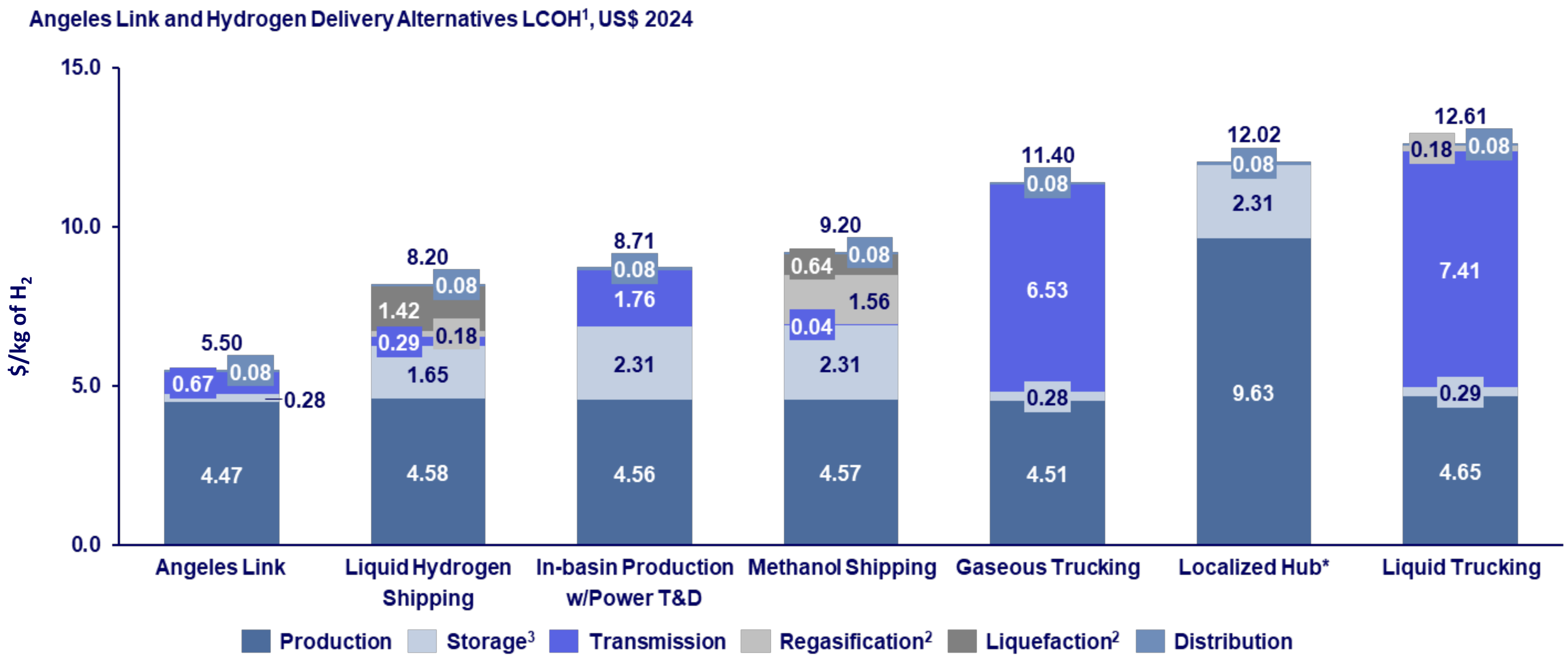
Angeles Link and Hydrogen Delivery Alternatives LCOH[1], US$ 2024



1) Assumes commencement of construction in 2028 and it includes ITC/PTC as well as tax shields
2) Liquefaction and regasification – also includes conversion to methanol and vice versa for the methanol shipping alternative
3) Due to accessibility, we assumed underground storage for Angeles Link and trucking options, and above ground storage for the rest of the alternatives

Key Takeaways

- Angeles Link is the most cost-effective hydrogen delivery method analyzed to bring hydrogen into Central and Southern CA, including the LA Basin
- Localized Hub feasibility is limited by renewable electricity supply constraints and high cost of in-basin production

NON-HYDROGEN ALTERNATIVES – ELECTRIFICATION*

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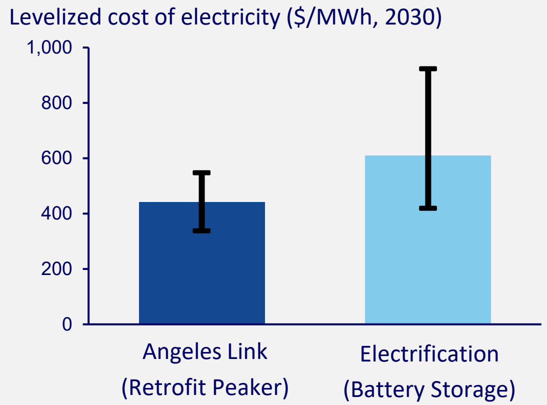
Power
(peaking/reliability: 12-hour duration)



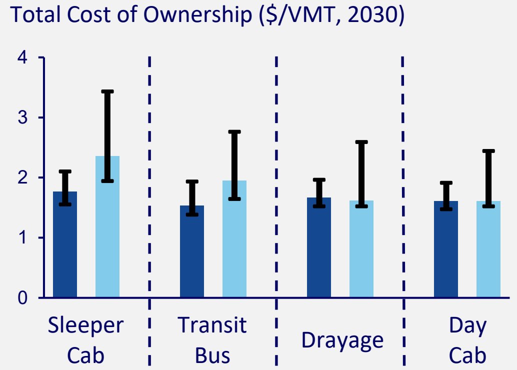
- High relative capital costs of oversized battery storage outweigh H2 fuel costs, making AL more cost-effective
- Maturation of other Long Duration Energy Storage (LDES) technologies like Compressed Air Energy Storage (CAES) and Vanadium Redox Flow Batteries (VRFB) will likely be needed to serve this role with electrification

Key Takeaways*

Angeles Link is more economical to serve several key sectors of the California economy including:

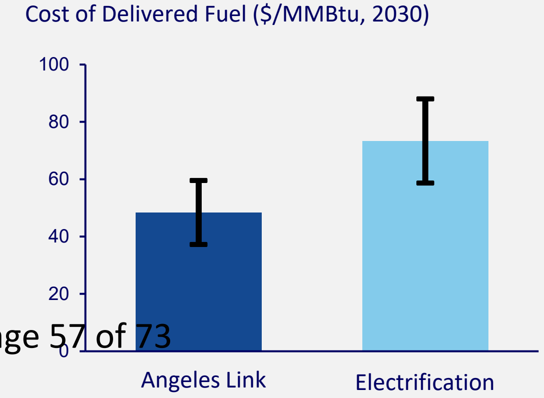
- Power
- Mobility
- High heat industrial processes

Mobility
(long-haul, heavy-duty)



- Fuel cell Electric Vehicles (FCEVs) are most cost-effective vs. Battery Electric Vehicles (BEVs) where faster refueling times offer operational cost savings
- Fuel/charging cost and operational patterns are largest drivers of sensitivity ranges
- FCEVs have technical advantages in applications with high duty cycles, long range requirements, and heavy payloads

Industry – Food & Beverage
(fuel switching)



- AL is cost-effective due to relatively high electricity tariffs in California
- Electrification of low-medium heat is more technically feasible

** Electrification refers to a combination of system level transformation and use-case level technology changes including the grid infrastructure required to support growing electric load. In our analysis we evaluated the cost effectiveness at the use case level.*

COST EFFECTIVENESS: Non-Hydrogen Alternatives - Electrification

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Alternative	Use Case	State Policy	Reliability & Resiliency	Maturity	Scalability	End-User Requirements	Cost Eff.*	$ Key Findings
Angeles Link	Power							• Molecules are easier to store than electrons, supporting system reliability • While battery storage is mature and simpler to deploy at scale, it is cost-prohibitive to overbuild for longer duration system reliability needs without advances in other Long Duration Energy Storage (LDES) technologies
Electrification								
Angeles Link	Mobility							• Molecule-based storage and refueling is more reliable and resilient • Fuels are better suited to serve the operational requirements of long-haul, high payload, high duty-cycle vehicles than batteries
Electrification								
Angeles Link	Food & Bev							• AL is more cost-effective for high heat applications. • Electrification is the more mature, scalable solution for low-medium heat applications
Electrification								
Angeles Link	Cement							• Molecules are easier to store than electrons, supporting system reliability • AL is more cost-effective than electrification.
Electrification								

*The purpose of this slide is to illustrate the comparison between Angeles Link and electrification. Cost effectiveness reflects the cost of the alternative indexed to the cost of Angeles Link

Highest Score — Lowest Score

COST EFFECTIVENESS:
Non-Hydrogen Alternatives - CCS

Although CCS is unable to serve the mobility sector, and best suited for specific conditions including site-level capacity for capture equipment and proximity to industrial clusters, it is a strong decarbonization pathway for certain sectors like cement and refineries. However, these sectors represent a low percentage of demand for hydrogen delivered by Angeles Link.

Alternative	Use Case	State Policy	Reliability & Resiliency	Maturity	Scalability	End-User Req'ments	Cost Eff.*	Key Findings
Angeles Link	Power							• CCS is more cost-effective as long as transport and storage utilization is relatively high • However, CCS is only feasible for higher capacity factor applications and is subject to site-level constraints and proximity to other CO2 sources
CCS								
Angeles Link	Cogen							• CCS is more cost-effective as long as transport and storage utilization is relatively high • Cogen units collocated with refineries will be best candidates for CCS; others may be better suited for hydrogen
CCS								
Angeles Link	Cement							• CCS is more cost-effective as long as transport and storage utilization is relatively high • CCS can-capture emissions from heating and chemical process of production (hydrogen decarbonizes heating process only) • CCS is a scalable solution for the cement industry, which needs to be net zero by 2045 based on SB596** • However, CCS is subject to site-level constraints and proximity to other CO2 sources
CCS								
Angeles Link	Refinery							• CCS is a strong tool for refinery decarbonization due to cost advantage and existing contracts with grey H2 suppliers • However, AL can play a role where site constraints or lack of existing near site supply create opportunity
CCS								

Highest Score — Lowest Score

*Cost effectiveness reflects the cost of CCS indexed to the cost of Angeles Link

** https://ww2.arb.ca.gov/our-work/programs/net-zero-emissions-strategy-cement-sector

SUMMARY OF INITIAL FEEDBACK

Key themes from stakeholder feedback are summarized below:

Thematic Comments	Plan to Incorporate/Address
A hydrogen pipeline would provide the lowest cost pathway to deliver clean renewable hydrogen to the LA Basin to meet demand expectations and be competitive.	The High-Level Economics and Cost Effectiveness Study concludes that Angeles Link is the lowest cost method to bring clean renewable Hydrogen to Central and Southern California, including the LA Basin.
The cost effectiveness study does not justify the ratepayer investment. The studies do not result in a demonstrated need for such a significant ratepayer investment in a major new hydrogen pipeline system	The High-Level Economics and Cost-Effectiveness Study estimates the levelized cost of delivered hydrogen for the Angeles Link Project and compares that to the various alternatives. The ratepayer investment analysis is currently out of scope as part of the Phase 1 preliminary feasibility analysis.
Because current information suggests that renewable hydrogen is expensive, it is important that reasonable cost estimates are included in the demand forecast calculations. Omitting or using unrealistic prices delivers unreliable demand projections.	SoCalGas is evaluating cost effectiveness for the Angeles Link project using the levelized cost of energy framework, which considers asset related costs across the hydrogen value chain over its lifetime, to determine the levelized cost of delivered clean renewable hydrogen (LCOH) and comparing it do other clean renewable hydrogen alternatives and non-hydrogen alternatives. This approach is appropriate for feasibility/pre-FEED analysis at this stage of the project.

1. All comments are available on the living library in the Comment Letters folder located on the Homepage. https://arellanoassociates.sharepoint.com/sites/SCGAngelesLink

MEMBER DISCUSSION: HIGH-LEVEL ECONOMIC ANALYSIS AND COST EFFECTIVENESS

- Please announce your name and speak directly into the microphone
- Be concise and focus on discussion topics
- Verbal comments are not the only way to provide input, feel free to type a chat
- We are accepting written input after this meeting if we run short on time, or you think of things later

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BREAK

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ENVIRONMENTAL ANALYSIS

PRELIMINARY FINDINGS

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JESSICA FOLEY
Regulatory Strategy & Financial Controls Manager
Angeles Link

SoCalGas

ESJ PLAN (JULY WORKSHOP) & ENVIRONMENTAL ANALYSIS (TODAY)

ESJ PLAN

Addressing potential impacts and directing project benefits to Disadvantaged Communities (DACs) and Environmental Social Justice (ESJ) communities is a top priority for SoCalGas with the Angeles Link project.

+

ENVIRONMENTAL ANALYSIS

Studies environmental impacts associated with the construction and operation, and maintenance

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ENVIRONMENTAL ANALYSIS PRELIMINARY FINDINGS

- High-level evaluation of potential impacts associated with the construction and operation and maintenance of Angeles Link, as well as other potential alternatives to the project.
- Plans for addressing and mitigating impacts and provide the findings from Phase 1 feasibility studies demonstrating the Project’s compliance with environmental law and public policies.

RELATIONSHIP TO OTHER STUDIES AND PROCEEDINGS

- Preliminary pipeline routes have been developed as part of the Preliminary Routing/Configuration Analysis and project alternatives as part of the Project Options and Alternatives study
    - Preliminary pipeline routes are subject to change and will be further refined, which will further inform the environmental analysis of the Project in future phases

STUDY APPROACH AND ASSUMPTIONS

- Results and impact analysis are based upon publicly available datasets and information
- Pipeline would be located underground and within previously disturbed areas to the extent feasible
- Study evaluated potential impacts that could occur within 100 feet of each side of the proposed pipeline corridors for certain topic areas (i.e., air quality, greenhouse gas emissions, biological resources, energy, hazards and hazardous materials, hydrology and water quality, land use and planning, and environmental justice), and within a 0.25 miles of the proposed pipeline corridors for cultural/tribal cultural resources
- Construction of the pipeline could be in stages

ENVIRONMENTAL ANALYSIS PRELIMINARY FINDINGS

- This preliminary evaluation indicates that Angeles Link can be constructed and operated in accordance with environmental laws and public policies.
- This study determines that the project may lead to potential impacts from construction and operation and maintenance (O&M) activities in all resources analyzed in this study.
- Potential environmental impacts will continue to be analyzed once preferred pipeline routes are identified at the conclusion of Phase 1. This additional analysis will be used to help refine the preferred routes in Phase 2 to avoid and minimize potential environmental impacts. The extent of potential impacts will not be known until the project is refined and engineering is developed.
- The project is expected to undergo review pursuant to the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA) at the conclusion of Phase 2, in compliance with applicable environmental laws.
- The project is being undertaken in furtherance of the State's climate goals.

ENVIRONMENTAL ANALYSIS PRELIMINARY FINDINGS

- Angeles Link and eight (8) alternatives evaluated according to environmental topic areas:
  - Air quality, cultural and tribal cultural resources, biological resources, energy, greenhouse gas emissions, hazards and hazardous materials, hydrology and water quality, land use and planning
- Study identifies "potential impact" or "no impact" in each topic area given the level of detail known about the project and alternatives at this time
- The high-level assessment uses applicable questions from the CEQA Guidelines Appendix G as a framework to evaluate potential impacts in selected resource areas.

Findings are preliminary and high level and therefore 1) do not represent if an impact is significant from the CEQA/NEPA perspective nor address the magnitude of the impact; 2) do not capture all impact areas that will be evaluated in a CEQA/NEPA document; and 3) do not account for the project's or alternatives' benefits, including those benefits from the use of the clean energy delivered by the project or alternative.

Hydrogen Delivery Alternatives

- Alt. 1: Gaseous Trucking
- Alt. 2: Liquid Trucking
- Alt. 3: Liquid Hydrogen Shipping
- Alt. 4: Methanol Shipping
- Alt. 5: In-basin hydrogen production using transmission and distribution (In-basin)
- Alt: 6: Localized Hub

Non-Hydrogen Alternatives

- Alt. 7: Electrification
- Alt. 8: Carbon Capture Utilization & Storage (CCS)

SUMMARY OF INITIAL FEEDBACK

Preliminary findings are currently available for comment. The close of the comment window is June 25, 2024.

Thematic Comments	Plan to Incorporate/Address
EJ/ESJ considerations are a priority and must encompass more than projected impacts forecasted with desktop tools.	SoCalGas separated the EJ/ESJ component from the Environmental Analysis to ESJ as a standalone consideration. The analysis will include a combination of desktop tools with feedback from impacted communities, via the CBOSG in Phase One and as regionally appropriate in subsequent phases.
	ESJ Plan developed in response to stakeholder feedback provided during July 2023 CBOSG workshop.

1. All comments are available on the living library in the Comment Letters folder located on the Homepage. https://arellanoassociates.sharepoint.com/sites/SCGAngelesLink

MEMBER DISCUSSION: ENVIRONMENTAL ANALYSIS

- Please announce your name and speak directly into the microphone
- Be concise and focus on discussion topics
- Verbal comments are not the only way to provide input, feel free to type a chat
- We are accepting written input after this meeting if we run short on time, or you think of things later

NEXT STEPS

- Feedback on Environmental Analysis Preliminary Findings due Tuesday, 6/25
- Feedback on Hydrogen Leakage Assessment Draft Report due Wednesday, 6/26
  - PAG Feedback: ALP1_Study_PAG_feedback@insigniaenv.com

- Next Meeting date: Summer Workshops: Wednesday, July 24 at the SoCalGas Energy Resource Center in Downey
  - Please note we will be meeting in the Energy Solutions Auditorium
  - Topics and additional details to follow

- Today's presentation and meeting recording will be available soon on the living library

- If you have questions or comments, please submit them in writing at your next convenience

THANK YOU FOR YOUR PARTICIPATION

Appendix 8 – Link to PAG and CBOSG Meeting Recordings

PAG and CBOSG Joint Update Meeting

April 23, 2024 - CBOSG/PAG Joint April Meeting

CBOSG Meeting Recordings

June 18, 2024 – CBOSG Q2 Meeting Recording

PAG Meeting Recordings

June 21, 2024 - PAG Q2 Meeting Recording

Appendix 9 – Summary of CBOSG Stakeholder Meeting

SoCalGas Angeles Link
Planning Advisory Group (PAG) &
Community Based Organizations Stakeholder Group (CBOSG)
April Update Meeting Summary

<u>4/24 PAG/CBOSG Update Meeting (10:00AM-11:30AM)</u>
Online via Zoom

I. Attendee Report

- 46 attendees (27 PAG; 16 CBOSG; 3 PAG/CBOSG)

Please refer to Attachments A for a complete list of attendees.

II. Purpose

- Provide information on the following topics:
  - Phase 1 Studies Review and Commenting Process
  - Phase 1 Remaining Stakeholder Calendar
  - CBOSG Compensation Plan

III. Presentation Highlights and Feedback Themes

- **Phase 1 Studies Review and Commenting Process:** The presentation focused on providing an update on the stakeholder preliminary findings comment process, highlighting a more streamlined approach.
  - <u>Feedback Themes:</u>
    - Some members stated the preliminary findings template lacked detail and could make it difficult for them to provide substantive feedback.
    - Other members were supportive of the new template and felt it would make commenting more accessible to organizations with less technical backgrounds.
    - Request for quicker responses to written comments from SoCalGas and communicating those responses back to members in meetings.
    - Request that SoCalGas identify jurisdictions on corridors under evaluation maps.
- **Phase 1 Remaining Stakeholder Calendar:** The presentation previewed the remaining Phase 1 2024 Stakeholder Calendar
  - <u>Feedback Themes:</u>
    - General appreciation for seeing the proposed calendar.
- **CBOSG Compensation Plan:** The presentation provided an update on the CBOSG Compensation Plan.
  - <u>Feedback Themes:</u>
    - None/no comments received.

- **Zoom Polling:**
    - 84% were interested in an Interim Workshop over the summer to review select draft study reports.
    - Of the remaining studies, members were most interested in:
        - Project Options & Alternatives
        - Environmental & Environmental Social Justice Analysis
        - High-Level Economic Analysis & Cost Effectiveness

Attachment A

April Update Attendee Roster

#	First Name	Last Name	Affiliation
Members			
1	JP	Gunn	Air Products
2	Sarah	Wiltfong	Bizfed
3	Rizaldo	Aldas	California Energy Commission
4	Katrina	Fritz	California Hydrogen Business Council
5	Arthur (Iain)	Fisher	California Public Utilities Commission
6	Christopher	Arroyo	California Public Utilities Commission
7	Sasha	Cole	California Public Utilities Commission
8	Anthony	D'aquila	CIty of Burbank
9	Tony	Foster	City of Long Beach - Utilities
10	Dennis	Burke	City of Long Beach - Utilities
11	Heather	Hamilton	City of Long Beach - Utilities
12	Tyson	Siegele	Clean Energy Strategies representing the Utility Consumers' Action Network
13	Jay	Parepally	Communities for a Better Environment*
14	Lauren	Gallagher	Communities for a Better Environment*
15	Joon Hun	Seong	Environmental Defense Fund
16	Janice	Lin	Green Hygroden Coalition
17	Karla	Sanchez	Harbor Trucking Association
18	Aaron	Guthrey	Los Angeles Department of Water and Power
19	Jesse	Vismonte	Los Angeles Department of Water and Power
20	Xinhe	Le	Los Angeles Department of Water and Power
21	Eric	Hill	Los Angeles Department of Water and Power
22	Pete	Budden	Natural Resources Defense Council
23	Erik	Johnson	Pasadena Water & Power
24	Mike	Galvin	Port of Los Angeles
25	Rashad	Rucker-Trapp	Reimagine LA*
26	Julia	Dowell	Sierra Club
27	Teresa	Cheng	Sierra Club
28	Maryam	Hajbabaei	South Coast AQMD
29	Sam	Cao	South Coast AQMD
30	Norman	Pedersen	Southern California Generation Coalition
31	Lourdes	Caracoza	Alma Family Services
32	Marcia	Hanscom	Ballona Wetlands Institute
33	Marc	Carrel	Breathe Southern California
34	Michael	Berns	California Greenworks
35	Ricardo	Mendoza	Coalition for Responsible Community Development

36	Kenta	Estrada-Darley	Coalition for Responsible Community Development
37	Roy	van de Hoek	Defend Ballona Wetlands
38	Andrea	Vega	Food and Water Watch
39	Jill	Buck	Go Green Initiative
40	Michael	Fisher	Greater Zion Church Family
41	Kisa	Ito	Little Tokyo Community Council
42	Alex	Jasset	Physicians for Social Responsibility-LA
43	Enrique	Aranda	Soledad Enrichment Action
44	Gerry	Salcedo	Southeast Rio Vista YMCA
45	Andrea	Williams	Southside Coalition of Community Health Centers
46	Autumn	Ybarra	Watts/Century Latino Organization
Non-Members			
47	Chester	Britt	Arellano Associates
48	Stevie	Espinoza	Arellano Associates
49	Keven	Michele	Arellano Associates
50	Sasha	Cole	California Public Utilities Commission
51	Christopher	Arroyo	California Public Utilities Commission
52	Armen	Keochekian	Insignia Environmental
53	Anniken	Lydon	Insignia Environmental
54	Julie	Roshala	Insignia Environmental
55	Alma	Marquez	Lee Andrews Group
56	Antonia	Issaevitch	Lee Andrews Group
57	Alyssa	Martinez	Lee Andrews Group
58	Emily	Grant	SoCalGas
59	Andy	Carrasco	SoCalGas
60	Frank	Lopez	SoCalGas
61	Amy	Kitson	SoCalGas
62	Jessica	Foley	SoCalGas
63	Shirley	Arazi	SoCalGas
64	Colby	Wells	SoCalGas

*both PAG and CBOSG member

SoCalGas Angeles Link

Community Based Organizations Stakeholder Group (CBOSG)

June Q2 Meeting Summary

<u>6/18 CBOSG Quarterly Meeting (10:00AM-2:00 PM)</u>

Hybrid (In-Person/Via Zoom)

I. Attendee Report

- 12 in-person attendees; 17 virtual attendees; 18 CBOs represented

*Please refer to Attachments A for a complete list of attendees.

II. Purpose

- Provide information and gather feedback on the following topics:
  - Preview of Draft Report: Project Options & Alternatives and High-Level Economic Analysis & Cost Effectiveness
  - Preliminary Findings: Environmental Analysis
- Introduce CBOSG to ARCHES with guest speaker:
  - Joy Langford, ARCHES Chief Community Officer
- Panel: Best Practices and Case Studies for Community Benefits Planning:
  - Robert Sainz, President and Executive Director at New Ways to Work
  - Veronica Soto, Senior Advisor for Los Angeles World Airports Capital Improvement Program

III. Presentation Highlights and Feedback Themes

- **Preview of Draft Report: Project Options & Alternatives and High-Level Economic Analysis & Cost Effectiveness:** The presentation focused on providing preliminary findings and evaluations of project options and alternatives.
  - <u>Feedback Themes:</u>
    - Some members requested that SoCalGas use a holistic approach to cost effectiveness and consider indirect costs in their evaluations.
    - Members questioned how environmental justice was considered in this study.
    - Members requested that SoCalGas explain what their definition of environmental justice is and to consider criteria that adequately weighs environmental justice concerns.
    - Some members were concerned about how power generation and other renewable energy sources are integrated into the cost effectiveness study and how hydrogen is adequate for power generation in face of the evolution of other renewables.
- **Preliminary Findings: Environmental Analysis:** The presentation focused on providing preliminary findings and evaluations for environmental and environmental social justice.
  - <u>Feedback Themes:</u>

    - Some members wanted clarification on whether SoCalGas will conduct an analysis of the Coastal Act since the maps show that some pipelines will go into the coastal zone.
    - Some members inquired about the specifics of the operation and maintenance aspects of the pipeline, seeking a layman's explanation.
    - Some members expressed concerns about the environmental impacts of Angeles Link, identifying a loophole in CEQA, and broader societal impacts.
    - Members requested a detailed map of the pipelines they can use to identify the communities the pipelines will pass through and inquired about whether more groups from the impacted communities will be added to the CBOSG.
    - Some members requested information regarding how the environmental injustice impacts on communities of color will be factored into project alternatives, routing, and pipeline decisions.
- **Panel: Best Practices and Case Studies for Community Benefits Planning:** Veronica Soto, Senior Advisor for Workforce Development and Economic Impact at Los Angeles World Airports (LAWA), and Robert Sainz, President and Executive Director at New Ways to Work, provided insight on community benefits planning and workforce development for infrastructure projects.
  - <u>Discussion Themes:</u>
    - Panelists commended the team for starting the community engagement process early, highlighting SoCalGas's commitment to community involvement.
    - Highlighted the challenges of gaining industry buy-in for green jobs programs and importance of engaging Workforce Development Boards and connecting with industry, community colleges, adult education, and social service providers.
    - Discussed examples of successful training elements in CBAs, including the Alameda Corridor local hire policy and the LAWA Apprenticeship Readiness Training Program.
    - Emphasis on community health impacts and the inclusion of health and safety standards in CBAs.
    - Importance of stakeholder engagement, community asset mapping, and leveraging modern tools for surveying and outreach.
    - Discussion about the disproportionate impact on Black and women workers and the need for preparedness for job opportunities, including the importance of comprehensive youth workforce development and support structures to address educational and systemic barriers.

Appendix A

CBOSG Q2 June Meeting Attendee Roster

#	First Name	Last Name	Affiliation
CBOSG Members			
1	Marcia	Hanscom	Ballona Wetlands Institute*
2	Michael	Berns	California Greenworks*
3	Ricardo	Mendoza	Coalition for Responsible Community Development
4	Kenta	Estrada-Darley	Coalition for Responsible Community Development*
5	Roy	van de Hoek	Defend Ballona Wetlands*
6	Hyepin	Im	Faith and Community Empowerment (FACE)
7	Andrea	Vega	Food and Water Watch*
8	Jill	Buck	Go Green Initiative
9	Kristin	Fukushima	Little Tokyo Community Council
10	Ava	Post	Watts Labor Community Action Committee
11	Rashad	Rucker-Trapp	Reimagine LA* +
12	Enrique	Aranda	Soledad Enrichment Action
13	Gerry	Salcedo	Southeast Rio Vista YMCA
14	Andrea	Williams	Southside Coalition of Community Health Centers
15	Thelmy	Alvarez	Watts Labor Community Action Committee
16	Faith	Myhra	Protect Playa Now*
17	Jay	Parepally	Communities for Better Environment +
18	Roslyn	Tovar	Communities for Better Environment +
19	Lauren	Gallagher	Communities for Better Environment +
20	Tigran	Agdaian	Breathe Southern California
21	Lourdes	Caracoza	Alma Family Services
22	Andrea	Slater	LA Black Workers Center/Care at Work, UCLA Labor Center
Non-CBOSG Members			
23	Christopher	Arroyo	California Public Utilities Commission
24	Armen	Keochekian	Insignia Environmental*
25	Julie	Roshala	Insignia Environmental*
26	Anniken	Lydon	Insignia Environmental
27	Joy	Langford	ARCHES*
28	Robert	Sainz	New Ways to Work*

29	Veronica	Soto	Los Angeles World Airports Capital Improvement Program*
30	Frank	Lopez	SoCalGas*
31	Emily	Grant	SoCalGas*
32	Yuri	Freedman	SoCalGas*
33	Jessica	Foley	SoCalGas*
34	Shirley	Arazi	SoCalGas*
35	Amy	Kitson	SoCalGas*
36	Chanice	Allen	SoCalGas*
37	Alma	Marquez	Lee Andrews Group*
38	Alyssa	Martinez	Lee Andrews Group*
39	Keshanna	Wiley	Lee Andrews Group*
40	Chester	Britt	Arellano Associates*
41	Stephanie	Espinoza	Arellano Associates*
42	Keven	Michel	Arellano Associates*
43	Suzanna	Tran	Arellano Associates*

In-Person Attendees (*)

PAG/CBOSG Members (+)

Appendix 10 – Summary of PAG Stakeholder Meeting

SoCalGas Angeles Link
Planning Advisory Group (PAG) &
Community Based Organizations Stakeholder Group (CBOSG)
April Update Meeting Summary

<u>4/24 PAG/CBOSG Update Meeting (10:00AM-11:30AM)</u>

Online via Zoom

I. Attendee Report

- 46 attendees (27 PAG; 16 CBOSG; 3 PAG/CBOSG)

Please refer to Attachments A for a complete list of attendees.

II. Purpose

- Provide information on the following topics:
    - Phase 1 Studies Review and Commenting Process
    - Phase 1 Remaining Stakeholder Calendar
    - CBOSG Compensation Plan

III. Presentation Highlights and Feedback Themes

- **Phase 1 Studies Review and Commenting Process:** The presentation focused on providing an update on the stakeholder preliminary findings comment process, highlighting a more streamlined approach.
    - <u>Feedback Themes:</u>
        - Some members stated the preliminary findings template lacked detail and could make it difficult for them to provide substantive feedback.
        - Other members were supportive of the new template and felt it would make commenting more accessible to organizations with less technical backgrounds.
        - Request for quicker responses to written comments from SoCalGas and communicating those responses back to members in meetings.
        - Request that SoCalGas identify jurisdictions on corridors under evaluation maps.
- **Phase 1 Remaining Stakeholder Calendar:** The presentation previewed the remaining Phase 1 2024 Stakeholder Calendar
    - <u>Feedback Themes:</u>
        - General appreciation for seeing the proposed calendar.
- **CBOSG Compensation Plan:** The presentation provided an update on the CBOSG Compensation Plan.
    - <u>Feedback Themes:</u>
        - None/no comments received.

- **Zoom Polling:**
    - 84% were interested in an Interim Workshop over the summer to review select draft study reports.
    - Of the remaining studies, members were most interested in:
        - Project Options & Alternatives
        - Environmental & Environmental Social Justice Analysis
        - High-Level Economic Analysis & Cost Effectiveness

Attachment A

April Update Attendee Roster

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Members			
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2	Sarah	Wiltfong	Bizfed
3	Rizaldo	Aldas	California Energy Commission
4	Katrina	Fritz	California Hydrogen Business Council
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6	Christopher	Arroyo	California Public Utilities Commission
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11	Heather	Hamilton	City of Long Beach - Utilities
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19	Jesse	Vismonte	Los Angeles Department of Water and Power
20	Xinhe	Le	Los Angeles Department of Water and Power
21	Eric	Hill	Los Angeles Department of Water and Power
22	Pete	Budden	Natural Resources Defense Council
23	Erik	Johnson	Pasadena Water & Power
24	Mike	Galvin	Port of Los Angeles
25	Rashad	Rucker-Trapp	Reimagine LA*
26	Julia	Dowell	Sierra Club
27	Teresa	Cheng	Sierra Club
28	Maryam	Hajbabaei	South Coast AQMD
29	Sam	Cao	South Coast AQMD
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39	Jill	Buck	Go Green Initiative
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44	Gerry	Salcedo	Southeast Rio Vista YMCA
45	Andrea	Williams	Southside Coalition of Community Health Centers
46	Autumn	Ybarra	Watts/Century Latino Organization
Non-Members			
47	Chester	Britt	Arellano Associates
48	Stevie	Espinoza	Arellano Associates
49	Keven	Michele	Arellano Associates
50	Sasha	Cole	California Public Utilities Commission
51	Christopher	Arroyo	California Public Utilities Commission
52	Armen	Keochekian	Insignia Environmental
53	Anniken	Lydon	Insignia Environmental
54	Julie	Roshala	Insignia Environmental
55	Alma	Marquez	Lee Andrews Group
56	Antonia	Issaevitch	Lee Andrews Group
57	Alyssa	Martinez	Lee Andrews Group
58	Emily	Grant	SoCalGas
59	Andy	Carrasco	SoCalGas
60	Frank	Lopez	SoCalGas
61	Amy	Kitson	SoCalGas
62	Jessica	Foley	SoCalGas
63	Shirley	Arazi	SoCalGas
64	Colby	Wells	SoCalGas

*both PAG and CBOSG member

SoCalGas Angeles Link
Planning Advisory Group (PAG)
June Q2 Quarterly Meeting

6/21/24 PAG Q2 Meeting (10:00AM-2:00PM)
Banning's Landing Community Center & Online via Zoom

I. Attendee Report

- 29 PAG attendees (9 in-person; 20 via Zoom)

Please refer to Attachments A for a complete list of attendees.

II. Purpose

- Provide information and gather feedback on the following topics:
  - Preview of Draft Report: Project Options & Alternatives
  - Preview of Draft Report: High-Level Economic Analysis & Cost Effectiveness
  - Preliminary Findings: Environmental Analysis

III. Presentation Highlights and Feedback Themes

- **Preview of Draft Report: Project Options & Alternatives:** The presentation focused on the options of delivering hydrogen and non-hydrogen alternatives to the Los Angeles Basin.
  - Feedback Themes:
    - Multiple members voiced support for use of hydrogen to decarbonize hard-to-electrify equipment used for port operations.
    - Members requested access to the underlying data used for studies to ensure findings are accurate and to provide better feedback.
    - What assumptions were used in determining that Angeles Link is more cost effective than the electrification alternative.
    - Questions about the environmental impact of port activities and the production of hydrogen via methane.
    - Emphasis on the importance of multiple pathways, including electricity and hydrogen, to ensure resilience and adaptability in reducing emissions across all port operations.
    - Request for SoCalGas to take a position supporting three pillars
    - Need for an efficient hydrogen transportation system, highlighting that pipelines are significantly cheaper and more effective for distributing hydrogen compared to other methods.
    - Emphasis on the importance of maintaining system resiliency, workforce safety, and efficiency during the transition to zero emissions.

- **Preview of Draft Report: High-Level Economic Analysis & Cost Effectiveness:** The presentation previewed the economic analysis and cost effectiveness comparison of delivering hydrogen and non-hydrogen alternatives to the Los Angeles Basin.
    - Feedback Themes:
        - Emphasis that hydrogen is needed to collectively move away from fossil fuels and achieve the state's carbon neutrality goal.
        - Multiple requests for more detailed information, including inputs and calculations behind the data presented, noting the difficulty of providing informed feedback.
        - Request for clarification on whether the levelized cost of hydrogen figures are dependent on hydrogen supply assumptions.
        - Question about the scalability of hydrogen pipelines and how they are related to their levelized costs.
        - Question regarding the logistics of hydrogen delivery to trucking stations.
        - Request for the full report to quantify the levelized cost of assumption for San Joaquin Valley, Lancaster, and Blythe regions.
- **Preliminary Findings: Environmental Analysis:** The presentation provided an overview of the preliminary findings for environmental and environmental social justice including, study approach and assumptions, analyses, and summary of initial feedback.
    - Feedback Themes:
        - Question on how findings in the environmental studies will be incorporated into routing determinations.
        - A member asked about the distance for considering impacts on air quality, hydrology, hazards, and hazardous materials around the proposed corridors is limited to only 100 feet on either side, questioning if this range is sufficiently comprehensive.
        - Concern that limiting routing analysis to existing ROW will not result in a route that does not traverse through DACs
        - Request that ESJ Analysis and Plan be released prior to July Workshop

Attachment A

June Q2 2024 Attendee Roster

#	First Name	Last Name	Affiliation
Members			
1	JP	Gunn	Air Products
2	Miles	Heller	Air Products
3	Sarah	Wiltfong	Bizfed
4	Rizaldo	Aldas	California Energy Commission
5	Katrina	Fritz	California Hydrogen Business Council*
6	Arthur (Iain)	Fisher	California Public Utilities Commission
7	Christopher	Arroyo	California Public Utilities Commission
8	Matthew	Taul	California Public Utilities Commission
9	Benjamin	Tang	California Public Utilities Commission
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11	Heather	Hamilton	City of Long Beach - Utilities
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14	Jay	Parepally	Communities for a Better Environment*
15	Lauren	Gallagher	Communities for a Better Environment
16	Joon Hun	Seong	Environmental Defense Fund*
17	Janice	Lin	Green Hydrogen Coalition*
18	Sophia	Dubrovich	International Longshore and Warehouse Union Local 13*
19	Joseph	Ortiz	LAWDP
20	Aaron	Guthrey	Los Angeles Department of Water and Power
21	Jesse	Vismonte	Los Angeles Department of Water and Power
22	Pete	Budden	Natural Resources Defense Council
23	Mike	Galvin	Port of Los Angeles*
24	Julia	Dowell	Sierra Club
25	Sam	Cao	South Coast AQMD
26	Norman	Pedersen	Southern California Generation Coalition*
27	Jack	Brouwer	UCI Advanced Power and Energy Program
28	Stefania	Mitova	UC Davis Sustainable Transportation Energy Pathways
29	Ernest	Shaw	Utility Workers Union of America 483*
Non-Members			
30	Chester	Britt	Arellano Associates*
31	Stevie	Espinoza	Arellano Associates*
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45	Neil	Navin	SoCalGas*
46	Chanice	Allen	SoCalGas*

*In person attendee