ANGELES LINK PHASE 1
PRELIMINARY ROUTING/CONFIGURATION ANALYSIS
FINAL REPORT – DECEMBER 2024

SoCalGas commissioned this Preliminary Routing/Configuration Analysis from Burns & McDonnell. The analysis was conducted, and this report was prepared, collaboratively.

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LIST OF ABBREVIATIONS

Abbreviation	Term/Phrase/Name
AFC	Alternative Fuel Corridors
AFDC	Alternative Fuels Data Center
ARCHES	Alliance for Renewable Clean Hydrogen Energy Systems
Burns & McDonnell OR BMcD	Burns & McDonnell Engineering Company, Inc.
CARB	California Air Resources Board
CBOSG	Community Based Organization Stakeholder Group
CPCN	Certificate of Public Convenience and Necessity
CPUC	California Public Utilities Commission
DACs	Disadvantaged Communities
DOE	United States Department of Energy
DOT	United States Department of Transportation
ESJ	Environmental Social Justice
EHB	European Hydrogen Backbone
EV	Electric vehicle
FEED	Front-End-Engineering and Design
FEP	Front-End Planning
FHWA	Federal Highway Administration
GIS	Geographic Information Systems
HCA	High Consequence Areas
HDD	Horizontal Directional Drill
HSR	High Speed Rail
IIJA	Infrastructure Investment and Jobs Act
MLV	Mainline Valve
NHS	National Highway System
NPMS	National Pipeline Mapping System
NRHP	National Register of Historic Places
OCED	Office of Clean Energy Demonstrations
PAG	Planning Advisory Group
PHMSA	Pipeline and Hazardous Materials Safety Administration
ROW	Right-of-Way
SJV	San Joaquin Valley
SoCalGas	Southern California Gas Company
UOM	Unit of Measure

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 potential storage sites to various delivery points and end users in Central and Southern California, including in the Los Angeles Basin. CPUC Decision (D.) 22-12-055 (Phase 1 Decision) approved the Memorandum Account for SoCalGas's proposed Angeles Link. Pursuant to D.22-12-055, SoCalGas identified and compared routes and configurations for Angeles Link. The Preliminary Routing/Configuration Analysis (Routing Analysis) evaluates a wide range of pipeline pathways in Central and Southern California and identifies several preliminary preferred routes and one variation to consider for further evaluation in subsequent phases.

The objective of this Routing Analysis is to evaluate and determine several possible preferred routes during the feasibility stage of Angeles Link. Subsequent Pre-FEED and FEED activities in Phase 2 will select one preferred route. This preliminary Routing Analysis was conducted at a high-level and sought to identify broad directional pathways with the highest potential of achieving the purpose of the Angeles Link pipeline system. In addition to determining the directional pathways, this Routing Analysis identified features and characteristics of the area around the potential pipeline route that would be considered and analyzed in more detail in future phases, including the identification of Disadvantaged Communities, and features related to engineering, social and environmental considerations.

This analysis integrated information from other Phase 1 feasibility studies, and the outputs from this analysis also informed other studies. Specifically, data was integrated into this analysis from the following studies, including: Production Planning & Assessment (Production Study), the Demand Study, and the Pipeline Sizing & Design Criteria (Design Study). Data from this study was also noted in the following studies: the Design Study, the Greenhouse Gas (GHG) Emissions Evaluation (GHG Study), the Nitrogen Oxide (NOx) and other Air Emissions Assessment (NOx Study), the High-Level Feasibility Assessment and Permitting Analysis (Permitting Analysis), the Environmental Analysis, and the Environmental Social Justice (ESJ) Analysis (ESJ Plan/Screening).

[1] In the California Public Utilities Commission (CPUC)'s 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 (CO_2e) 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.

Routing Analysis Framework

The Routing Analysis evaluated potential directional pathways for the Angeles Link pipeline system implementing the following framework:

- Consider the locations of potential third-party clean renewable hydrogen producers and the potential consumers of clean renewable hydrogen, including in the mobility, power generation, and industrial sectors, so clean renewable hydrogen can be effectively carried to entities looking to decarbonize.
- Consider the potential hydrogen production locations and offtake sites identified by California's hydrogen hub consortium—the Alliance for Renewable Clean Hydrogen Energy Systems (ARCHES)[2]. ARCHES is California's public-private hydrogen hub consortium that applied for federal funding from the U.S. Department of Energy (DOE) for a California Hydrogen Hub. SoCalGas joined ARCHES in October 2022 and was included on the ARCHES application to the DOE for the federal funding made available under The Regional Clean Hydrogen Hubs Funding Opportunity DE-FOA-0002779.[3] ARCHES published information siting the location of hydrogen production projects and offtake sites in California included in its application submitted to the DOE.
- Compare multiple potential routes from inputs from other Angeles Link Phase 1 feasibility studies and external data sources to identify three principal categories of information: (i) the initial route corridors for consideration; (ii) the routes of highest potential for Angeles Link; and (iii) characteristics and features along the routes of highest potential for further evaluation.

Results of Routing Analysis

Routes presented are preliminary and subject to change based on the final alignment in subsequent phases of Angeles Link. Based on the evaluation contained in this Routing Analysis, SoCalGas identified four (4) potential preferred routes that share the general characterizations below:

- Connect potential regional producers and end-users as identified by the Production and Demand studies, which includes 1.5 MMT/Y throughput
- Connect potential ARCHES production and offtake sites

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[2] ARCHES is co-founded by the Governor's Office of Business and Economic Development, the University of California, a statewide labor coalition organized by the State Building and Construction Trades Council of California, and the Renewables 100 Policy Institute. *See* https://archesh2.org/wp-content/uploads/2024/03/ARCHES-FAQ-Basic-1.pdf

[3] Refer to DOE Regional Clean Hydrogen Hubs at: https://www.energy.gov/oced/regional-clean-hydrogen-hubs-0

- Connect two SoCalGas segments within ARCHES to support the California Hydrogen Hub
- Route Variation 1 identified for evaluation in Phase 2, reducing route mileage through disadvantaged communities (DACs), as identified by the ESJ Plan/Screening
- Identify certain engineering, environmental, social, and environmental justice features along the potential preferred routes
- Traverse various land types including, but not limited to, urban areas, rural lands, and mountainous terrain

Stakeholder Feedback

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 Routing Analysis. For example, in response to stakeholder comments, the Routing Analysis clarifies that pipeline corridors initially considered focused on routes that are all intra-state. Additionally, the Routing Analysis evaluated certain Engineering, Environmental, and Social attributes, including DACs, cultural sites, land use, zoning, seismic activity, endangered species, and ROWs. The total mileage within these areas was identified, and a summary of the Pivvot[4] results were included in the Appendix. The thematic feedback that has been incorporated throughout the development of this study is summarized in Chapter 6. All feedback received is included, in its original form, in the quarterly reports submitted to the CPUC and published on SoCalGas' website.[5]

[4] Pivvot is a third-party cloud-based application that consolidates a vast library of public information such as jurisdictional boundaries, social and community data, physical infrastructure locations, and environmental considerations such as hydrology, geography, and ecology.
[5] Angeles Link: SoCalGas, (n.d.-a). https://www.socalgas.com/sustainability/hydrogen/angeles-link

1. INTRODUCTION – PIPELINE ROUTING

The Angeles Link pipeline system is envisioned as a non-discriminatory pipeline system that is dedicated to public use and aims 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. The system route is expected to consist of transmission pipeline(s), compressor station(s), and other related system components and appurtenances. The system will transport clean renewable hydrogen from regional third-party production and storage sources to various delivery points in Central and Southern California, including the Los Angeles Basin (LA Basin) which encompass the concentrated commercial and industrial area in and around the Ports of Los Angeles and Long Beach.

In accordance with D.22-12-055, OP 6 (i), SoCalGas identified and compared possible routes and configurations for Angeles Link. The Routing Analysis is a critical step in the development of the Angeles Link system and seeks to preliminarily (i) identify possible preferred routing/configurations; (ii) evaluate technical considerations, major crossings, elevations, terrain types, and other potential geographical and urban challenges; and (iii) identify existing SoCalGas Direct Land Rights and Rights-of-Way.

Gaseous hydrogen can be transported safely by pipeline much in the same way natural gas is today, as detailed in the Evaluation of Applicable Safety Requirements (Safety Study). Approximately 1,600 miles of pure hydrogen pipeline are currently operating in the United States.[6] At the time of this analysis, there are no known non-discriminatory pipelines transporting pure hydrogen. Hydrogen pipelines today are owned by merchant hydrogen producers.[7] As discussed in the Project Options & Alternatives (Alternatives Study), the High-Level Economic Analysis & Cost Effectiveness (Cost Effectiveness Study) studies and recognized by an Atlantic Council Global Energy Center report[8], pipelines are the safest and least costly means to move energy products. PHMSA acknowledges that the efficiency of volumes transported by pipeline are beyond the capacity of other forms of transportation[9], and furthermore DOE concludes that dedicated hydrogen pipelines moving large volumes over long distances are critical to achieving economies of scale.[10]

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[6] Hydrogen pipelines | Department of Energy. (n.d.-b). https://www.energy.gov/eere/fuelcells/hydrogen-pipelines.
[7] Ibid.
[8] Quarterman, C. (2021, July 21). Hydrogen Policy Brief 3: Hydrogen Transportation and Storage. Atlantic Council Global Energy Center. https://www.atlanticcouncil.org/wp-content/uploads/2021/07/AC_HydrogenPolicySprint_3.pdf
[9] General Pipeline Faqs. PHMSA. (n.d.-a). https://www.phmsa.dot.gov/faqs/general-pipeline-faqs
[10] Office of Technology Transitions, Office of Clean Energy Demonstrations, Hydrogen & Fuel Cell Technologies Office, Elgowainy, A., Penev, M., Crane, D., Cummins, K.,

1.1. Analysis Overview

Pipeline routing traditionally starts at a feasibility stage before moving into Front End Engineering Design (FEED) level of analysis, then transitioning into the final stages of design, permitting and construction. Consistent with that process, Angeles Link is expected to be developed and further refined in multiple Phases. Phase 1 focuses on a feasibility level analysis and study, including this Routing Analysis. For purposes of the Routing Analysis, Phase 2 will focus on pre-FEED and FEED activities specific to the potential preferred routes and variations identified in Phase 1, development of information to lead to selection of a preferred route, and further refinement of the chosen alignment. This multiphase approach creates multiple opportunities for incorporating stakeholder feedback and refinement of the associated proposed system route.

Pipeline routing generally begins by connecting two specific or known points, first focusing on the shortest distance between the two. For purposes of this feasibility stage, the Routing Analysis first defined an area of study, focusing on points of connection between the potential production areas and potential areas of offtake for the clean renewable hydrogen that Angeles Link would transport. Criteria was then applied to the study areas to inform the potential pipeline routes, including largely known geographical constraints such as mountain ranges or water bodies. In addition, other elements traditionally considered in pipeline routing and applied to this analysis included:[11]

- Cost efficiency
- Disadvantaged communities
- Land use limitations
- Impact to environment
- Pipeline integrity
- Public security
- Proximity to the facilities

Route features are categorized into Environmental, Social, or Engineering elements and are considered as the Routing Analysis seeks to identify potential pathways that, where possible, follow the most direct route between supply and offtake, avoid densely

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Klembara, M., Chan, V., Tian, L., Shah, J., & Wagner, J. (2023). Pathways to commercial liftoff: Clean hydrogen. https://liftoff.energy.gov/wp-content/uploads/2023/05/20230523-Pathways-to-Commercial-Liftoff-Clean-Hydrogen.pdf

[11] Optimization of gas pipeline route selection with goal ... - IEOM. (n.d.-l). http://www.ieomsociety.org/gcc2019/papers/132.pdf

populated areas, areas that are environmentally sensitive or have cultural significance, and minimize new environmental and community impacts.[12]

In Phase 2 of Angeles Link, pre-FEED activities and a FEED study would be conducted. These activities would build on Phase 1 feasibility studies currently underway. Multiple alignment variations of the preferred route will be considered in Phase 2. Stakeholder and community input would be solicited during the Phase 2 analysis and would be considered when making alignment decisions. Once a preferred system route is identified, SoCalGas would advance development of the preferred system route, including technical design, planning and engineering, to develop the information needed to complete a FEED study for the preferred system route.

This Routing Analysis identifies several possible preferred routes and Route Variation 1 at a feasibility level for further consideration and evaluation. These findings support Phase 2 pre-FEED and FEED work, to develop more detailed refinement of the Angeles Link pipeline system. The subsequent more detailed route evaluation, alignment, and scoring to be conducted in the future is discussed further below in Chapter 7, Future Considerations, of this report.

1.2. Phase 1 Feasibility Study Integration

This Routing Analysis incorporates information from other Angeles Link Phase 1 feasibility studies. In addition, information from this Routing Analysis informed other Angeles Link Phase 1 feasibility studies. A summary of how information related to the routing was informed by and/or incorporated into other Phase 1 studies includes:

- The Production Planning & Assessment (Production Study) identified three primary areas within Central and Southern California for potential third-party clean renewable hydrogen production. This informed the Routing Analysis by determining how pipeline routes could access production facilities.
- The Demand Study identified potential hydrogen users and offtake across Central and Southern California. This informed the Routing Analysis by identifying where higher concentrations of demand are anticipated to exist and grow, by sector, and this characterization can be applied to better understand the advantages to certain routes.
- The Pipeline Sizing & Design Criteria (Design Study) received mileage information from the Routing Analysis to evaluate the sizing and design of combinations of potential third-party production and storage locations to meet a corresponding proposed throughput, referred to as Scenarios. The Scenarios informed the potential preferred routes analyzed in this Routing Study. The

[12] Routing. Pipeline 101. (2024, May 30). https://pipeline101.org/topic/routing/

Design Study also completed high-level cost estimates for the Scenarios and potential preferred routes that are identified in this Routing Analysis.

- The Environmental Social Justice (ESJ) Analysis (ESJ Plan/Screening) received the potential corridors for consideration throughout Central and Southern California that were evaluated in this Routing Analysis for screening of the potential environmental social justice impacts associated with the construction and operation of Angeles Link in those potential pipeline corridors. Screening results informed the creation of Route Variation 1.
- The Greenhouse Gas (GHG) Emissions Evaluation (GHG Study) received approximate route length from this Routing Analysis to evaluate the upper range of benefits from potential GHG reductions associated with Angeles Link.
- The Nitrogen Oxide (NOx) and other Air Emissions Assessment (NOx Study) received approximate route length from this Routing Analysis to evaluate the range of impacts from potential air emissions associated with Angeles Link.
- The High-Level Feasibility Assessment & Permitting Analysis (Permitting Analysis) received the potential corridors for consideration throughout Central and Southern California that were evaluated in this Routing Analysis. Information regarding permitting is considered in the characterization of the potential preferred routes.
- The Environmental Analysis received the potential corridors for consideration throughout Central and Southern California evaluated in this Routing Analysis to provide a high-level analysis of the potential environmental impacts associated with the construction and operation of Angeles Link and to provide a high-level comparison of potential impacts of identified alternatives.

1.3. Routing Analysis Process

The methodology employed in conducting the Routing Analysis was based in two parts: System Evaluation and Route Evaluation. The process was inherently iterative, as it required the integration of a continuous influx of information received from various sources over the duration of this study. To effectively manage and incorporate this evolving data, the methodology was designed to be highly adaptable to allow for periodic evaluation and adjustment. This approach allowed each step to be informed by the most current and comprehensive data available, thereby enhancing the accuracy and relevance of the findings.

As illustrated in Figure 1, System Evaluation assessed the overall layout and pathways to safely transport clean renewable hydrogen by examining (1) the role of the system, (2) zone development, and (3) identifying initial corridors for consideration. Leveraging the role of Angeles Link and foundational information about expected supply and demand for clean renewable hydrogen in Central and Southern California, the basis for a system was identified. Three functional zones – Connection, Collection, and Central –

were then developed to allow for a systematic approach to the creation of potential routes that considers both short term and long-term operational needs and reliability.

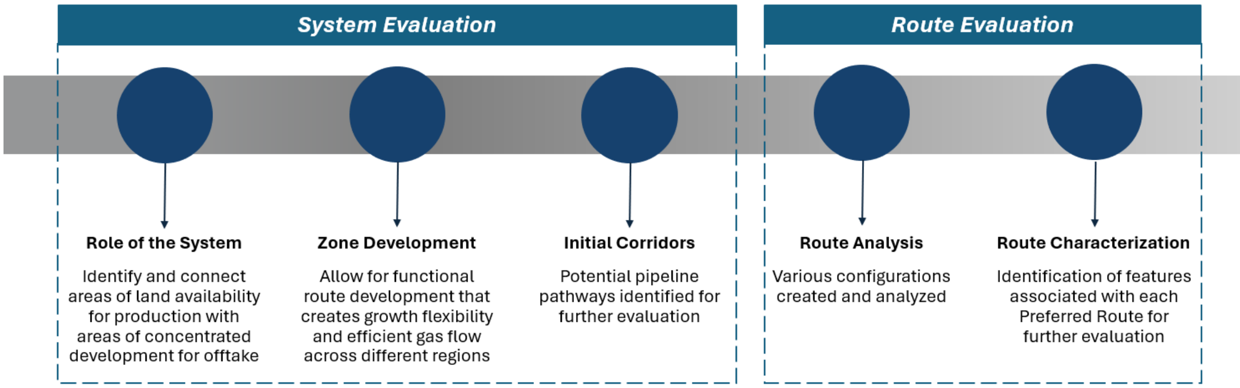

Figure 1. Routing Analysis Process: System and Route Evaluation

Preliminary pipeline feature analysis of a variety of route options was completed during the route evaluation and several potential preferred routes were selected and characterized. Route analysis included the preliminary siting of potential routes for Scenarios identified within the Design Study. An assessment was completed from a functional standpoint, examining operational characteristics that the potential route supports within a conceptual fully built-out clean renewable hydrogen system. As information was gathered and evaluated, additional data was integrated from external sources as well as from other Angeles Link Phase 1 activities. Routes were characterized using certain features, such as access to potential production, demand, common route attributes and permitting considerations.

2. SYSTEM EVALUATION

2.1. The Role of the System

As a non-discriminatory pipeline system dedicated to public use, Angeles Link is proposed to play a critical role in efficiently and safely providing the infrastructure to transport clean renewable hydrogen from one region to another (e.g., from multiple third-party production and storage sites to various delivery points and end users). Pipelines are capable of moving large volumes of gas resulting in connectivity that can be crucial for the seamless operation of many industrial, energy, and technology systems. Within this Analysis, Preferred Routes are routes which connect areas of clean renewable hydrogen production with areas of concentrated demand*.*

Angeles Link is intended to fulfill several underlying purposes, including the following:

1. To support the State of California's decarbonization goals, including the California Air Resources Board's (CARB) 2022 Scoping Plan for Achieving Net Neutrality, which identifies the scaling up of renewable hydrogen for the hard-to-electrify sectors as playing a key role in the State achieving carbon neutrality by 2045 or earlier.[13]
2. To support the State of California's decarbonization goals in the mobility sector, including the Governor's Executive Order N-79-202[14], which seeks to accelerate the deployment of zero- emission vehicles; CARB's implementation of the Advanced Clean Fleets regulation, which is a strategy to deploy medium- and heavy-duty zero-emission vehicles;[15] as well as the implementation of the March 15, 2021 Advanced Clean Truck regulation[16], which aims to accelerate a large-scale transition of zero-emission medium-and heavy-duty vehicles.
3. To optimize service to all potential end-users in the project area by operating an open access, common carrier clean renewable hydrogen transportation network dedicated to public use.
4. To support improving California's air quality by displacing fossils fuel for certain hard -to- electrify uses, including the mobility sector.
5. To enhance energy network reliability, resiliency, and flexibility as California industries transition fuel usage to achieve the State's decarbonization goals.

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[13] California Air Resources Board's 2022 Scoping Plan for Achieving Carbon Neutrality (November 16, 2022), at pp. 9-10, available at https://ww2.arb.ca.gov/sites/default/files/2022-12/2022-sp.pdf.

[14] NEWSOM, G. (2020). EXECUTIVE ORDER N-79-20. In STATE OF CALIFORNIA. https://www.gov.ca.gov/wp-content/uploads/2020/09/9.23.20-EO-N-79-20-Climate.pdf

[15] Advanced Clean Fleets | California Air Resources Board. (n.d.). https://ww2.arb.ca.gov/our-work/programs/advanced-clean-fleets/about

[16] California Air Resources Board. (n.d.). Advanced Clean Trucks Regulation. In FINAL REGULATION ORDER. https://ww2.arb.ca.gov/sites/default/files/2023-06/ACT-1963.pdf

6. To enable long duration clean energy storage that can further accelerate renewable development and minimize grid curtailments.
7. To provide a cost effective and affordable open access clean renewable hydrogen transportation network at just and reasonable rates.
8. To provide efficient and safe clean renewable energy transportation in support of the State's decarbonization goals.
9. Over time and combined with other current and future clean energy projects and reliability efforts, to help reduce reliance on natural gas use served by the Aliso Canyon storage facility, while continuing to provide reliable and affordable energy service to the region.

Initial Awareness of Demand

The Los Angeles Basin (LA Basin), as a major urban and industrial hub, represents a significant demand center for clean renewable hydrogen. Many potential end-users in the hard-to-electrify sectors evaluated in the Demand Study can be identified using public resources, several of which are listed below. ARCHES, discussed in further detail in later chapters, also identified anticipated off-take sites in Central and Southern California that are part of a diverse portfolio of clean hydrogen projects and infrastructure to advance California's ambitious clean energy goals. The major industrial activity in the LA Basin and anticipated ARCHES projects were considered in the System Evaluation for the Angeles Link pipeline system.

Listed below are public resources available to identify potential off takers in the LA Basin include, but are not limited, to:

- **Alternative Fuel Corridors**, designated by the Federal Highway Administration, aim to support installation of electric vehicle (EV) charging, hydrogen, propane, and natural gas fueling infrastructure at strategic locations along major national highways.[17] These corridors are also aligned with the heavy-duty trucks, transit vehicles, and fuel cell and battery electric vehicles identified in Mobility sector per the Demand Study.
- **California Oil Refineries and Terminals**, designated by the California Energy Commission[18], are currently the largest industrial consumers of hydrogen which is primarily produced via steam methane reformation and other non-renewable

[17] Alternative fuel corridors. (n.d.). https://hepgis-usdot.hub.arcgis.com/pages/alternative-fuel-corridors
[18] California Energy Commission. (n.d.). California's oil refineries. https://www.energy.ca.gov/data-reports/energy-almanac/californias-petroleum-market/californias-oil-refineries

methods.[19] Refineries and shipping terminals are aligned with the Industrial and Mobility sectors evaluated in the Demand Study.

- **California Power Plants**, designated by the California Energy Commission[20], and the power generation sector could become the anchor hydrogen infrastructure driver, per the Demand Study.

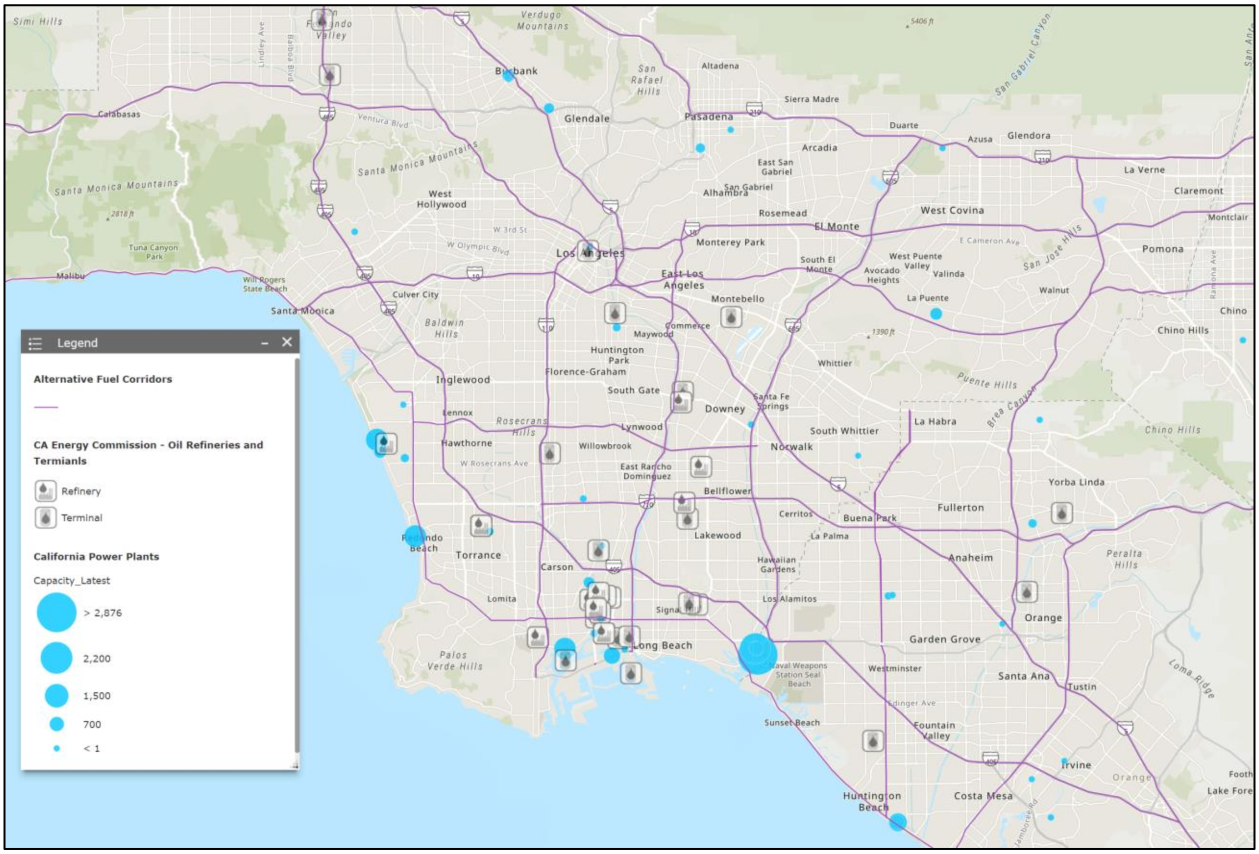

Figure 2. Illustration of Alternative Fuel Corridors, Refineries, and Power Plants in the LA Basin

[19] Alternative Fuels Data Center: Hydrogen production and distribution. (n.d.). https://afdc.energy.gov/fuels/hydrogen-production#:~:text=Natural%20gas%20reforming%20using%20steam,with%20lower%20carbon%20dioxide%20emissions.

[20] California power plants. (n.d.). https://cecgis-caenergy.opendata.arcgis.com/datasets/CAEnergy::california-power-plants/about

Figure 3. Illustration of Anticipated ARCHES Projects[21]

Initial Awareness of Production

Areas of production for clean renewable energy are typically located where renewable energy resources, such as wind and solar, are abundant and can be harnessed efficiently. These are often rural or less densely populated regions with favorable conditions for renewable energy generation. The less densely populated regions shown in Figure 4 also coincide with the potential ARCHES projects identified in Central and Southern California, shown in Figure 3, and the areas of highest likelihood to generate large-scale clean renewable hydrogen analyzed in the Production Study. See Production Study for further details.

[21] ARCHES H2, *Meet ARCHES* (October 2023), *available at:* https://archesh2.org/wp-content/uploads/2023/10/Meet-Arches_October-2023.pdf; DOE – Office of Clean Energy Demonstrations

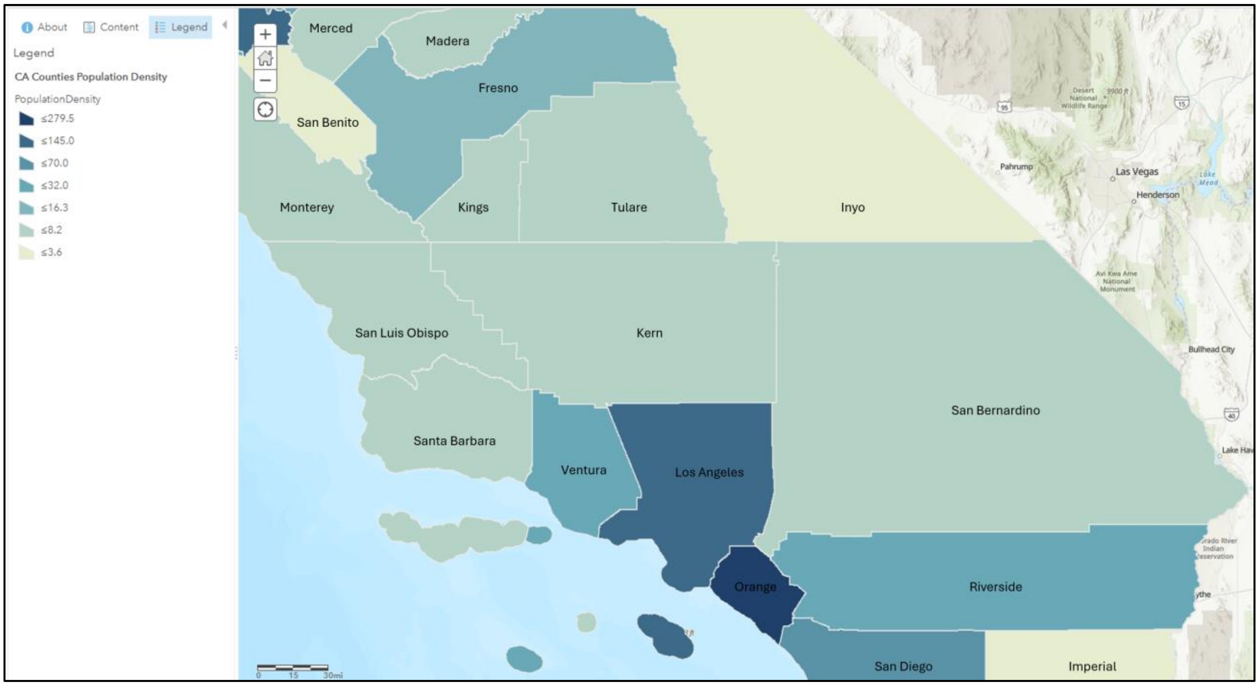

Figure 4. Illustration of Population Density calculated as Total Population Per Square Mile[22]

As the connective infrastructure between the demand and production components, potential pipeline routes for Angeles Link would connect production sites to demand centers, incorporating the following considerations:

- Geographical Directness: Selecting the most direct routes that efficiently connect the production sites with end users in Central and Southern California, including the LA Basin
- Topographical Feasibility: Avoidance of natural barriers like extensive mountain ranges or protected areas that could complicate construction and increase costs.

2.2. Zone Development

A systematic approach was critical for identifying and developing preliminary routing options for Angeles Link as this pipeline would be a new system. In contrast to a traditional pipeline project where a pipeline is routed between two identified points within an established system, Angeles Link would be a new gas transportation system. Identification of preferred routes must be based on operational resiliency and energy

[22] Population_Density_2020_California_Counties (FeatureServer). (n.d.). https://services1.arcgis.com/ZIL9uO234SBBPGL7/arcgis/rest/services/Population_Density_2020_California_Counties/FeatureServer

reliability in order for the system to successfully help decarbonize the identified sectors of California's industry and economy. Zone development allows for designing a system that is functionally diverse to support cohesive, efficient long-term operation.

SoCalGas established three zones within the Central and Southern California region that each reflected different aspects of hydrogen delivery.[23] Each Zone has a primary, but not exclusive, function which allows for system versatility. The Central Zone is primarily the area known as LA Basin, the Collection Zone is located outside the LA Basin, where regional hydrogen production and demand centers are likely located, and the Connection Zone is the region where pipelines are needed to connect producers and end-users furthest away from the LA load center. Refer to Figure 5 for an illustration of the three zones.

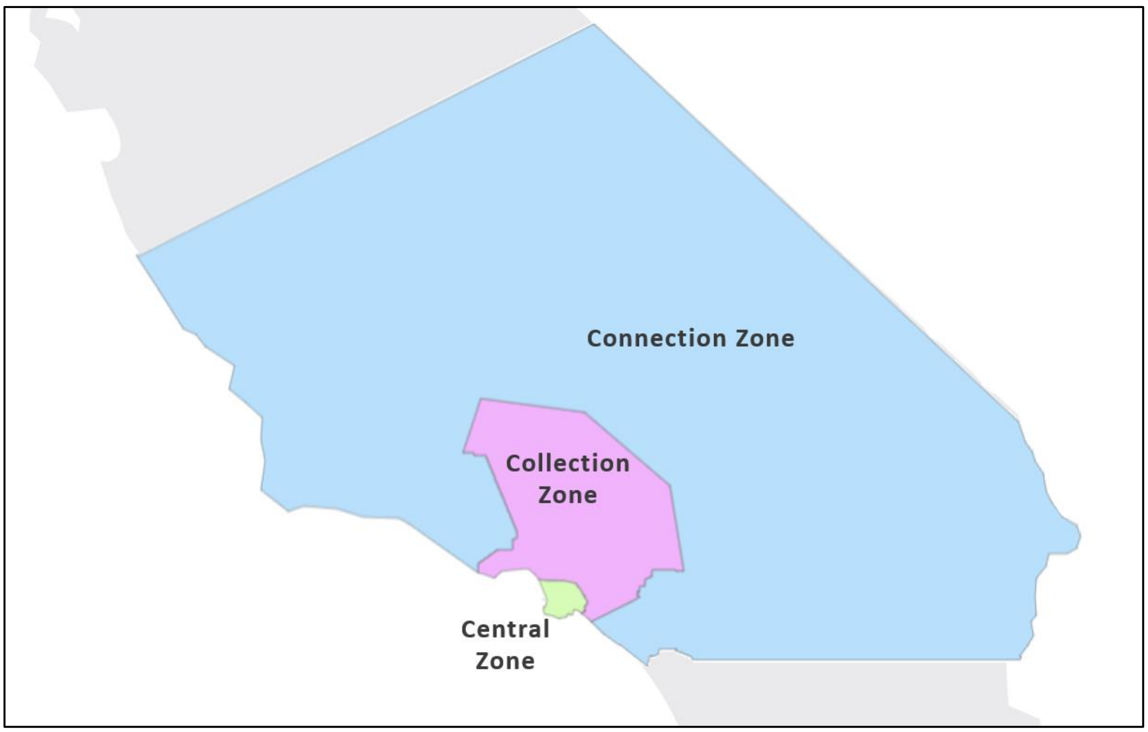

Figure 5. Illustration of Connection, Collection, and Central Zones

While each zone serves a specific purpose – delivery, supply, and a combination of both – a pipeline system that interconnects these zones allows the gas to be efficiently transferred from the likely points of supply (Connection Zone) through the areas of collection (where gas might also be used, sourced or stored) to the points of demand in the delivery areas (primarily in the Central Zone, although broader offtake demand is anticipated throughout Central and Southern California. See the Demand Study for

[23] Zone boundaries are approximate and subject to change.

additional details). This integration helps in managing the flow of gas according to the needs and capacities of each zone, enhancing the overall system functionality. Within this Analysis, Preferred Routes are routes which have pipeline passing through all three zones.

Key characteristics and the anticipated function of the different zones is as follows:

Central Zone. The LA Basin area is anticipated to contain the densest area of potential offtake given the concentration of demand from the hard-to-electrify sectors. The Angeles Link system in this area would serve as pipeline delivery system to Power Generation, Mobility, and Commercial/Industrial Manufacturing sectors. The primary role of the Central Zone is to support large-scale delivery of clean renewable hydrogen.

Collection Zone. Pathways in this zone bridge the more focused functionality of the Central Zone and the Connection Zone by taking on a dual nature. Pipeline in this area is anticipated to serve multiple roles simultaneously, both allowing for collection of gas from hydrogen suppliers but also supporting gas delivery to end users.

Connection Zone. Pathways in this zone present opportunities for connection to other hydrogen networks in-state and/or out-of-state. These pathways allow for connectivity and reduce the possibility of isolating access to critical energy infrastructure. While Angeles Link is envisioned to be an intrastate system, interconnectivity is pivotal for establishing a resilient system, furthering the operator's ability to weather challenges, unexpected events, and maintain a steady supply. The primary role of the Connection Zone is to support supply and reliability.

Connections between different hydrogen networks, both in- and out-of-state, allow for a more reliable supply by providing multiple sources of clean renewable hydrogen. This redundancy can be critical for resiliency by preventing supply disruptions that may occur due to maintenance issues, unanticipated events, or natural disasters affecting one part of the network. Broad ability to source hydrogen gas can also create flexibility in load balancing between supply and demand across broader regions more effectively. If one area experiences a spike in demand or a drop in supply, gas can be rerouted from areas with a surplus, creating a stable supply and preventing local shortages.

Potential for market integration is also a potential aspect of this zone. The Connection Zone would allow for the creation of a more integrated clean renewable hydrogen gas market. Integration enables more efficient trading and price stabilization across different regions by smoothing out local price volatility due to isolated supply or demand shocks.

The potential integrated hydrogen gas market that the Connection Zone may create is similar to hydrogen "backbone" networks currently under exploration and planning globally as the hydrogen economy seeks to expand and the co-location of supply with demand is not always viable. For example, the European Hydrogen Backbone (EHB)

Initiative[24] has taken a coordinated approach toward the identification of infrastructure needs and minimization of barriers, driving forward the rapid deployment of an efficient hydrogen network in Europe. Locally, the initiation of a North American Hydrogen Backbone collaborative, driven by Guidehouse and Rocky Mountain Institute (RMI)[25], underscores the need for this connection in the form of transparency between midstream infrastructure development.

2.3. Initial Corridors for Consideration

As a basis was created for route evaluation, corridors were narrowed based on factors such as geological structure and features. Access to the LA Basin area is constrained by geology, including several mountain ranges: Sierra Madre Mountains, San Gabriel Mountains, and the Santa Rosa Mountains. Additionally, there are multiple National Forests that also surround the LA Basin. Given these features, there is a limitation of potential pathways that enter the LA Basin from the lands that surround it.

[24] The European Hydrogen Backbone (EHB) initiative. EHB European Hydrogen Backbone. (n.d.). https://ehb.eu/
[25] Mills, R. (2023, December 20). An urgency for connective hydrogen infrastructure. RMI. https://rmi.org/an-urgency-for-connective-hydrogen-infrastructure/

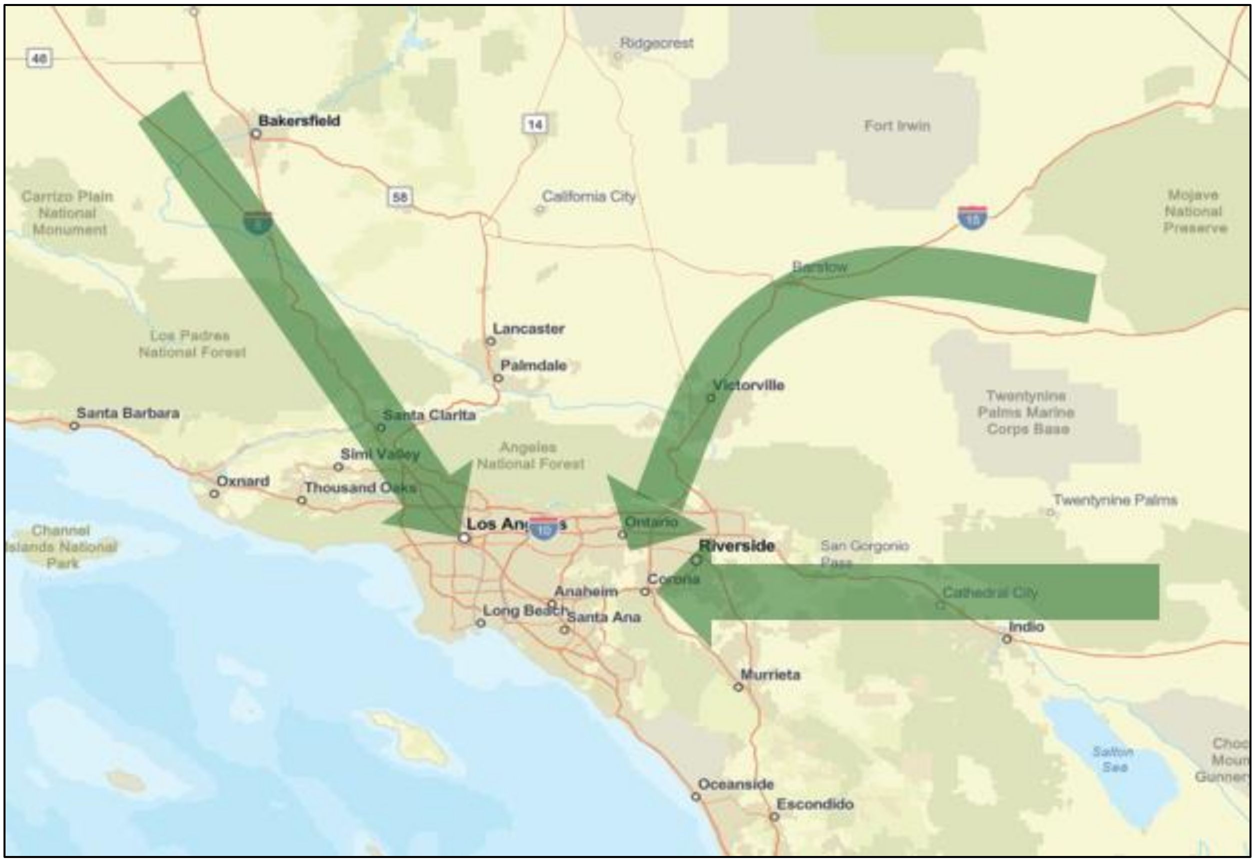

Figure 6. Illustration of Potential Pathways to Enter the LA Basin

The Angeles Forest and San Gabriel Mountains have highly variable terrain in terms of elevation changes and dense vegetation cover. To limit disturbance to these natural areas and prevent construction and operational challenges associated with variable topography, routes outside of established transportation corridors were eliminated from consideration.

Coastal routes present specific challenges in terms of access limitations, coastal weather conditions, and limitation in space. Routes accessing LA Basin along the Central California coast and leading to LA Basin from the Southern region of the state, face these complexities. In addition, the extensive mountainous terrain and numerous protected lands make it more likely that hydrogen production facilities would be located further away, necessitating significantly longer routes. This combination of coastal conditions, unsuitable terrain, and increased distances made these regions less viable for preliminary route exploration.

During this initial evaluation, focus was placed on corridors that reside in close proximity to the potential demand sectors for Angeles Link to connect that demand with potential areas for clean renewable hydrogen production. Information generated by SoCalGas during the pre-feasibility SPEC Reports, coupled with other public data including

National Pipeline Mapping System (NPMS), Alternative Fuels Data Center (AFDC) Corridors, and Federal Corridors was used to create a variety of different pipeline pathways that fall North-to-South and East-to-West.

2.3.1. Agency Data Sets

SoCalGas identified potential opportunities for routing that include energy corridors on federal lands, federal interstate corridors, Alternative Fueling Corridors, and industrial areas with high demand to minimize impacts to the community and the environment.

Energy Corridors on Federal Lands. SoCalGas utilized the United States Department of Energy (DOE) Energy Corridors on Federal Lands resource that provides a map of corridors on Federal Lands throughout the United States.[26,27] SoCalGas reviewed the data to identify federal corridors as a method of addressing increasing energy demands of oil, gas, hydrogen pipelines, electricity transmission, and distribution facilities in the coming future. Moreover, the map supports the creation of the Connection Zone by designating energy corridors in the High, Low, and Southern Desert areas that contact federal land, as well as corroborating the Collection and Central Zone by designating areas with fewer sensitive and federal land concerns that are more suitable for pipeline networks instead of long, transmission pipelines.

[26] Energy Corridors on Federal Lands | Department of Energy. (n.d.-c). https://www.energy.gov/gdo/energy-corridors-federal-lands

[27] West-wide energy corridor information center. West-wide Energy Corridor Information Center. (n.d.). https://corridoreis.anl.gov/

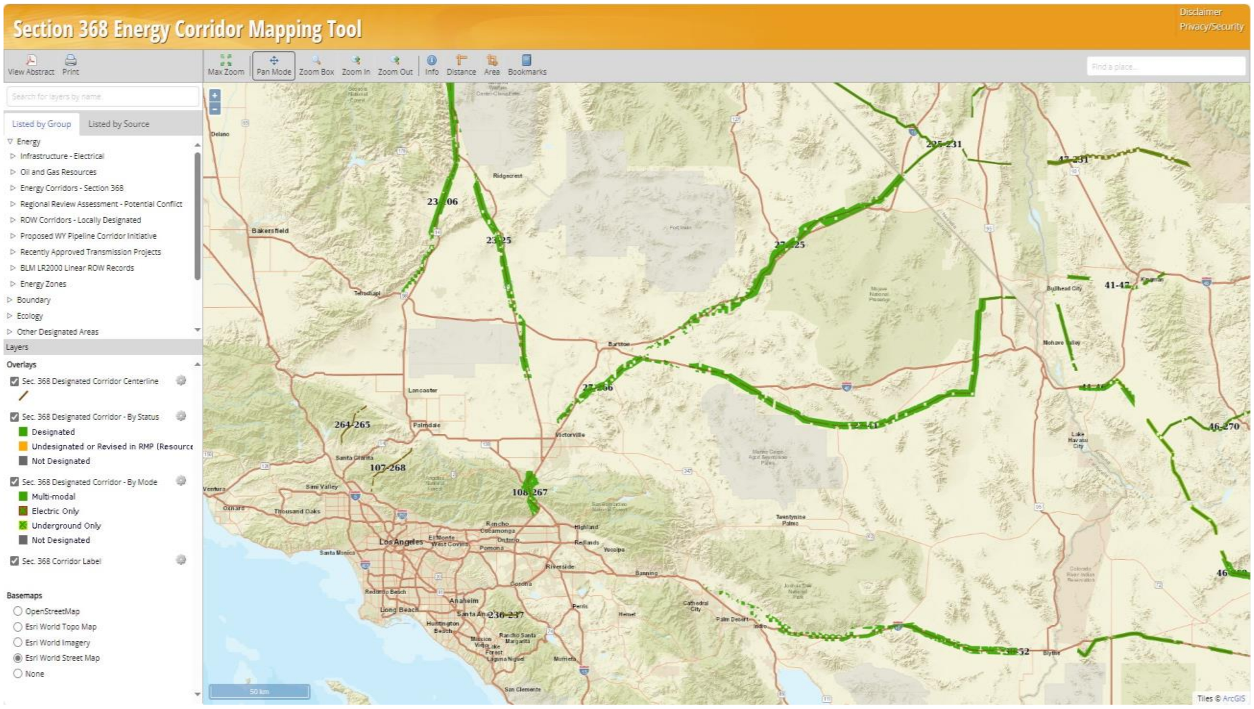

Figure 7. Illustration of Section 368[28] Energy Corridor Public Viewer[29]

National Pipeline Mapping System (NPMS). The NPMS is a resource published by the Pipeline and Hazardous Materials Safety Administration (PHMSA).[30] The mapping system details a network of existing corridors, including gas transmission and hazardous liquid pipelines that are under the jurisdiction of the United States

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[28] As summarized by the U.S. Department of Energy, Section 368 of the Energy Policy Act of 2005 (EPAct) "directs the Secretaries of Agriculture, Commerce, Defense, Energy, and Interior to designate, under their respective authorities, corridors for oil, gas, and hydrogen pipelines and electricity transmission and distribution facilities on Federal lands in the 11 contiguous Western States (Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming), to perform any required environmental reviews, and to incorporate the designated corridors into relevant agency land use and resource management plans or equivalent plans. Section 368 also directs the agencies to take into account the need for upgraded and new infrastructure and to take actions to improve reliability, relieve congestion, and enhance the capability of the national grid to deliver energy. EPAct also calls for identifying corridors in the other 39 states and to expedite processes for future projects in these energy corridors." *See* https://www.energy.gov/gdo/energy-corridors-federal-lands.

[29] Section 368 Energy Corridor Mapping Tool. (n.d.). https://bogi.evs.anl.gov/section368/portal/

[30] Home. NPMS. (n.d.). https://www.npms.phmsa.dot.gov/

Department of Transportation (DOT) and PHMSA.[31] Resulting observations from these corridors aided in the development of the Central Zone by identifying existing locations of oil and gas refineries, and analyzing industrial activity data in that region. Initial corridor siting also considered proximity of existing SoCalGas high pressure pipeline facilities.

Figure 8. Illustration of SoCalGas Transmission Pipelines (part of National Pipeline Mapping System)[32]

Alternative Fuels Data Center (AFDC). The AFDC is a joint effort between the United States Department of Energy (DOE) and the United States Department of Transportation (DOT) to establish a national network for alternative fueling and electric vehicle charging infrastructure along national highway network corridors. The AFDC website provides a public source of data surrounding alternative and renewable fuels within each state.[33] Furthermore, the Alternative Fuel Corridors (AFC) noted by the Data Center were designated by the Federal Highway Administration (FHWA) to

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[31] Learn About the Public Map Viewer. About public map viewer. (n.d.). https://www.npms.phmsa.dot.gov/AboutPublicViewer.aspx

[32] SoCalGas Internal GIS has been used for illustrative purposes and user readability.

[33] EERE: Alternative fuels data center home page. EERE: Alternative Fuels Data Center Home Page. (n.d.). https://afdc.energy.gov/

support installation of electric vehicle charging, hydrogen, propane, and natural gas fueling infrastructure at strategic locations along major highways.[34]

For the Routing Analysis, AFC was utilized to identify approximately 200 miles of the initial corridors considered. This data characterizes where the Routing Analysis identifies pipelines could potentially transport hydrogen from producers to fueling station demand centers. The AFC also displays potential hydrogen consumers.

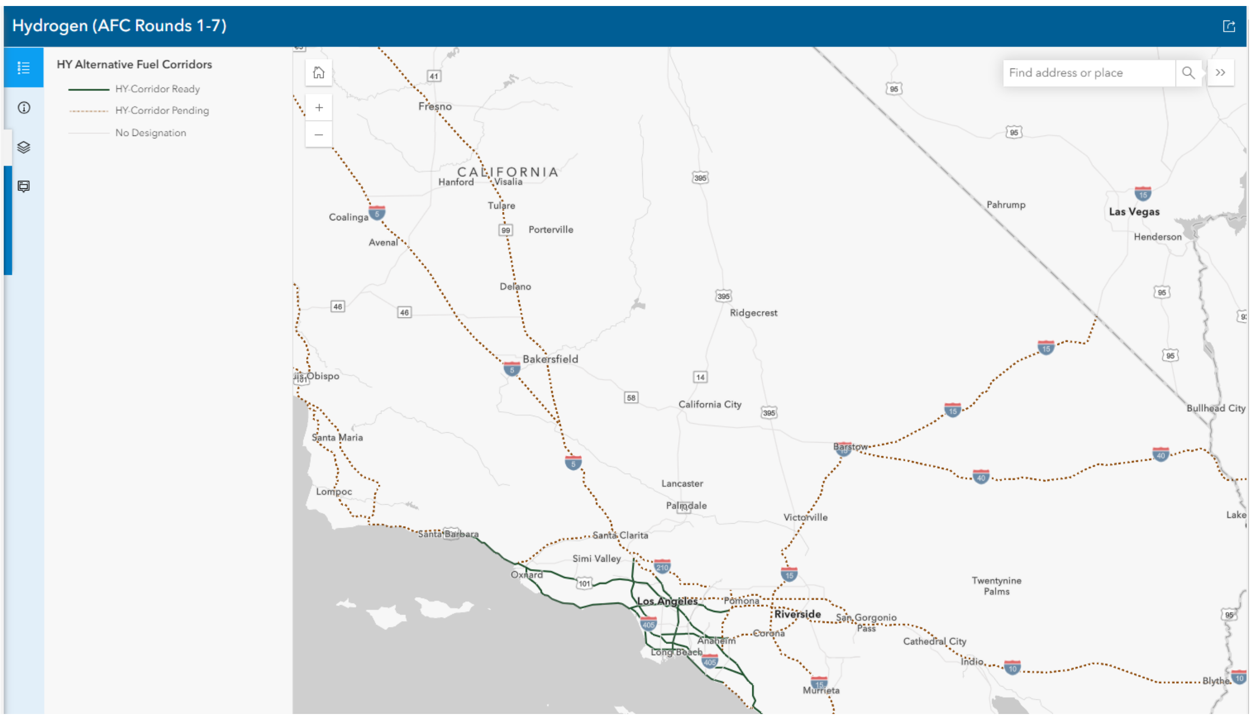

Figure 9. Illustration of Alternative Fuels Corridors[35]

2.3.2. Initial Corridors

This initial map identifies potential corridors for a new pipeline system, considering a range of developed and undeveloped lands and terrains. This includes urban, rural, and mountainous terrain features, while also including different ecological conditions. Since a single pipeline often traverses land with varied features, it will be crucial to conduct detailed evaluation and analysis in subsequent phases of the project.

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[34] Alternative Fuel Corridors - Environment - FHWA. (n.d.). https://www.fhwa.dot.gov/environment/alternative_fuel_corridors/
[35] Alternative fuel corridors. (n.d.-b). https://hepgis-usdot.hub.arcgis.com/pages/alternative-fuel-corridors

The development of a new pipeline system rather than a route in an already established system, necessitated a broad approach that allowed for comprehensive assessment of the Central and Southern California regions. When combined, these initial corridors traverse a total of approximately 1,300 miles, providing a wide range of options within which to narrow down the routes for the Angeles Link system. The illustration in Figure 10 presents this wide range of options for evaluation and multiple pathways for the incorporation of new data. Of the approximately 1,300 miles of initial corridors evaluated, 500 miles were estimated to be within Section 368 Federal Energy Corridors, 200 miles were estimated to be aligned with the Alternative Fuel Corridors, and approximately 950 miles were within 50 feet of existing SoCalGas high pressure pipeline facilities. The approach lays a strong foundation for the Routing Analysis and allows data and other related information to be applied. As the Routing Analysis developed, the initial set of pathways were progressively narrowed down to the preliminary preferred routes.

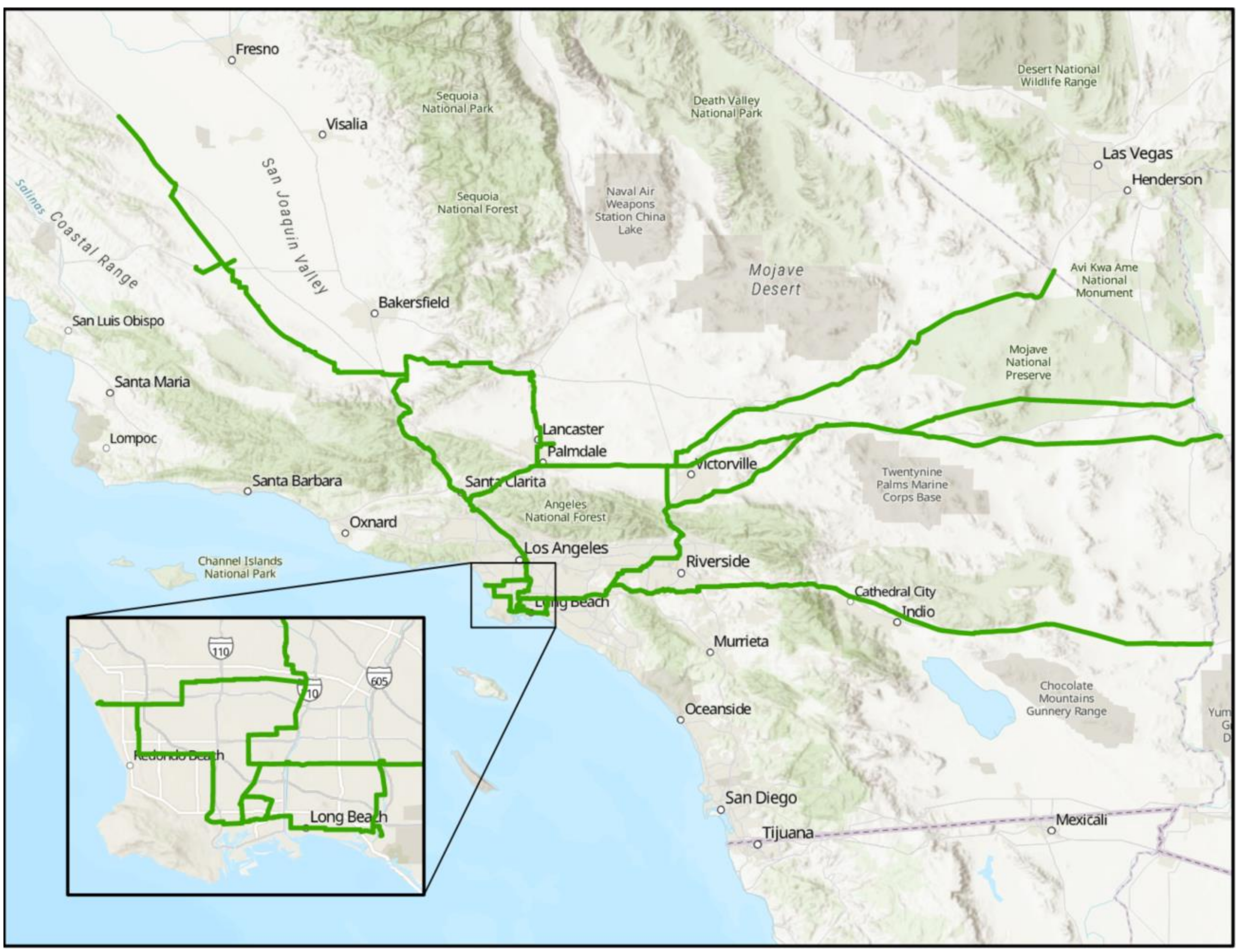

Figure 10. Initial Corridors Evaluated

2.3.3. Corridor Segmentation

All initial corridors identified were broken down into smaller pieces for more practical evaluation. These segments, identified by letter designations, were evaluated for characteristics and attributes. By analyzing these smaller sections individually, work could be conducted in an organized structure. As the routing evaluation proceeded, the segments could be used to craft a variety of different routes.

These twenty-five pipeline segments represent conceptual routing within available corridors for consideration in a preferred routing configuration and made up the initial potential options for Angeles Link. The illustration of these segments is displayed in Figure 11 below.

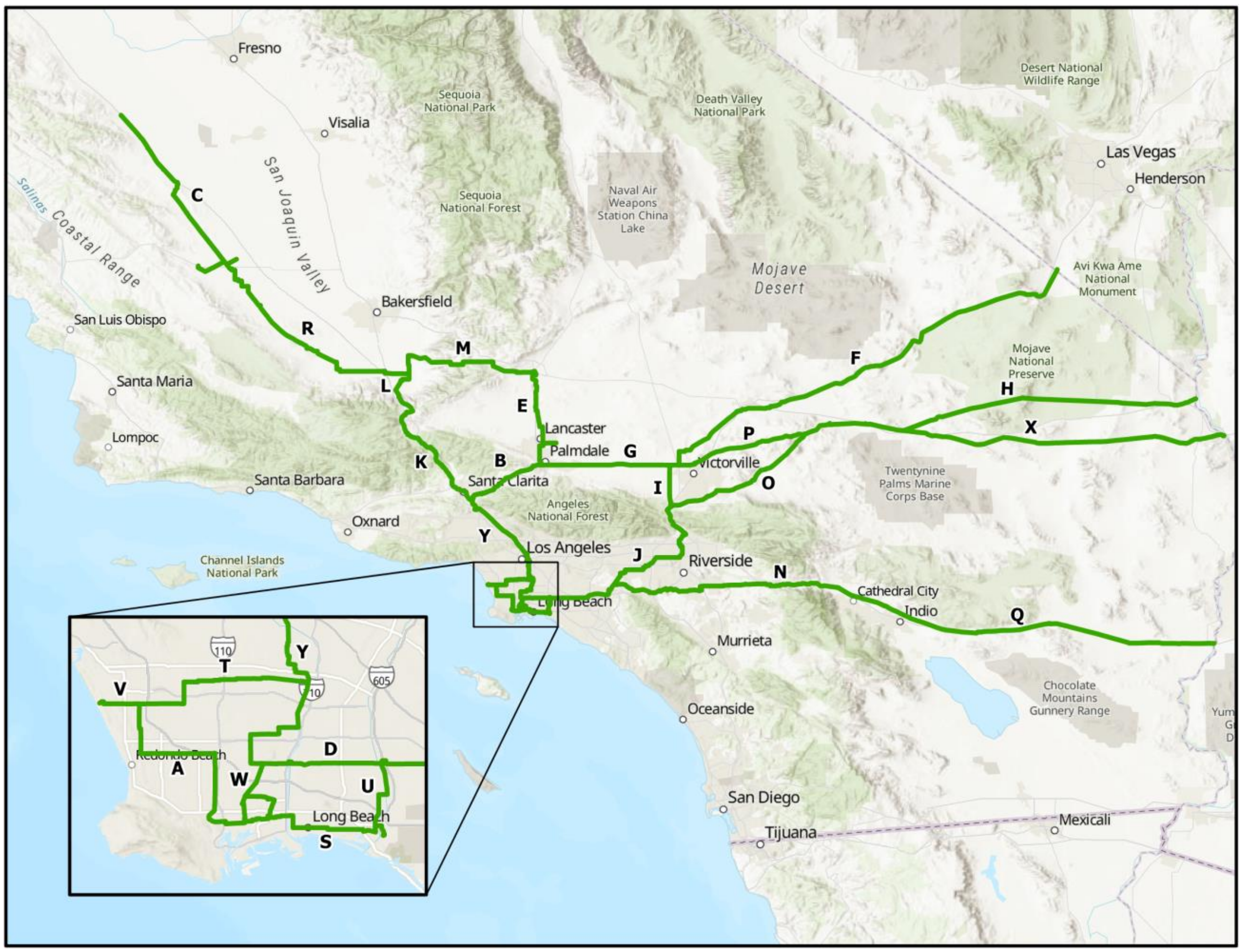

Figure 11. Evaluated Corridors by Segment

SoCalGas

3. ROUTE EVALUATION

3.1. Feature Evaluation

3.1.1. Segment Analysis & Evaluation

As selected routes are further explored in subsequent phases, information about the routes will be essential for detailed alignments that seek to minimize potential impacts on the community and the environment. Cataloging the network by segments allowed for an efficient and systematic approach to routing analysis. A comprehensive approach was utilized to build assessment matrices and to develop the following three categories for routing analysis for each segment:

- Engineering: constructability factors that can create logistical problems or excessive costs to pipeline construction, operation, or maintenance. For example, incorporating construction staging considerations involves evaluating potential routes for compatibility with the logistical requirements of construction staging. Staging areas must be established along the selected route where materials such as pipes, valves, and fittings can be efficiently received, stored, and accessed. The proximity of these staging areas to existing infrastructure like major roads and railways significantly reduces the time and cost associated with transporting materials to the construction sites.
- Environmental: challenging topography that may prevent construction or regulated lands that may require additional permits or mitigation before construction activities would be allowed. For example, choosing routes that require less intensive land clearing and grading to minimize ecological disruption.
- Social Category: factors that may have direct or indirect effects on people. Routes that include sensitive crossing areas, such densely populated areas, might require advanced techniques like horizontal directional drilling to minimize surface disturbance. Supplementary analysis was performed related to Disadvantaged Communities or DACs (see Chapter 4 of this analysis), as well as the Environmental and Social Justice Analysis.

Within each of the three categories, attributes were identified as a component to measure routing characteristics, each measured with relative units (see Appendix for full matrix details, including attribute definitions). For each of the segments, a matrix was developed that indexed individual attributes, equating to characteristics relative to each specific segment. The segment characterization was used to identify features that provide additional insight into the preferred routes in Sections 5.1.1. The attributes identified for each segment are displayed in Table 1 below:

Table 1. Matrix Categories Used for Segment Characterization

CATEGORY	ATTRIBUTE	GIS DATA LAYER OWNER*
Engineering	49 CFR 192 Class Location	SoCalGas GIS
Engineering	Adverse Soil Conditions	Pivvot
Engineering	Centerline (CL) length with 15% Slope	Pivvot
Engineering	Fault Areas	Pivvot
Engineering	High Consequence Areas (HCA)	N/A, BMcD Engineering Assessment
Engineering	Mainline Valve (MLV)	N/A, BMcD Engineering Assessment
Engineering	Number of Overhead Utility Crossings	Pivvot
Engineering	Physical Conflict	Pivvot, BMcD Engineering Assessment
Engineering	Pipeline Constructability - Inadequate Temporary Workspace	N/A, BMcD Engineering Assessment
Engineering	Railroad Crossings	Pivvot
Engineering	Road Crossings	Pivvot
Engineering	Route Length	N/A, BMcD Engineering Assessment
Engineering	Trenchless Crossings	N/A, BMcD Engineering Assessment
Engineering	Trenchless Crossings length	N/A, BMcD Engineering Assessment
Engineering	Underground Foreign Utilities	Pivvot
Environmental	Coastal Zone	Pivvot, BMcD Engineering Assessment
Environmental	Conservation Areas	Pivvot
Environmental	Federal Endangered or Threatened Species Critical Habitat	Pivvot
Environmental	Floodplain	Pivvot
Environmental	Landfills & Hazardous Waste Sites	Pivvot
Environmental	Stream Crossings	Pivvot
Environmental	Wetlands	Pivvot
Social	Agricultural/Pastureland	Pivvot
Social	Commercial Land	Pivvot
Social	Cultural & Tribal Resources	Pivvot
Social	Federal Land/Property	Pivvot
Social	Industrial Land	Pivvot
Social	Institutional Land	Pivvot
Social	Maintained Public & Recreational Areas	Pivvot
Social	National Register of Historic Places (NRHP) locations	Pivvot
Social	Proximity to Buildings	Pivvot

*BMcD “Engineering Assessment” was a desktop user analysis.

The importance of the feature characterization is to serve as a quantitative method of cataloging routing characteristics. In addition, the matrices developed for each segment are intended to be used as the foundation to further engineering, design, planning, permitting, and stakeholder outreach in Phase 2 that will be required to achieve feasible routes that are constructible and sustainable. Each of the evaluation criteria listed in Table 1 correlates with one or multiple GIS data sources, as detailed below.

3.1.2. Route Feature Evaluation

The initial segment criteria were identified and used to develop characteristics for the preferred routes. The full matrices and a summary table of the length for each segment is shown in Appendix B and C.

3.1.3. Data Sources & Attribute Measurement Approach

The Pivvot software was utilized in the segment analysis efforts to efficiently streamline data collection and measurement. Pivvot is a GIS software program that allows a pipeline route to be identified, studied, reviewed, and updated based on hundreds of data sources available within the software. GIS Data Layer Sources are shown in Appendix B. Routes were uploaded to Pivvot for analysis based on the attributes listed in Table 1 above. Pivvot's database is comprised of the following data:

Table 2. Evaluation Criteria and Data Source

JURISDICTIONAL DATA	HYDROLOGY DATA	BOUNDARY DATA	GEOTECHNICAL DATA
County Boundary	Aquifer	Congressional District	Depth to Bedrock
Dept. of Transportation Districts	Commercially Navigable Waterway	Electric Retail Service Territories	Elevation
Municipal Boundary	EPA Protected Waterbody	Energy Regulatory Region	Fault Area
State Boundary	100-Year Flood Plain	Natural Gas Service Territories	Fault Lines
U.S. ACE Districts	500-Year Flood Plain	Oil & Gas Production Area	Geological Unit
U.S. BIA Regions	Levee	Organizational Boundary	Enhanced Karst Topography (Terracon)
U.S. BLM Admin. Units	NHD Flowline	PHMSA Populated Places	Landslide Risk

U.S. BOR Regions	NDH Waterbody	Public Land Survey	Peak Ground Acceleration
U.S. EPA Regions	NWI Wetlands	Public Safety Answering Point	Percent Slope
U.S. FEMA Regions	Watershed	School Districts	Depth to Water
U.S. Federal Lands	Wild & Scenic Rivers	State Legislative Districts	Hydric Soils (Potential Wetland Soil Landscape)
U.S. FWS Regions	USGS Stream Gauges		Hydrologic Soil Groups
U.S. FS Regions			Prime Farmland (Terracon)
U.S. NMFS Regions			Soil Behavior Class (Terracon)
U.S. NRCS Regions			Soil Corrosivity (Terracon)
U.S. Tribal Lands			Soils
			Steel Corrosivity
WEATHER DATA	**ENERGY & INFRASTRUCTURE DATA**	**ECOLOGY & ENVIRONMENTAL DATA**	**LAND USE DATA**
Hail Events	Communication Towers & Obstacles	Critical Species Habitat	Property Parcel
Lightning Strikes	Contaminated Sites	Species/Habitat Range	Land Cover
Tornado Events	Electric Transmission Powerline	Ecosystem Region Boundary	Land Ownership Conflicts
Wind Events	Electric Transmission Substations	Species Habitat	Community & Society Data
	Existing Pipeline		Environmental Justice
	Fifty Foot Structure Buffer		Social Vulnerability
	Greenhouse Gas Emitters		
	Interconnect Queue		
	Points of Interest		
	Cemeteries		
	Federal Registered Sites		
	Railroads		
	Roads		
	Trails		
	Wind Turbines		

3.2. Land Rights

A preliminary analysis of existing Direct Land Rights and rights to use Rights of Way pursuant to a municipal franchise agreement (described below) was performed to inform the Routing Analysis. This information is based on the current preliminary alignment of the routes and will be a basis for further exploration in subsequent phases as preferred routes are evaluated from a more granular perspective and new alignments options are determined.

3.2.1. Franchise Rights

SoCalGas operates and maintains a significant portion of its pipeline system in Rights of Way pursuant to local ordinances (i.e., franchise agreements) that generally grant SoCalGas the right to construct, operate, and maintain in Rights of Way pipeline infrastructure to transmit and distribute gas for any and all purposes consistent with applicable law. Sixty-four (64) municipalities were identified that are crossed by the potential pipeline segments, sixty (60) of which have some form of franchise agreement with SoCalGas. Certain terms and conditions of the sixty (60) franchise agreements (which vary by city and county) were reviewed, as well as relevant applicable local codes and state statutes (i.e., the Broughton Act, the Franchise Act and the regulations of the CPUC) for those city and county jurisdictions crossed by the proposed 25 routing segments.

3.2.2. Existing Direct Land Rights

Sites within each of the 25 routing segments where SoCalGas linear pipeline facilities are located in relation to the proposed routes were identified using GIS and SoCalGas facility maps to preliminarily evaluate those portions of the segments in, or in proximity to, its existing Direct Land Rights, and, as available, retrieved copies of the relevant easements, rights-of-way and licenses. (SoCalGas fee-owned land was not included.).[36] Each segment was reviewed on a parcel-by-parcel basis, each "parcel" having a county-assigned tax identification number.

Once the parcels in each segment were identified, research of publicly available data was conducted to obtain ownership from property detail reports, county tax roll databases and real estate data service providers. Note that neither detailed title review (e.g., review of relevant preliminary title reports or property surveys to identify complex ownership interests, title exceptions, concurrent usage or specific land use restrictions) nor physical surveys or inspections of existing SoCalGas or third-party facilities were performed for this analysis. The evaluation of property ownership and SoCalGas Direct Land Rights agreements included:

[36] Fee owned land refers to real property owned by SoCalGas.

- Identification of parcels traversed by the proposed segments owned by federal, state or local governmental agencies, railroads, other utilities, and certain private parties (e.g., state or local conservation agencies, oil and gas entities) that typically present acquisition challenges due to long lead time or permitting requirements
- Identification of defined widths permitted to construct and maintain pipeline facilities

3.3. Route Analysis

Various route configurations were created and analyzed, and relevant information was integrated from the Production, Demand, and Design Studies, in addition to incorporating ARCHES-related information as it became available.

3.3.1. Scenarios

The Phase 1 Production Study[37] identified three potential areas—referenced in this section as “San Joaquin Valley” (SJV), “Lancaster”, and “Blythe”—with the highest likelihood to generate large-scale clean renewable hydrogen by third parties. Angeles Link is proposed to transport up to 1.5 million metric tons per year (MMTPY) by the Demand Study. Combinations of the identified potential production locations were analyzed to achieve a range of 0.5 MMTPY, 1.0 MMTPY, and 1.5 MMTPY total throughput (See Production and Design studies for further detail). These combinations are identified as Scenarios 1-8, which provide potential pathways to deliver hydrogen from the primary potential production locations to demand centers in the Central and Southern California, including the LA Basin.

Table 3 - Scenario 1-8 Results

Scenario	Total Throughput, MMTPY	Primary Production Location(s)	Total Route Mileage*
1	0.5	San Joaquin Valley (SJV)	355
2	0.5	Lancaster	314
3	0.5	Blythe	303
4	1.0	SJV, Lancaster	392

[37] Clean hydrogen production and above-ground and underground storage are not currently part of Angeles Link. 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 should be considered.

Scenario	Total Throughput, MMTPY	Primary Production Location(s)	Total Route Mileage*
5	1.0	Lancaster, Blythe	537
6	1.0	SJV, Blythe	578
7	1.5	SJV, Lancaster	390
8	1.5	SJV, Lancaster, Blythe	616

*Single-Run configuration mileage. Refer to the Design Study for more details.

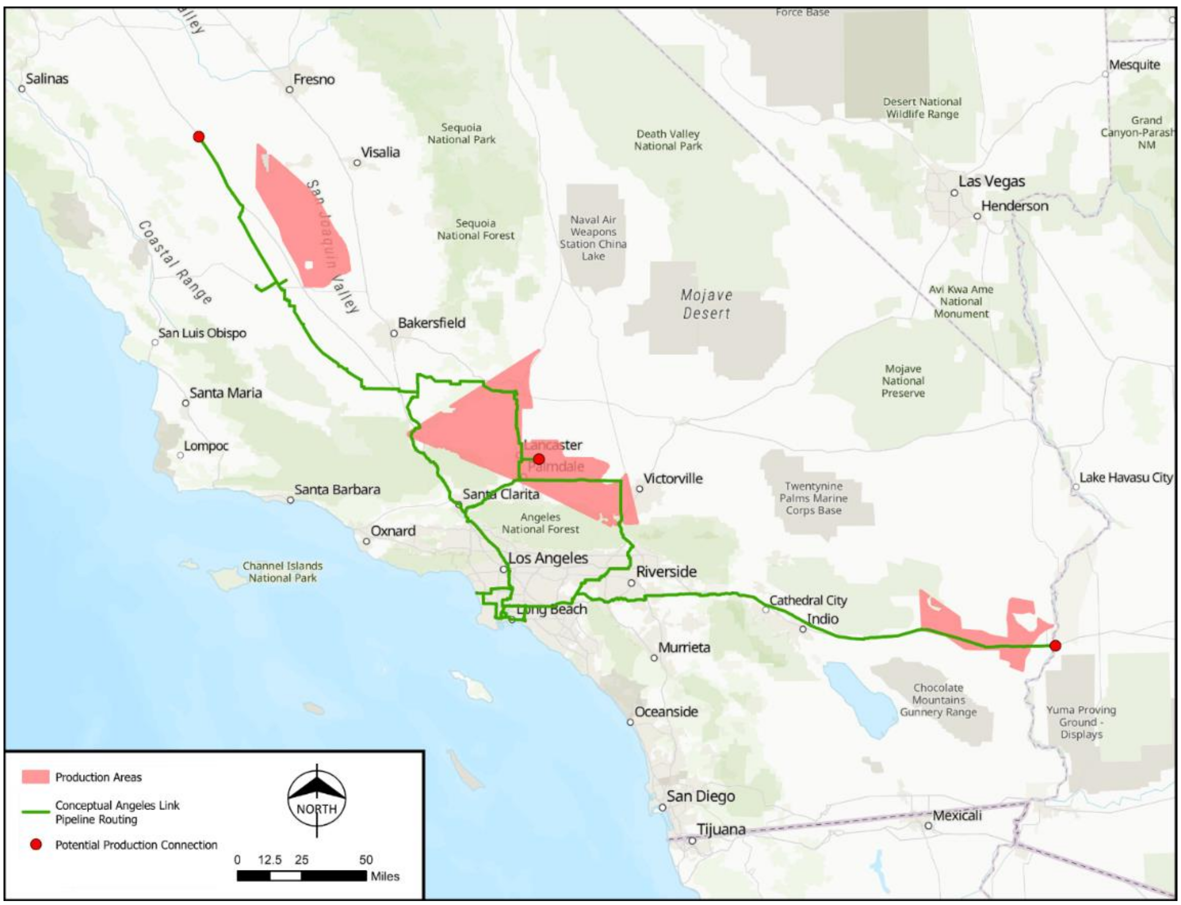

Figure 12. Conceptual Production Areas and Pipeline Routing

Figure 12 depicts the conceptual production areas and pipeline routing for Scenarios 1-8, which are further described in this section.

As described in previous sections, one objective of this Routing Analysis was to develop an efficient pipeline network that could transport up to 1.5MMTPY. To access this volume, based on the Production Study, it was determined that at least two of the areas identified for potential production may be necessary. Initial corridors evaluated pipelines that extend East from the Lancaster Production Area to the California and Nevada border. These corridors were not pursued in Scenarios 1-8 as the excessive mileage and land disturbance of these potential corridors are not necessary to reach an identified Production Area. Scenarios 5, 6, and 7 all illustrate potential routes that connect to at least two of the potential production areas. Averaged, these scenarios indicate that a route that traverses up to 500 miles may be necessary to achieve this. Therefore, within this Analysis, Preferred Routes traverse 500 miles in distance or less.

Scenario 1: San Joaquin Valley (SJV)

Scenario 1 consists of a pipeline system that initiates in the SJV Production Area in the Connection Zone, before heading south through the Connection and Collection Zones to potential storage and delivery to end users and ending in the Central Zone. The total mileage for this scenario is 355 miles, with approximately 165 miles in the Connection Zone, 110 miles in the Collection Zone, and 80 miles in the Central Zone. Of the 0.5 MMTPY throughput scenarios, Scenario 1 has the longest total distance and allows for the most direct access to potential depleted oil and gas fields for underground storage in Central California. Figure 13 illustrates the potential production location, zones, and conceptual pipeline routing for this scenario.

Figure 13. Scenario 1 Illustration

Scenario 2: Lancaster

Scenario 2 consists of a pipeline system that initiates in the Lancaster Production Area in the Collection Zone, before heading southwest within the Collection Zone to deliver hydrogen to potential end users and ending in the Central Zone. There is also a portion of this system heading north into the Connection Zone to accommodate potential storage and delivery to end users in the Connection Zone. The total distance for this scenario is 314 miles, with approximately 87 miles in the Connection Zone, 147 miles in the Collection Zone, and 80 miles in the Central Zone. Of the 0.5 MMTPY throughput scenarios, Scenario 2 presents the shortest distance from a potential production location (Lancaster) to the LA Basin and is located relatively close to potential Central California underground depleted oil and gas fields storage access. Figure 14 illustrates the potential production locations, zones, and conceptual pipeline routing for this scenario.

Figure 14. Scenario 2 Illustration

Scenario 3: Blythe

Scenario 3 consists of a pipeline system that initiates in the Blythe Production Area in the Connection Zone, before heading west through the Connection and Collection Zones to deliver hydrogen to potential users, and ending in the Central Zone. The total distance for this scenario is 303 miles, with approximately 200 miles in the Connection Zone, 23 miles in the Collection Zone, and 80 miles in the Central Zone. Of 0.5 MMTPY throughput scenarios, Scenario 3 has the shortest total distance and is located closest to potential underground salt basin storage outside of California. Figure 15 illustrates the potential production locations, zones, and conceptual pipeline routing for this scenario.

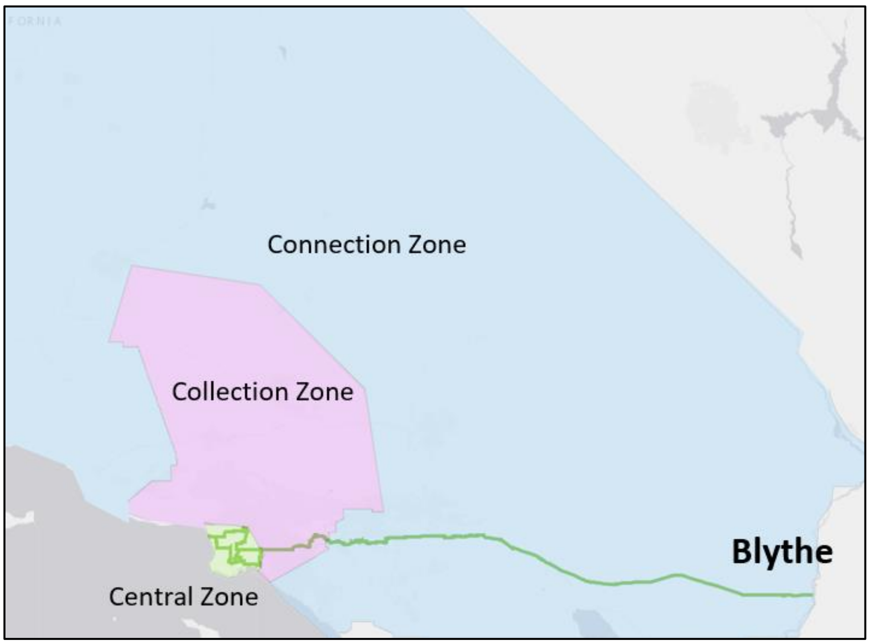

Figure 15. Scenario 3 Illustration

Scenario 4: SJV and Lancaster

Scenario 4 consists of a pipeline system that combines flow from the SJV and Lancaster Production Areas in the Connection and Collection Zones to potential storage and delivery end users, and ending in the Central Zone. The total mileage for this scenario is 392 miles, with approximately 165 miles in the Connection Zone, 147 miles in the Collection Zone, and 80 miles in the Central Zone. Of the 1.0 MMTPY throughput scenarios, Scenario 4 has the shortest total distance and provides potential access to underground storage located between the SJV and Lancaster production locations. Figure 16 illustrates the potential production locations, zones, and conceptual pipeline routing for this scenario.

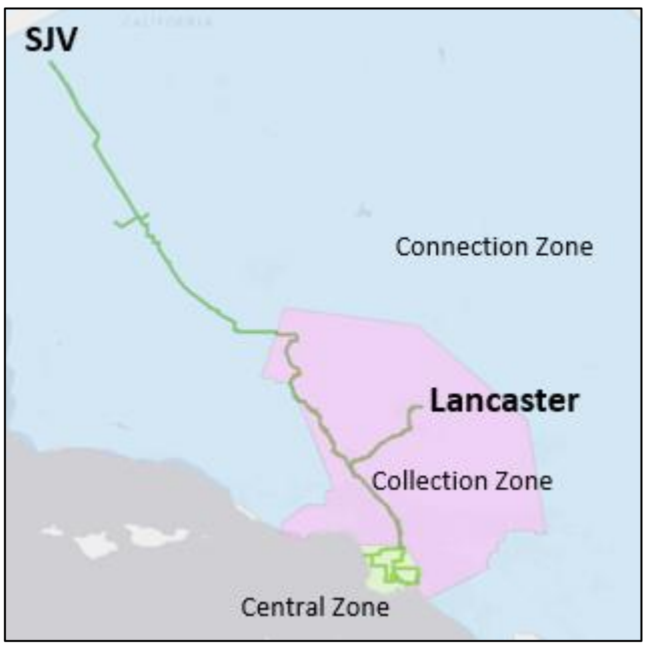

Figure 16. Scenario 4 Illustration

Scenario 5: Lancaster and Blythe

Scenario 5 consists of a pipeline system where flow from the Lancaster and Blythe Production Areas are combined in the Central zone to deliver hydrogen to potential users. The pipeline from the Lancaster Production Area is located in the Collection Zone and splits south towards the Central Zone to deliver hydrogen to Southern California, and north towards potential access to storage and delivery to end users in the Connection Zone. The pipeline from the Blythe Production Area travels west through the Connection and Collection Zones to transport hydrogen to the Central Zone. The total mileage for this scenario is 537 miles, with approximately 286 miles in the Connection Zone, 171 miles in the Collection Zone, and 80 miles in the Central Zone. Of the 1.0 MMTPY throughput scenarios, Scenario 5 assumed potential depleted oil and gas fields storage access in Central California for the Lancaster production location, and storage access outside of California for the Blythe production location. Figure 17 illustrates the potential production locations, zones, and conceptual pipeline routing for this scenario.

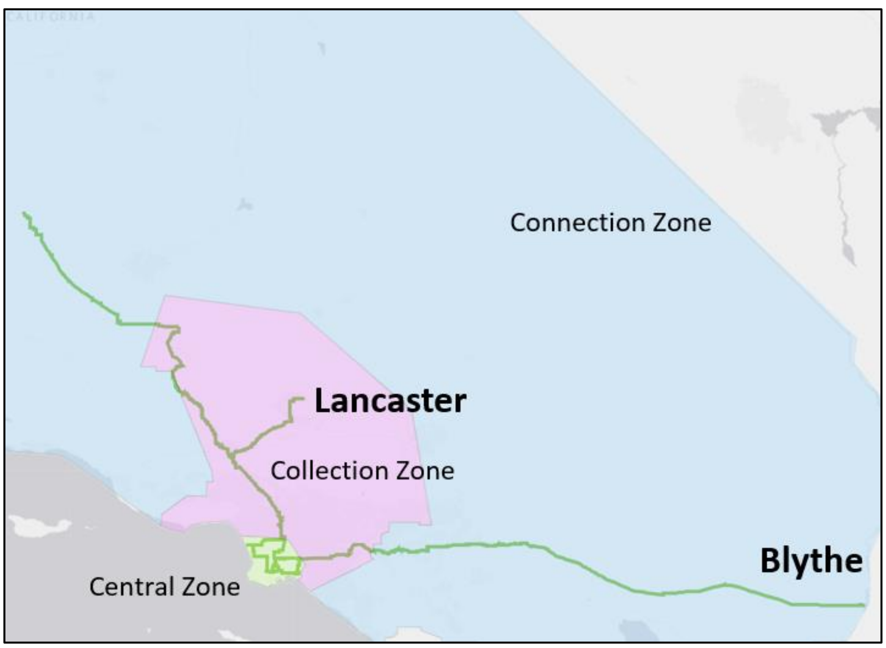

Figure 17. Scenario 5 Illustration

Scenario 6: SJV and Blythe

Scenario 6 consists of a pipeline system where flow from SJV and Blythe Production Areas are combined in the Central Zone to deliver hydrogen to potential users. The pipeline from the SJV Production Area is located in the Connection Zone and travels south towards potential storage access and delivery to end users in Central and Southern California, ending in the Central Zone. The pipeline from the Blythe Production Area travels west through the Connection and Collection Zones to transport hydrogen to the Central Zone. The total mileage for this scenario is 578 miles, with approximately 364 miles in the Connection Zone, 134 miles in the Collection Zone, and 80 miles in the Central Zone. Of the 1.0 MMTPY throughput scenarios, Scenario 6 has the longest total distance and assumed Central California storage access for the SJV production location, and storage access outside of California for the Blythe production location. Figure 18 illustrates the potential production locations, zones, and conceptual pipeline routing for this scenario.

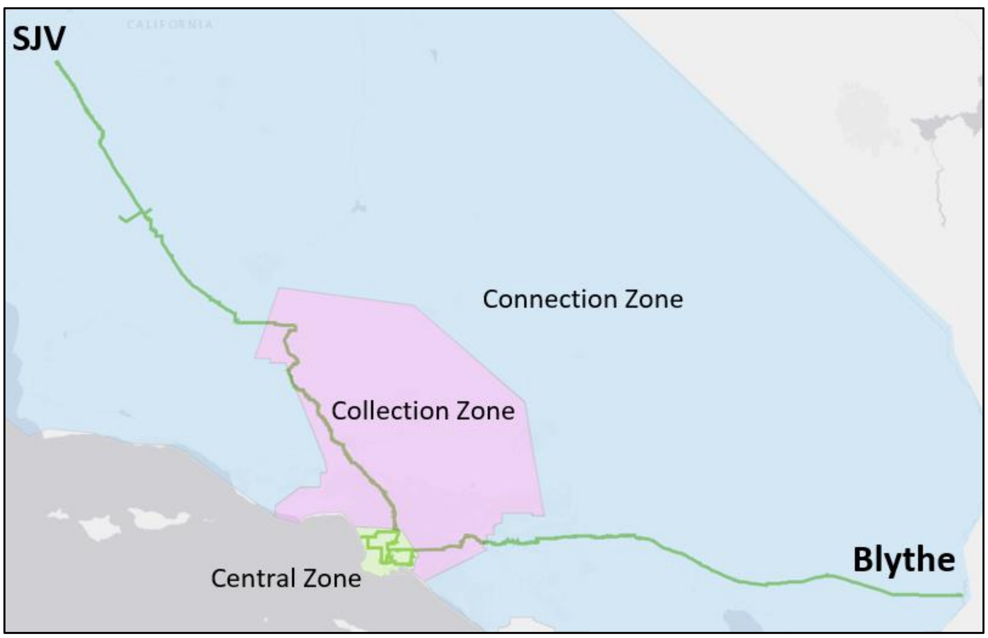

Figure 18. Scenario 6 Illustration

Scenario 7: SJV and Lancaster

Scenario 7 consists of a pipeline system combining flow from the SJV and Lancaster Production Areas in the Connection and Collection Zones to potential storage and delivery to end users, ending in the Central Zone. The total mileage for this scenario is 390 miles, with approximately 164 miles in the Connection Zone, 146 miles in the Collection Zone, and 80 miles in the Central Zone. This pipeline route is identical to Scenario 4 but with increased production capacity of 0.75 MMTPY at each location, resulting in the 1.5 MMTPY throughput. Of the 1.5 MMTPY throughput scenarios, Scenario 7 has the shortest total distance and provides access to potential in-state underground storage located between the SJV and Lancaster production locations. Figure 19 illustrates the potential production locations, zones, and conceptual pipeline routing for this scenario.

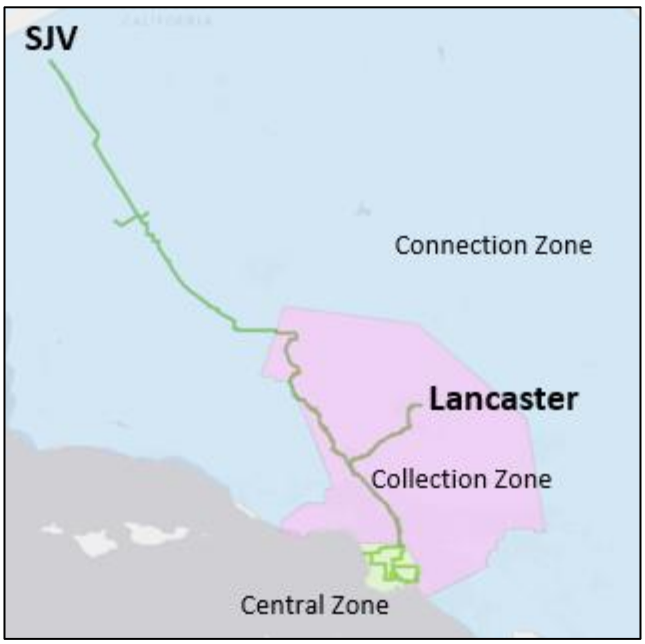

Figure 19. Scenario 7 Illustration

Scenario 8: SJV, Lancaster, and Blythe

Scenario 8 consists of a pipeline combining flow from the SJV and Lancaster Production Areas, and a separate pipeline from the Blythe Production Area to deliver hydrogen to end users, ending in the Central Zone. The total mileage for this scenario is 616 miles, with approximately 364 miles in the Connection Zone, 171 miles in the Collection Zone, and 80 miles in the Central Zone. Of the 1.5 MMTPY throughput scenarios, Scenario 8 has the longest total distance and assumed Central California storage access for the SJV and Lancaster production locations, and storage access outside of California for the Blythe production location. Figure 20 illustrates the potential production location, zones, and conceptual pipeline routing for this scenario.

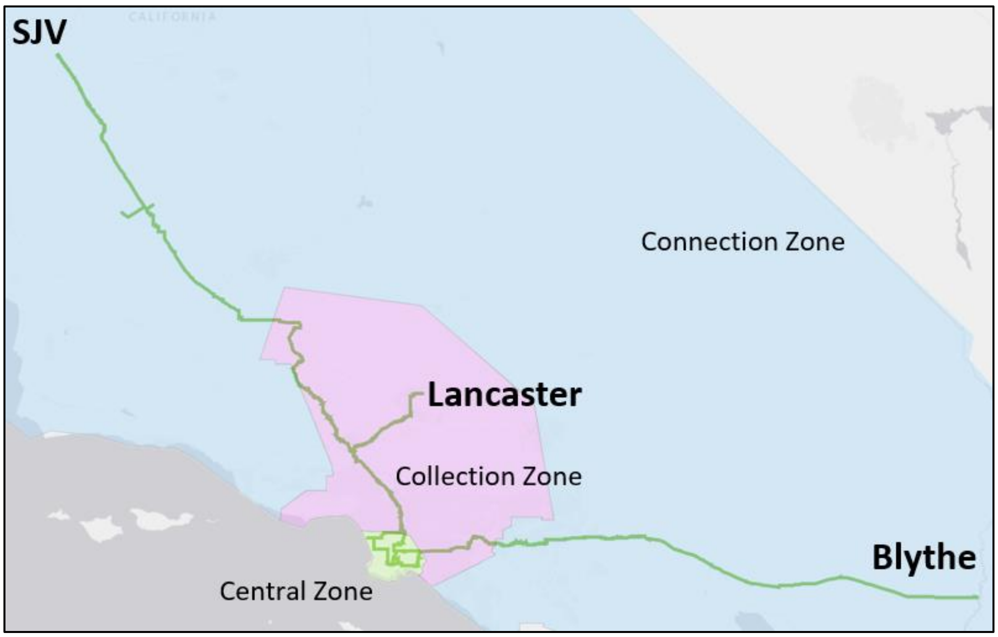

Figure 20. Scenario 8 Illustration

3.3.2. Alliance for Renewable Clean Hydrogen Energy Systems (ARCHES)

In October 2022, SoCalGas joined with ARCHES[38], which is a public-private partnership to create a sustainable, statewide, clean hydrogen hub in California utilizing local renewable resources. The ARCHES consortium's objective is to fully decarbonize the regional economy, while prioritizing environmental justice, equity, economic leadership and workforce development.

In September 2022, DOE's Office of Clean Energy Demonstrations (OCED) issued Funding Opportunity Announcement DE-FOA-0002779 (FOA) to solicit applications from six to ten regional Hydrogen Hubs to receive federal funding from the 2021 Infrastructure Investment and Jobs Act (IIJA). The stated purpose of this program is to "catalyze investment in the development of Hydrogen Hubs that demonstrate the production, processing, delivery, storage, and end-use of clean hydrogen, in support of the Biden Administration's goal to achieve a carbon-free electric grid by 2035 and a net zero emissions economy by 2050."[39] As explained in the FOA, each Hydrogen Hub is to be executed over approximately 8-12 years, or sooner, depending on the size and complexity of the Hydrogen Hub.[40]

SoCalGas coordinated with ARCHES throughout the development of ARCHES's application for federal funding for the California Hydrogen Hub, and designated segments of Angeles Link were included as part of ARCHES's application in April 2023. On October 13, 2023, DOE announced that the California Hydrogen Hub was selected for an award up to $1.2 billion. A cooperative agreement was signed between DOE and ARCHES in July 2024.

Two segments of Angeles Link are part of this foundational California Hydrogen Hub. One segment will be an approximately 80-mile pipeline near existing SoCalGas pipeline rights-of-way, expected to connect various producers in the San Joaquin Valley in Central California.

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[38] ARCHES is co-founded by the Governor's Office of Business and Economic Development, the University of California, a statewide labor coalition organized by the State Building and Construction Trades Council of California, and the Renewables 100 Policy Institute. *See* ARCHES-FAQ-Basic-1.pdf (archesh2.org)

[39] DOE, FOA (September 22, 2022) at 6, *available at:* https://oced-exchange.energy.gov/FileContent.aspx?FileID=40a1ff87-622d-4ef5-8d7c-89bfe089fd11.

[40] *Id.* at 18.

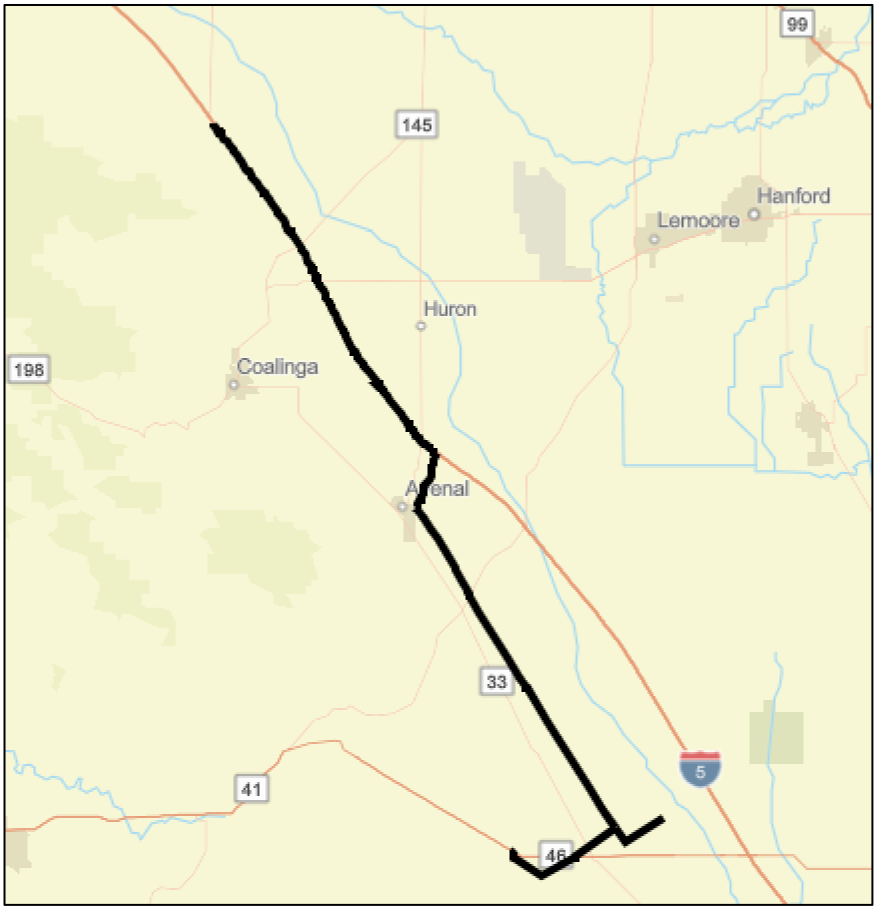

Figure 21. Illustration of ARCHES, Segment C

The second segment would run approximately 45 miles from Lancaster to the Los Angeles Basin with proposed routing configured near existing pipeline rights-of-way and previously disturbed corridors, as feasible, and would transport clean renewable hydrogen from producers in the Lancaster area directly to end users in the Los Angeles Basin.

Figure 22. Illustration of ARCHES, Segment B

The broader Angeles Link project would connect both segments within a pipeline system and provide backbone infrastructure dedicated to public use to allow the efficient movement of clean renewable hydrogen from producers to end users to support California's initiative to accelerate renewable hydrogen projects.[41] Within this Analysis, Preferred Routes are routes which connect Segments B and C.

3.3.3. Configuration Narrowed

To achieve the vision of Angeles Link to connect clean renewable hydrogen production sources to various delivery points anticipated in Central and Southern California, including the LA Basin, the pipeline network was evaluated holistically, leading to a route evaluation. This information was integrated in the following ways within this Analysis to identify those routes of highest possible potential to achieve the objectives of Angeles Link:

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[41] ARCHES Mission, available at: https://archesh2.org/about/

- Preferred Routes are routes which connect areas of clean renewable hydrogen production with areas of concentrated demand (Section 2.1 – The Role of the System)
- Preferred Routes are routes which have pipeline passing through all three zones (Section 2.2 – Zone Development).
- Preferred Routes are routes that traverse 500 miles in distance or less (Section 3.3.1 – Scenarios)
- Preferred Routes are routes which connect SoCalGas's ARCHES Projects, Segments B and C (Section 3.3.2 – Alliance for Renewable Clean Hydrogen Energy Systems).

The objective of this Routing Analysis in Phase 1 is to evaluate and determine several possible preferred routes during the feasibility stage of Angeles Link. Subsequent Pre-FEED and FEED activities in Phase 2 will select one preferred route and will assess the routes on a more granular level.

3.3.4. Preferred Routes Identified

Preliminary pipeline segments were assembled in various configurations to meet the established criteria for preferred route. Following the previously described evaluation efforts, four preferred route configurations emerged. The four Preferred Route Configurations titled: A, B, C, and D, are shown in Figure 23 below. Route Variation 1 was also added after evaluating ESJ Screening information and in response to stakeholder feedback as a variation for further evaluation in Phase 2 as it has the potential to minimize route mileage traversing disadvantaged communities in the LA Basin. Chapter 4 of this Analysis includes more detailed information about Route Variation 1. These configurations represent high-level preliminary pathways of highest potential to connect clean renewable hydrogen production with concentrated areas of demand at the time the analysis was conducted. The routes and variation will be evaluated in further detail in subsequent Phases and are subject to change based on additional information and continued developments in the hydrogen economy in Central and Southern California.

These four Preferred Route Configurations share the common characteristic of delivering up to 1.5 MMTPY of clean renewable hydrogen from third-party production locations in San Joaquin Valley and Lancaster to Central and Southern California, including the Los Angeles Basin, while passing through the Connection, Collection, and Central Zone and supporting connection between the two ARCHES segments. On average, they traverse approximately 450 miles.

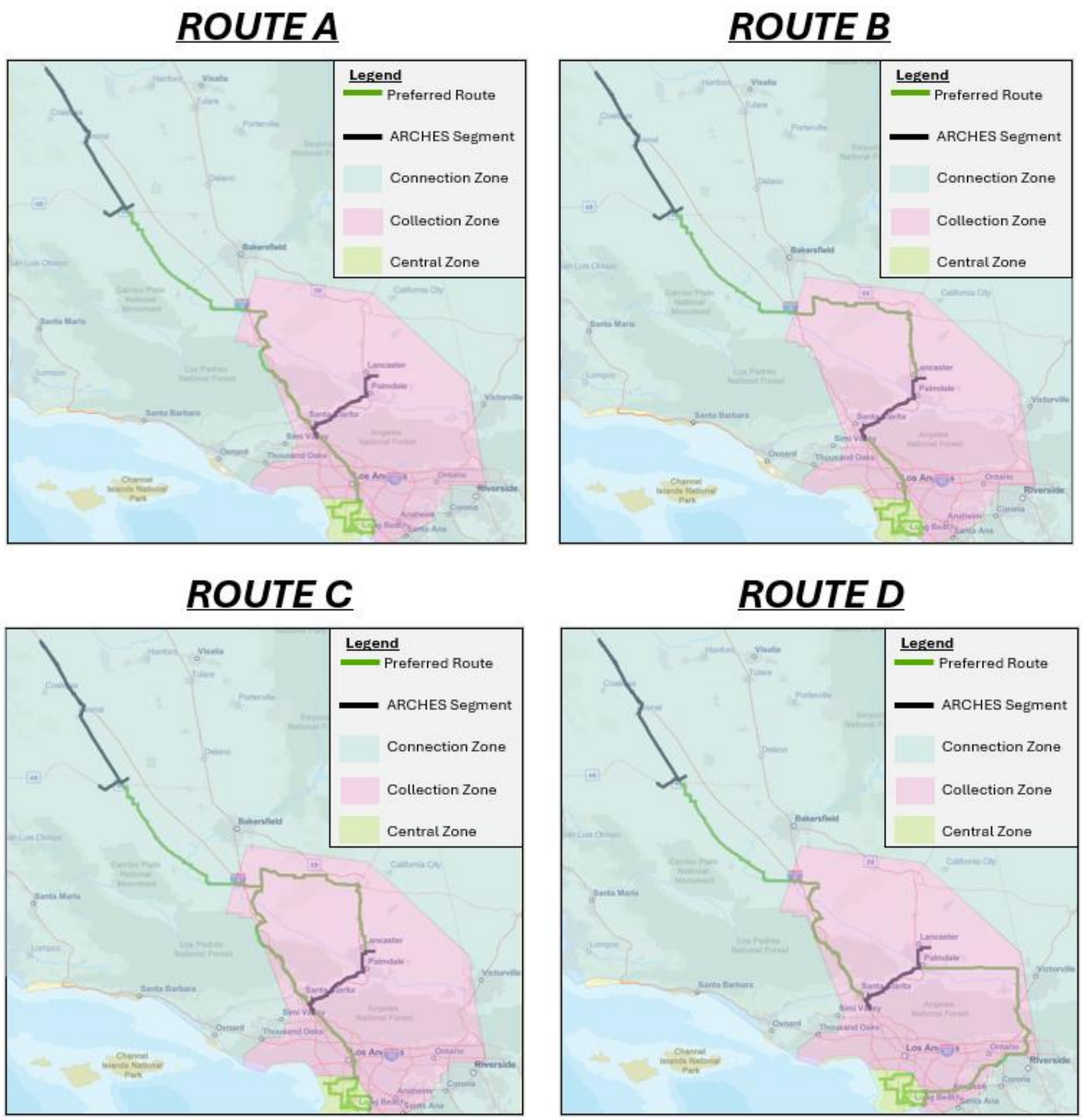

Figure 23. Preferred Route Configurations with Zones

Figure 24 below illustrates LA Basin and includes Routes A, B, and C, as a solid line from their access point into LA Basin. Route Variation 1 would be a part of these routes in their entirety and is depicted as a dashed line for differentiation in the below image. Route D can also be seen in the Figure as it accesses LA Basin from the East.

Figure 24. Illustration of Preferred Routes and Route Variation 1

4. DISADVANTAGED COMMUNITIES AND ENVIRONMENTAL SOCIAL JUSTICE

SoCalGas's Angeles Link ESJ Plan/Screening describes how SoCalGas proposes to work with community-based organizations and Disadvantaged Communities (DACs) in Phase 2 to prioritize community engagement activities in order to inform route selection and alignment, mitigate potential impacts, and maximize Project benefits (subject to CPUC approval).

This Routing Analysis describes how DACs and ESJ communities were evaluated in Phase 1 (selection of initial routing corridors) and will be taken into consideration when selecting a single preferred route in Phase 2.

4.1. Preliminary Route Identification and ESJ/DAC Considerations

As part of this initial route identification process, SoCalGas used information from its ESJ Plan to identify DAC and ESJ communities via a desktop GIS analysis. SoCalGas used two datasets to identify DACs:

- CalEnviroScreen (managed by the California Office of Environmental Health Hazard Assessment) which uses environmental, health, socioeconomic information to produce scores for every census tract in the state
- Climate and Economic Justice Screening Tool (Biden administration directed the Council on Environmental Quality to develop tool) which has datasets that are indicators of burdens in eight categories: climate change, energy, health, housing, legacy pollution, transportation, water and wastewater, and workforce development.

SoCalGas then considered evaluating hydrogen corridors that would avoid DAC and ESJ communities entirely. However, as described in Section 2.3, access to the LA Basin area from the San Joaquin Valley is constrained by geological features, including several mountain ranges and National Forests. Given these features, there are limitations to the potential pathways that enter the LA Basin from the areas that surround it. Figure 25 also illustrates that large areas in the San Joaquin Valley and LA Basin are designated as DACs or ESJ communities.

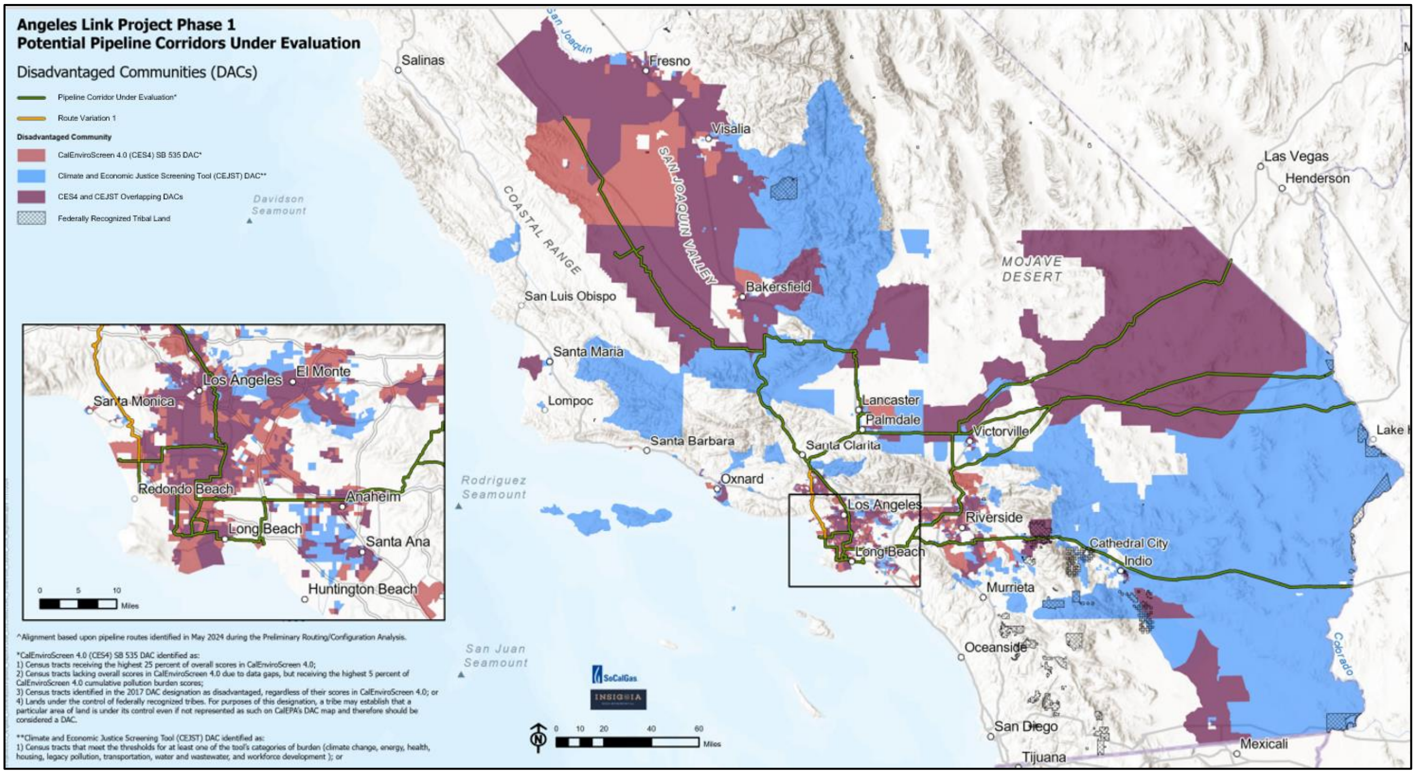

Figure 25. Illustration of Preferred Routes A, B, C, D and DACs

Routing completely out of DACs may not be feasible due to various factors including technical challenges and operational considerations that may compromise system efficiency, safety, affordability, and reliability. As described in the Chapter 2, initial selection of the corridors considered was primarily driven by the need to efficiently connect hydrogen production facilities to off taker. Many of the potential off takers Angeles Link intends to serve are concentrated within DACs. However, locating Angeles Link near these off takers could result in localized air quality improvements. For example, as demonstrated by the Nitrogen Oxide (NOx) and other Air Emissions Assessment (NOx Study), the zip codes closest to ports, goods movement corridors, electric generation, and other industrial activities that Angeles Link would serve benefit the most from NOx reductions in the study area. Refer to the NOx Study for information about NOx reductions by sector and geography.

4.1.1. Route Variation – DAC Minimization

During the initial refinement process of the routes completed during Phase 1, adjustments were made to avoid instances of overlap between the corridors evaluated within 1000-ft of disadvantaged communities. As more detailed DAC data became available as part of ESJ Plan and based on PAG and CBOSG feedback, SoCalGas made further changes to its potential routes by adding a Route Variation 1. As illustrated above in Figure 25 and below in Figure 26, the Route Variation 1 is an alternative routing for the pipeline segment that runs parallel to the Interstate 5 (I-5) in the LA Basin, which traverses through densely populated DACs. This is an example of a specific evaluation for Preferred Routes A, B, and C[42] which would be studied further in Phase 2 when alignment evaluation at the street-level is conducted to determine how DAC impacts may be avoided and benefits maximized.

The Route Variation 1 presents a potential pipeline pathway for Preferred Routes A, B, and C that would potentially reduce main pipeline route mileage traversing DACs in the LA Basin. The percentage of Preferred Routes A, B, and C that traverse disadvantaged communities was found to range from 76-81%. Based on preliminary desktop analyses and following existing SoCalGas pipeline alignment, the potential Route Variation 1, if feasible, may reduce the distance that traverses DACs to approximately 67-73% of the total route distance, a decrease of approximately 8% by route and overall decreases the percentage of pipeline traversing DACs within LA Basin for these routes by approximately 20%.

Preferred Route D presents another option to reduce DAC impacts. As shown in Section 3.3.4, Preferred Route D does not contain pipelines that parallel I-5 in the LA Basin thereby avoiding the corresponding DACs in the area. The percentage of Preferred Route D that traverse disadvantaged communities was found to be approximately 69%, which is within the potential Route Variation 1 range.

In Phase 2, additional considerations will be needed to evaluate changes to accessibility, environmental impacts, and other logistic factors. SoCalGas emphasizes that preferred routes are not final and will implement its ESJ Plan in Phase 2 to incorporate community feedback into its final preferred route selection process.

[42] Preferred Route D does not contain pipeline segments in LA Basin parallel to the I-5, as described in Section 5.1.2.

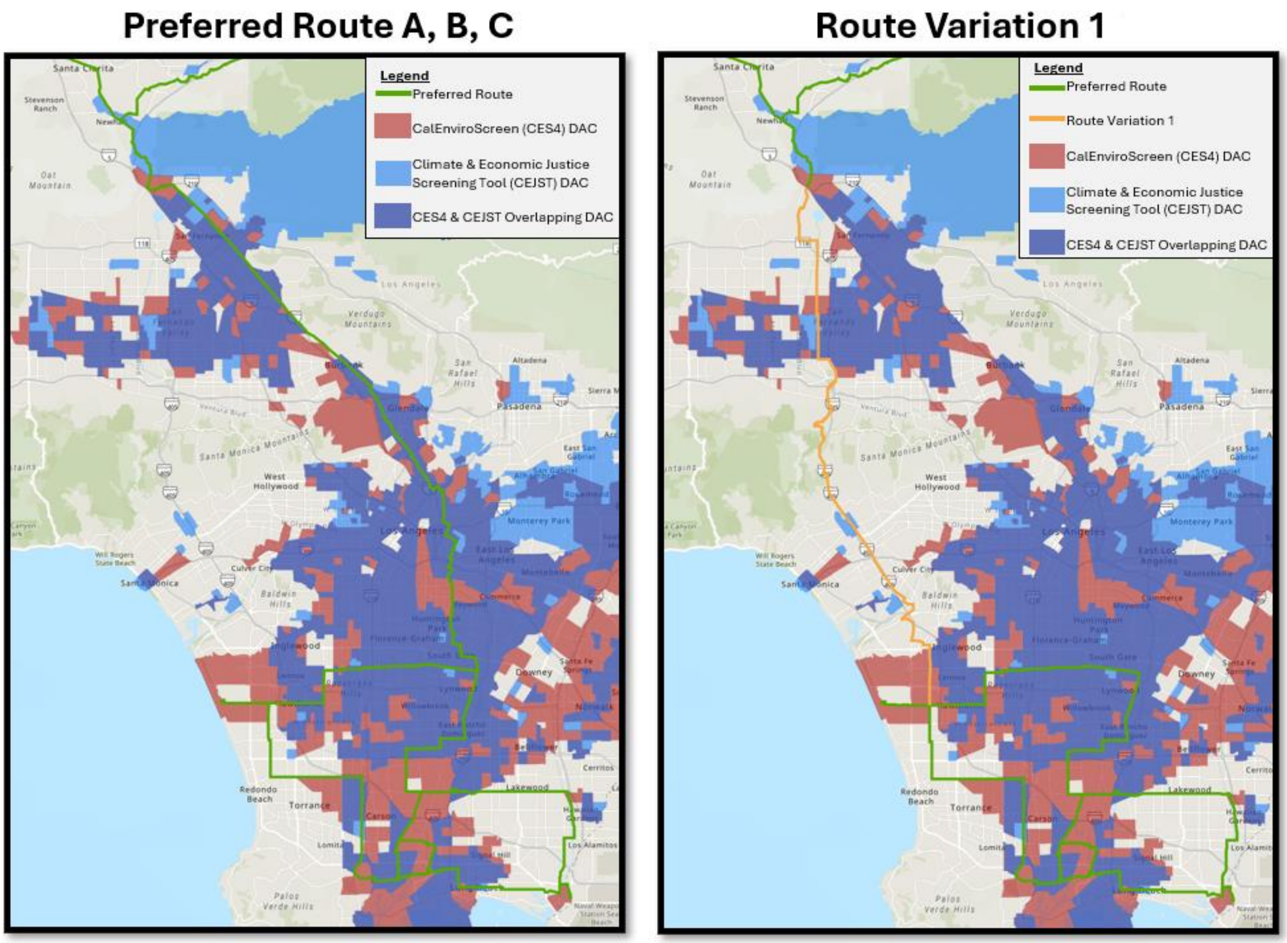

Figure 26. Illustration of Route Variation 1 and DAC[43]

4.2. Future Route Refinement and ESJ/DAC Considerations

As described in its ESJ Plan, SoCalGas proposes to meet with a broader range of stakeholders and utilize more community engagement strategies in Phase 2 to collaborate and seek input from DACs on route alignment. SoCalGas intends to convene route-specific regional stakeholder groups composed of community-based and environmental justice organizations, as well as other 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.

[43] DAC information extracted from ESJ Plan described in Section 4.1.

5. ROUTE CHARACTERIZATION

5.1. Overview

The preferred routes selected have the potential to achieve the objectives Angeles Link and can be characterized in multiple ways based on the route and its integration to the other Phase 1 Feasibility Studies. This information will be used for further evaluation in subsequent phases of Angeles Link.

5.1.1. Preferred Routes – Descriptions

Engineering Design Characteristics. Based on hydraulic analyses conducted in the Design Study, the preferred routes may have pipe diameters ranging from 16” to 36” and may require 2-3 compressor stations at 50,000 horsepower (hp) each to transport the throughput of 1.5 MMTPY. These preliminary design results were used to develop Class 5 estimates for the preferred routes that range from approximately $9-$14B. Refer to the Cost Estimates Chapter in the Design Study, for additional details.

Geographic Characteristics & Land. The Feature Evaluation described in Section 3.1 concluded that each preferred route, on average, is currently composed of approximately 40% urban areas, 53% rural land, and 7% mountainous terrain. The overall range of land type composition for the preferred routes are 38-45% for urban area, 48-56% rural land, and 6-8% mountainous terrain. Another geographic consideration is the class location, which can be used to guide pipeline design for varying population density and nearby infrastructure occupancy.[44] On average, a preferred route is composed of approximately 35% Class 1[45] location, 0.5% Class 2[46] location, 64% Class 3[47] location, and 0.5% Class 4[48] location. The overall range of class

[44] 49 CFR 192.5 -- Class locations. (n.d.-b). https://www.ecfr.gov/current/title-49/subtitle-B/chapter-I/subchapter-D/part-192/subpart-A/section-192.5

[45] Per 49 CFR 192.5(b)(1), Class Location 1 is any area that extends 660-feet on either side of the centerline of any continuous 1-mile length of onshore pipeline that has 10 or fewer buildings for human occupancy

[46] Per 49 CFR 192.5(b)(2), Class Location 2 is any class location unit that has more than 10 but fewer than 46 buildings intended for human occupancy

[47] Per 49 CFR 192.5(b)(3), Class Location 3 is any class location unit that has 46 or more buildings intended for human occupancy or any area where the pipeline lies within 300-feet of either a building or a small, well-defined outside area (such as a playground, recreational 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.)

[48] Per 49 CFR 192.5(b)(4), Class Location 4 is any class location unit where buildings with four or more stories are prevalent.

location composition for the preferred routes are 32-37% Class 1 location, 0.5% Class 2 location, 62-67% Class 3 location, and 0.5% Class 4 location.

A high-level desktop review of the SoCalGas transmission system concluded that, on average, approximately 96% of the total mileage of each preferred route was within approximately 50 feet of an existing SoCalGas high pressure pipeline asset. For each of the preferred routes, the percentage of the route that was identified in close proximity existing SoCalGas high pressure pipeline assets ranged from 94-98% of the total mileage of each route.

Based on the preliminary land rights analysis described in Section 3.2 and the current alignment of the routes, on average, approximately 41% of the total mileage of each preferred route was identified as potentially able to be located parallel to facilities for which SoCalGas has existing Direct Land Rights. For each of the preferred routes, the percentage of the route that was identified as potentially able to be located parallel to facilities for which SoCalGas has existing Direct Land Rights ranged from 36-48% of the total mileage of such route. If a broader spectrum of public rights of way within each of the preferred routes were considered,[49] the range of the preferred routes' percentage of total mileage within existing rights of way could potentially increase to 53-76% and would be on average, approximately 63% of the total mileage of each preferred route. These percentages are preliminary and subject to change based on the final alignment in subsequent phases of Angeles Link. Refer to Section 3.2 for additional Land Rights details and discussion.

The Production Study identified potential third-party underground storage locations in Central California, near the San Joaquin Valley (SJV) to balance projected fluctuations in production and demand. Since the preferred routes include the same potential SJV and Lancaster third-party hydrogen producers, they also share the same potential Central California storage prospects.

Social Characteristics. The Feature Evaluation described in Section 3.1 concluded that the preferred routes avoid physical conflicts with existing infrastructure and buildings, most landfills and hazardous waste sites, cultural and tribal resource areas,[50] and historic locations designated by the National Register of Historic Places.

An evaluation was also conducted to determine the distance of the preferred pipeline route alignments that traverses census tracts designated as disadvantaged communities (DACs) as defined by CalEnviroScreen and Climate & Economic Justice Screening Tool data. The distance of each preferred route that traverses DAC census tracts range from 69-81%. Rerouting the pipeline configuration in the LA Basin using the Route Variation 1 reduces the percentage of pipeline that traverse DAC census tracts to

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[49] Analysis inclusive of public rights of way, conducted separately as part of the Feature Evaluation.

[50] Cultural and tribal areas identified by Tribal Nations, Bureau of Indian Affairs, or State Historic Preservation Office. Refer to the Segment Attribute Glossary in Appendix A.

67% - 73%. The Route Variation 1 will be studied in more detail in Phase 2. Refer to Chapter 4 for details on Disadvantaged Communities (DACs) and Environmental Social Justice (ESJ) analyses, including proposed routing variation that would reduce the main pipeline distance routed through these communities.

System Zones. Table 4 below shows the various composition of the four preferred routes. As evaluated, each route is composed of preliminary segments that fall within the Connection, Collection, and Central Zones. Both potential production and demand may be accessed in every Zone.

Table 4. Preferred Routes A, B, C, D Segments and Zones

		Preferred Routes			
Zone	**Segment**	**A**	**B**	**C**	**D**
Connection	C *(ARCHES Segment)*	✓	✓	✓	✓
	R	✓	✓	✓	✓
Collection	B *(ARCHES Segment)*	✓	✓	✓	✓
	E		✓	✓	
	G				✓
	I				✓
	J				✓
	K	✓		✓	✓
	L	✓		✓	✓
	M		✓	✓	
	Y	✓	✓	✓	
Central	A	✓	✓	✓	✓
	D	✓	✓	✓	✓
	S	✓	✓	✓	✓
	T	✓	✓	✓	✓
	U	✓	✓	✓	✓
	V	✓	✓	✓	✓
	W	✓	✓	✓	✓
	Y	✓	✓	✓	✓

ARCHES Production and Offtake Sites. Each preferred route can be evaluated within the context of sites identified by ARCHES for potential hydrogen production or offtake. Table 5 below summarizes the number of preliminary production sites identified by

ARCHES[51] that are in close proximity to each configuration. Preferred Route Configurations A, B, and C can potentially access 5 ARCHES production sites located primarily in SJV and Lancaster areas. Preferred Route Configuration D can potentially access 7 sites located in SJV, Lancaster, and Riverside County areas. Figures 27 through 30 show the proximity of Preferred Route Configurations A, B, C, D to the ARCHES production sites.

Table 5. Preferred Route Specific Characterization Comparison

	Route Configuration			
Characterization	**A**	**B**	**C**	**D**
ARCHES Production Sites	5	5	5	7
ARCHES Offtake Sites	8	8	9	15
Demand Access, %	83%	83%	83%	92%

The number of preliminary offtake sites identified by ARCHES[52] located near each configuration is also summarized in Table 5. Preferred Route Configurations A, B, and C can potentially access 8 and 9 ARCHES offtake sites located primarily in southern SJV, Lancaster, and the LA Basin. Preferred Route Configuration D can potentially access 15 sites located in southern SJV, Lancaster, LA Basin, and Riverside County. Figures 26 through 29 shows the proximity of Preferred Route Configurations A, B, C, D to the ARCHES offtake sites.

[51] ARCHES H2, *Meet ARCHES* (October 2023), *available at:* https://archesh2.org/wp-content/uploads/2023/10/Meet-Arches_October-2023.pdf; DOE – Office of Clean Energy Demonstrations
[52] Ibid.

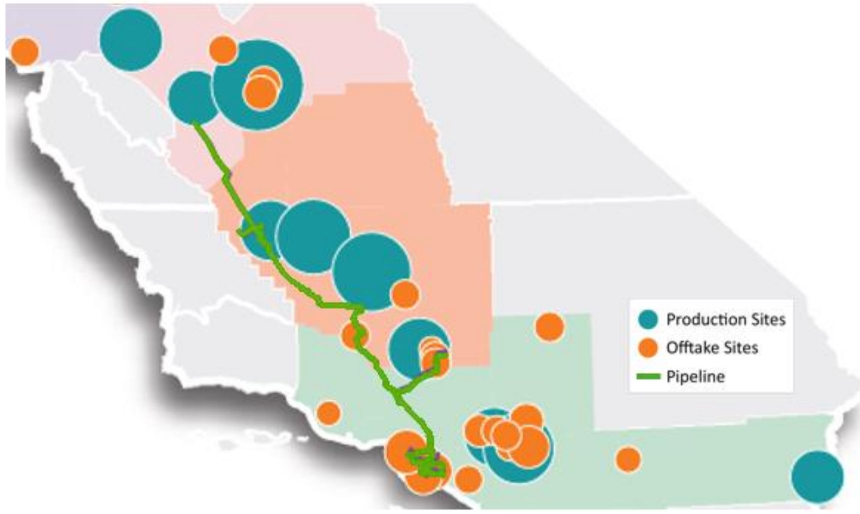

Figure 27. Preferred Route Configuration A and ARCHES Map

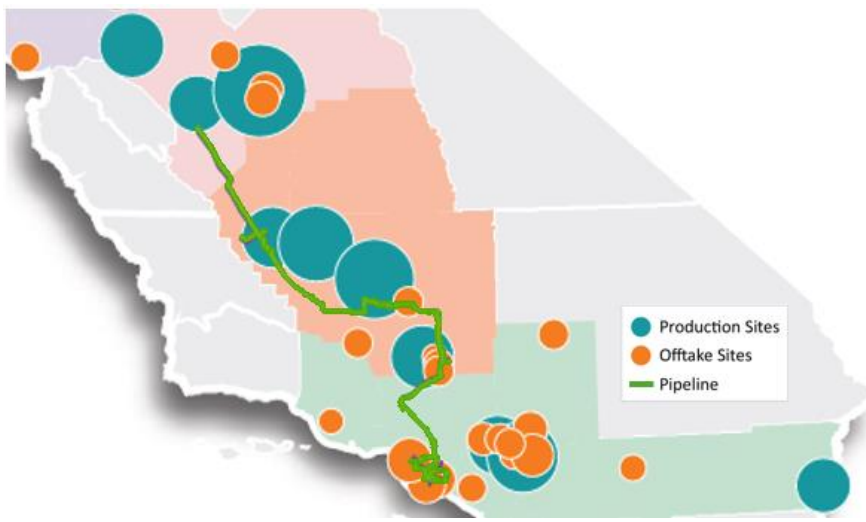

Figure 28. Preferred Route Configuration B and ARCHES Map

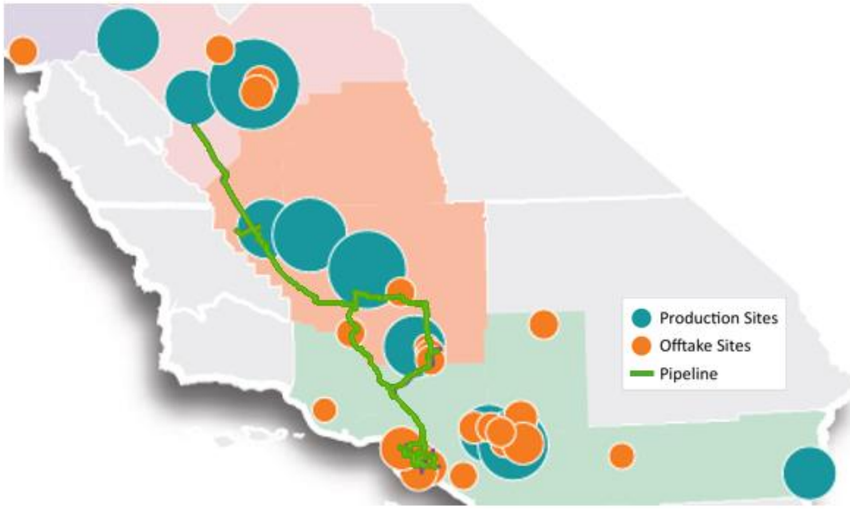

Figure 29. Preferred Route Configuration C and ARCHES Map

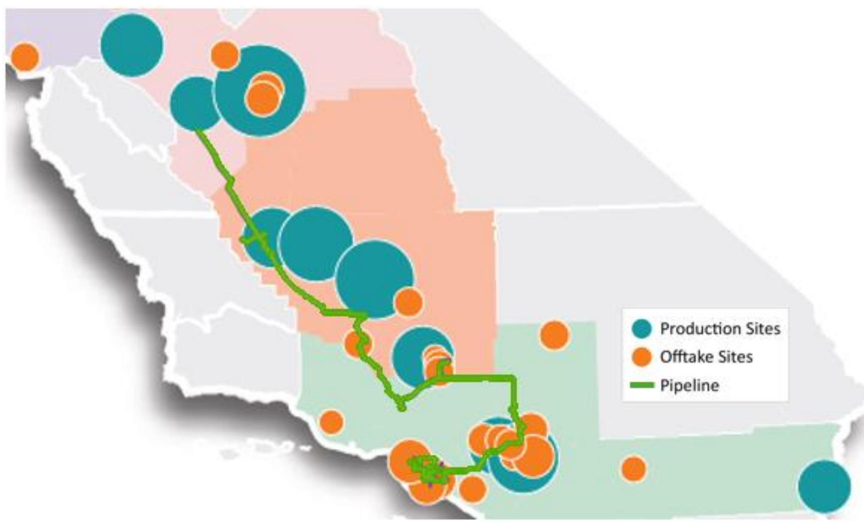

Figure 30. Preferred Route Configuration D and ARCHES Map

Demand Access. The Demand Study identified potential clean renewable hydrogen demand in Central and Southern California. The geographic distribution of this demand – specifically the 2045 Ambitious Demand Case – is illustrated below by percentage into geographic regions. Preferred Route Configurations A, B, and C are capable of accessing 83% of the total 2045 high demand projected in the Bakersfield, Lancaster, and Los Angeles geographic regions. Preferred Route Configuration D is capable of accessing 92% of the total 2045 high demand projected in the Bakersfield, Lancaster, Los Angeles, and Riverside geographic regions. Figure 31 shows a map of the Demand breakdown by geographic region and these percentages, as they apply per route, are included in Table 5.

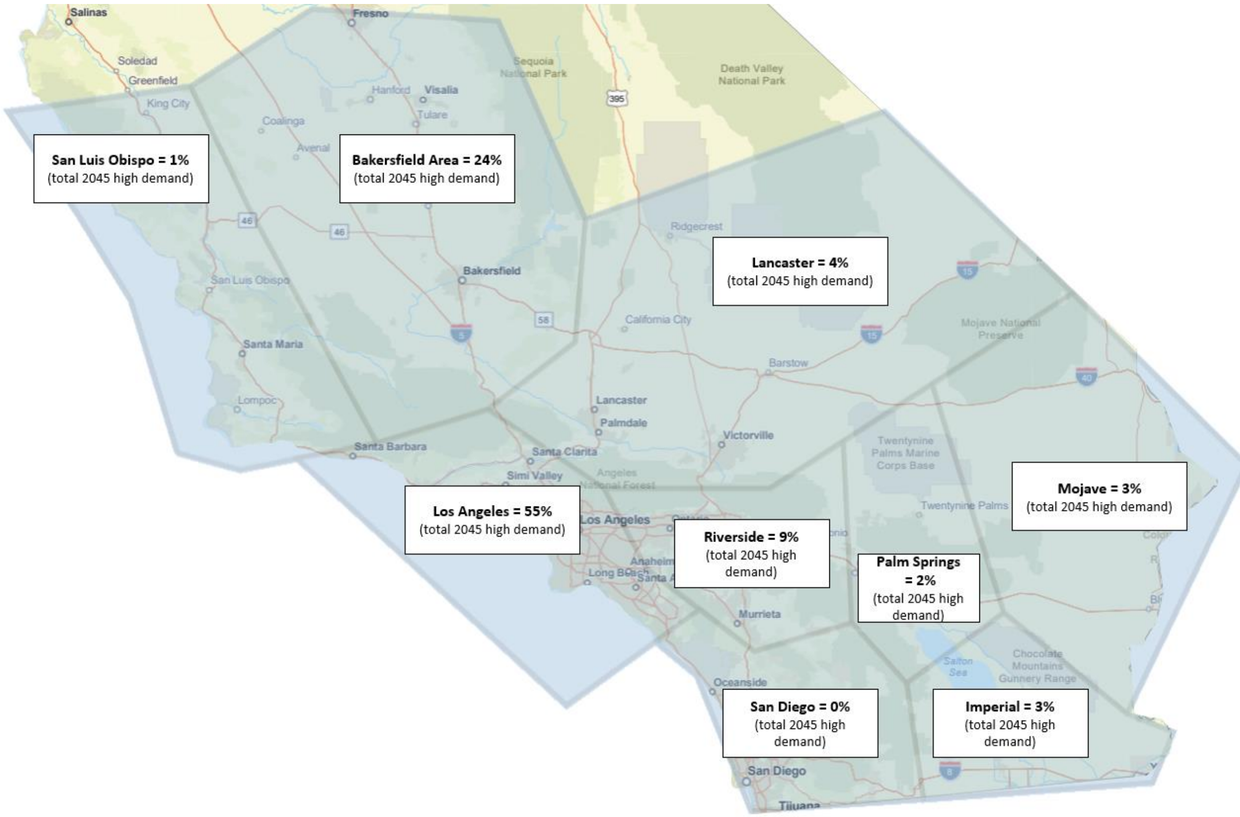

Figure 31. Demand by Geographic Region

5.1.2. Preferred Route – Geography

Preferred Route A

Preferred Route A starts in the San Joaquin Valley, approximately 40 miles southwest of Fresno, CA, near Interstate 5 and US 33. It heads southeast, roughly paralleling I-5 for 30 miles, then turns southwest near Avenal. Continuing southeast through Valley Acres and the San Gabriel Mountains, it roughly parallels I-5 to Valencia and Santa Clarita. Another section starts in Lancaster, goes south through Palmdale, and roughly parallels US 14 to Santa Clarita, connecting to the main route. The route then goes through Sylmar and Burbank, heading south to South Gate. It branches off, with one segment heading west to El Segundo, Lawndale, Carson, and ending in Wilmington, and the other through Compton and Long Beach, ending at the Port of Long Beach. Total route mileage is approximately 390 miles.

Figure 32. Preferred Route A Map

Preferred Route B

Preferred Route B also begins in the San Joaquin Valley, approximately 40 miles southwest of Fresno, CA, near I-5 and US 33. It heads southeast, roughly paralleling I-5 for 30 miles, then turns southwest near Avenal. Continuing southeast through Valley Acres, it then turns east for 25 miles to Lancaster. From there, it heads south through the San Gabriel Mountains to Valencia and Santa Clarita. It continues through Sylmar and Burbank, heading south to South Gate. It branches off, with one segment heading west to El Segundo, Lawndale, Carson, and ending in Wilmington, and the other through Compton and Long Beach, ending at the Port of Long Beach. Total route mileage is approximately 406 miles.

Figure 33. Preferred Route B Map

Preferred Route C

Preferred Route C combines routing from configurations A and B in a loop. One side roughly parallels I-5 through the San Gabriel Mountains to Valencia and Santa Clarita. The other side roughly parallels US 14 to Santa Clarita. The route begins in the San Joaquin Valley and ends at the Ports of Los Angeles and Long Beach. Total route mileage is approximately 472 miles.

Figure 34. Preferred Route C Map

Preferred Route D

Preferred Route D starts in the San Joaquin Valley and branches at Lancaster, heading further east to Victorville, then south to Cajon Junction, roughly paralleling I-15. It turns west near Fontana, southwest through Ontario Ranch and Chino Hills, then west through Yorba Linda and Anaheim. It continues west through Lakewood and Long Beach, ending at the Ports of Los Angeles and Long Beach. An additional branch starts in South Gate, heads west to El Segundo, then south through Lawndale and Carson, ending in Wilmington. Total route mileage is approximately 481 miles.

Figure 35. Preferred Route D Map

Route Variation 1

Route Variation 1 starts in Northern San Fernando Valley as a continuation of Preferred Routes A, B, and C[53], and replaces a portion of 42 miles of segment Y in the previously identified routes. Starting at approximately the Newhall Pass, the route variation roughly parallels I-405 and proceeds South through the Sepulveda Pass. In Hawthorne, the route rejoins the pipeline pathways identified in the Central Zone. Total route variation mileage is approximately 43 miles.

Figure 36. Route Variation 1 Map

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[53] Preferred Route D does not contain pipeline segments parallel to the I-5, as described in Section 5.1.2.

6. STAKEHOLDER FEEDBACK

SoCalGas presented opportunities for the PAG and CBOSG to provide feedback at four key milestones in the course of conducting this study: (1) the draft description of the Scope of Work, (2) the draft Technical Approach, (3) Preliminary Data and Findings, and (4) the Draft Report. These milestones shown in Table 6 below were selected because they are critical points at which relevant feedback can meaningfully influence the study.

Table 6: Key Milestone Dates

Milestone	Date Provided to PAG/CBOSG	PAG/CBOSG Comment Due Date	Responses to Comments in Quarterly Report[54]
1. Scope of Work	July 6, 2023	July 31, 2023	Q3 2023
2. Technical Approach	September 7, 2023	November 3, 2023	Q3 2023/Q4 2023
3. Preliminary Data and Findings	April 11, 2024	May 3, 2024	Q2 2024
4. Draft Report	July 19, 2024	August 30, 2024	Q3 2024

Feedback provided at the PAG and CBOSG meetings is memorialized in the transcripts of the meeting. Written feedback received is included in the quarterly reports, along with responses. Meeting transcripts are also included in the quarterly reports. The quarterly reports are submitted to the CPUC and are published on SoCalGas's website.

Feedback was incorporated as applicable at each milestone throughout the progression of the study. Some feedback was not incorporated for various reasons including feedback that was outside the scope of the Phase 1 Decision or study or feedback that would be addressed in future phases. A summary of stakeholder input that was incorporated throughout the development of the Routing Analysis and into this Final Report is provided in Table 7: Summary of Incorporated Stakeholder Feedback. All feedback received, whether incorporated into the study or not as described above, has been recorded in the quarterly reports, along with SoCalGas's responses.

[54] Each Quarterly Report can be found on SoCalGas's website. (SoCalGas Angeles Link website, https://www.socalgas.com/sustainability/hydrogen/angeles-link)

Table 7: Summary of Incorporated Stakeholder Feedback

Thematic Comments from PAG/CBOSG Members	Incorporation of and Response to Feedback
Pipeline Criteria Evaluation Stakeholders requested assumptions and results of pipeline features evaluated to be provided in the routing study.	Consistent with this feedback, Chapter 3 outlines the route evaluation assumptions, methodology, and pipeline features (or attributes) considered for the potential preferred route identification. The various engineering, environmental, and social attributes identified and evaluated for each pipeline segment is provided in Section 3.1, "Feature Evaluation." The definitions of each feature is provided in Appendix A, "Segment Attribute Glossary," and the Pivvot results for each individual segment evaluated is provided in Appendix B.
Land Use Stakeholders recommended additional analysis of existing energy infrastructure, potential land use and zoning constraints for potential pipeline routes.	In alignment with stakeholder comments, Section 3.2 of this study includes a preliminary analysis of existing Direct Land Rights and rights to use Rights of Way pursuant to a municipal franchise agreement. This analysis is based on the current preliminary routing of the pipeline segments and will be a basis for further exploration in subsequent phases as preferred routes are evaluated from a more granular perspective and new alignments options are determined. Refer to Section 3.2, "Land Rights" for more details.
Multiple Routing Scenarios Stakeholders requested multiple scenarios for pipeline routing to be examined that include a hub model and different ways of disaggregating production. Stakeholders also requested inter-state options evaluated to be marked distinctly from intra-state options, and assumptions to be identified.	In alignment with stakeholder comments, multiple scenarios and four preferred routes were evaluated as potential systems to deliver clean renewable hydrogen from the primary production locations identified to potential demand centers in Central and Southern California in Section 3.3.1 and Section 3.3.4, respectively. The scenarios and preferred routes contain exclusively intra-state pipelines and the study indicates if

Thematic Comments from PAG/CBOSG Members	Incorporation of and Response to Feedback
	inter-state analysis was performed such as for potential storage locations. Refer to the Production Study for details on assumptions on production locations. Refer to the Alternatives Study for details on the localized hub evaluation.
DAC and ESJ Impacts Stakeholders requested analysis of the potential routing pathways to already overburdened and disadvantaged communities (DACs). Stakeholders also requested minimizing potential impacts to overburdened DACs.	In consideration of stakeholder comments, a summary of how DACs and Environmental Social Justice (ESJ) communities were considered in Phase 1 routing analysis is described in Chapter 4. Refer to the ESJ Plan/Screening for details on how SoCalGas proposes to work with community-based organizations and DACs in Phase 2 to prioritize community engagement activities to inform route selection, mitigate potential impacts, and maximize benefits. In response to stakeholder comments to consider additional routing that could reduce potential impacts to overburdened communities, a new variation was added to the preliminary preferred routes (Route Variation 1) to illustrate potential routing modifications to be evaluated in Phase 2 to determine how DAC impacts may be reduced in the LA Basin. Refer to Section 4.1.1, "Route Variation – DAC Minimization" and Section 7.1, "Route Optimization" for additional details.
Connecting Producers and End-Users Stakeholders stressed the importance of connecting potential clean renewable hydrogen producers with end-users, such as municipal load centers and electric generation facilities, and providing access to hydrogen fueling along major	Consistent with these stakeholder comments, the scalability and connections to third-party producers and end-users is included in Section 7 as a future consideration to be further evaluated in Phase 2, as identified in Section 7.1, "Route Optimization". It is important to note that other viable routes

Thematic Comments from PAG/CBOSG Members	Incorporation of and Response to Feedback
transportation corridors and mobility hubs in the LA Basin.	may exist that were not identified in this analysis. The identification of potential preferred routes does not imply that these are the only or most advantageous options available. Examples of possible factors that will be thoroughly evaluated in Phase 2 before final preferred route is selected are: social and environmental impact, cost, safety, technical requirements, and energy needs.

7. FUTURE CONSIDERATIONS

7.1. Route Optimization

Route optimization is the process of determining the most efficient path for a pipeline, with consideration to a variety of factors that seek to avoid, minimize, and mitigate potential environmental and social impacts, costs, and risks while maximizing operational efficiency and safety. The key elements of route optimization include stakeholder impacts and land use, environmental considerations, safety and risk management, cost minimization, logistical and operational efficiency, technical feasibility, and future scalability. 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.

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 impacts to communities. These 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 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

A pipeline system like Angeles Link consists of many interconnected components that are designed to safely work together. During pre-FEED and FEED, these various components will be evaluated holistically to define a system route and develop a 30% engineering design of the route and associated facilities.

In Phase 2 of the Project, Pipeline routing will be advanced to a level of progressively higher detail and definition during pre-FEED and FEED activities. Detailed routing information supports the specification of critical pipeline characteristics such as diameter, grade, and wall thickness. During pre-FEED and FEED, the pipelines will be designed to meet or exceed applicable pipeline operating and safety standards, including those that may impact routing decisions, such as consideration of population density/class location, or material selection.[55]

Pipeline routing will be refined throughout Phase 2 following an iterative engineering process. Preferred routes identified within this report are relatively high-level and may look like bold lines on a map. In Phase 2, during pre-FEED, SoCalGas will identify a

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[55] Refer to the Angeles Link Phase 1 - Evaluation of Applicable Safety Requirements

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.

Potential route variations, which were not part of the initial corridors considered, would be further explored in subsequent phases of Angeles Link as appropriate. During the feasibility analysis conducted in Phase 1, data points were identified and PAG/CBOSG feedback received that that led to the inclusion of a Route Variation 1. Although route alignment was not an objective of this Feasibility Analysis, subsequent phases of Angeles Link will focus on determining pipeline alignment and minimizing impacts at a street-level using multiple siting features – social, engineering, and geological. An example of one of these areas identified for further exploration is in LA Basin.

Route Variation 1 follows the footprint of existing SoCalGas high pressure pipeline facilities from San Fernando Valley to Hawthorne. The initial Preferred Route alignment of the route along I-5 South was chosen for evaluation as it is located closer to potential offtake facilities and passes through more level terrain. During Phase 2, the Route Variation 1 and other potential routes that differ in alignment from what is currently identified in this report, will be studied for siting potential.

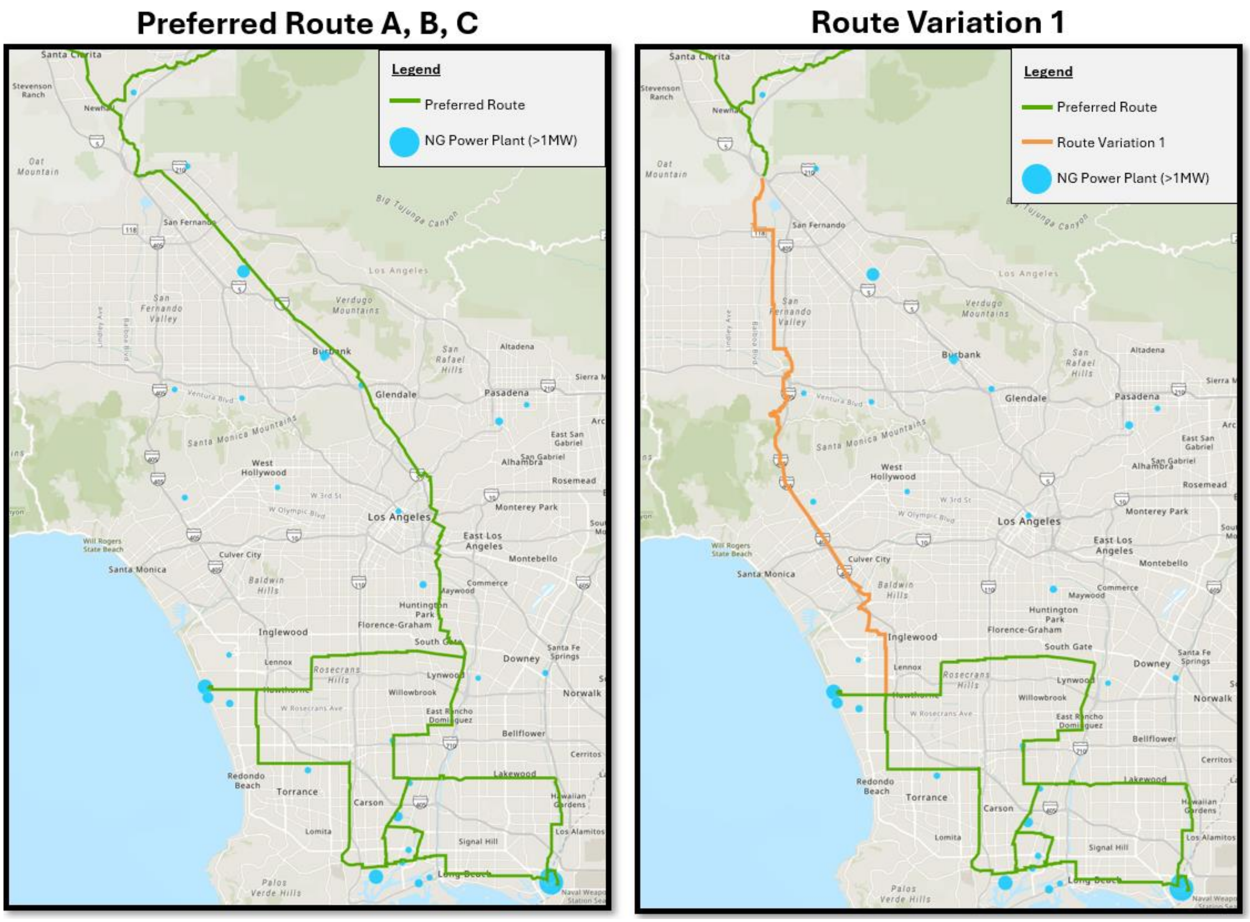

Figure 37. Illustration of Route Variation 1 and Power Plants (Natural Gas as Primary Energy Source)[56]

While this section identifies potential route variation, it is important to note that other viable options may exist that were not identified in this analysis. The identification of this variation does not imply it is the only or most advantageous option available. Numerous factors, including social and environmental impact, cost, safety, technical engineering, and logical considerations, must be thoroughly evaluated before final siting of a route.

7.2. Future Siting Analysis

In Phase 2, as a preferred route is selected, a detailed analysis of pipeline siting and land rights options (e.g., Rights of Way, Direct Land Rights, as well as new easements or licenses) for the proposed pipeline will be conducted for the selected configuration and any route variation(s). Future considerations will evaluate existing land rights and

[56] California power plants. (n.d.-b). https://gis.data.ca.gov/datasets/4a702cd67be24ae7ab8173423a768e1b_0/about

infrastructure, identify potentially complex ownership interests, title exceptions, concurrent usage or specific land use restrictions, and additional title due diligence and property surveys may be performed to develop further detailed refinement and a preliminary land acquisition plan.

7.3. Weighted Evaluation

This Routing Analysis conducted during the feasibility stage of Angeles Link, evaluated potential routes from a broad system perspective to identify those with the highest overall potential of connecting clean renewable hydrogen production with potential offtake. A weighted ranking system was not employed to evaluate the potential routes as the level of detail was premature for an accurate down-selection process to be employed and would have increased the risk of potentially overlooking options of greater performance ability.

In subsequent phases of the project, analysis of more detailed and precise data will allow ranking and scoring to be conducted based on specific features. This approach delivers a higher degree of accuracy and will allow for continued engagement with stakeholders for feedback and revision.

7.4. Large-Scale Local Infrastructure Initiatives

The identification and consideration of other on-going or planned large-scale infrastructure projects or initiatives expected to occur over the next five years holds value to the planning of Angeles Link. A comprehensive understanding of these events and projects will allow for strategic planning, coordination, collaboration, and risk management.

Resource allocation planning is an important consideration, as substantial labor, equipment, and materials are typically needed for infrastructure projects. Awareness of other project plans creates the ability to anticipate demand and strategically plan for appropriate resource allocation, including identifying and addressing any potential conflicts or opportunities with regard to physical project siting during the early stages of project planning.

Another important factor is the opportunity for coordination and identifying overlapping construction zones. Multiple projects planned in close proximity or within the same timeframe may lead to opportunities to share infrastructure such as access roads or staging areas. Identification of potential conflicts, such as overlapping construction zones allows for additional flexibility to be built into the project for adaptability, thereby managing risks more effectively throughout the execution of projects. This collaborative approach can lead to significant cost savings and reduced potential environmental and social impacts. It may also support synchronization of timelines and logistics to minimize disruption for local communities and more seamless project execution.

For example, known future infrastructure projects and events local to Central and Southern California could include the following:

- **Los Angeles 2028 Olympics**[57]
- **Brightline West**[58]
- **CA High-Speed Rail**[59]
- **LA Metro –** D Line Subway Extension Project[60]
- **LA Metro –** K Line Northern Extension[61]
- **LA Metro –** Sepulveda Transit Corridor[62]

[57] Los Angeles will host the 2028 US Summer Olympic Games
[58] Project Overview | Brightline West. (n.d.). https://www.brightlinewest.com/overview/project - A 218-mile passenger rail service planned to operate from Rancho Cucamonga, California to Las Vegas.
[59] About California High-Speed Rail | California High-Speed Rail Authority. (n.d.). https://hsr.ca.gov/about/high-speed-rail-authority/ - The California High-Speed Rail (HSR) project is a transportation initiative aimed at connecting Northern California to Southern California.
[60] D Line Subway Extension Project | LA Metro. (n.d.). https://www.metro.net/projects/westside/ - Extension of the subway from Wilshire/La Brea Station through Westwood/UCLA Station and is located in Central LA and Westside Cities
[61] Metro K Line Northern Extension | LA Metro. (n.d.). https://www.metro.net/projects/kline-northern-extension/ - Connect existing systems between Baldwin Hills and Hollywood
[62] Sepulveda Transit Corridor Project | LA Metro. (n.d.). https://www.metro.net/projects/sepulvedacorridor/ - Project evaluates the Sepulveda Pass for creation of transit options

8. CONCLUSION

Angeles Link is proposed to support California's transition towards sustainable energy infrastructure by laying down the first steps of a pipeline network to transport clean renewable hydrogen from various production sources to delivery points in the Los Angeles Basin, which span from the Ports of Los Angeles and Long Beach, to the broader Central and Southern California region.

The Routing Analysis is crucial to identify preliminary hydrogen pipeline route pathways. To reflect a connected analysis, information from other feasibility studies were incorporated, such as from the Production and Demand Studies. Results of this Routing Analysis will aid in developing a preferred system route in Phase 2, including engineering designs based on one preferred route configuration. SoCalGas estimated direct pathways for connecting clean renewable hydrogen producers to consumers, which concluded that preferred routing configurations would be approximately 450 miles in length.[63]

Further, aligning with the ARCHES mission to develop hydrogen infrastructure and a state-wide hydrogen hub, SoCalGas considered how the Angeles Link aligns with ARCHES hydrogen infrastructure placement to determine hydrogen pipeline locations in this Routing Analysis. As a result, the Routing Analysis aligned multiple segments of the proposed pipeline routing configurations with those Angeles Link segments included in ARCHES.

Integral to the planning process were the matrices developed for each of the 25 pipeline segments, which served as comprehensive tools for evaluating route development, assessing high-level engineering, environmental, and geographical attributes. These matrices incorporated a range of factors, including geological conditions, regulatory requirements, stakeholder suggestions, and potential community impacts.

Preliminary routes A, B, C, and D emerged as preferred route configurations as follows:

- Their alignment with the purpose and need of Angeles Link is supported by their ability to connect areas of high clean renewable hydrogen production potential to areas of concentrated demand;
- The layout of these routes supports reliability and resiliency of system planning in alignment with regional zones, alignment with ARCHES, and connect SoCalGas's ARCHES Projects, Segments B and C;
- Routes traverse less than 500 miles (and on average span 450 miles), to efficiently access and deliver a capacity up to 1.5 MMTPY; and
- Route Variation 1 was also added for further analysis in Phase 2 due to its potential to minimize traversing disadvantaged communities in the LA Basin.

[63] Average route mileage of final four preferred routes identified.

These route configurations represent high-level preliminary pathways for the Angeles Link system and will be evaluated in subsequent phases to reduce disruptions to communities and ecosystems while maximizing accessibility to key demand centers and existing infrastructure with potential for hydrogen use. The preliminary routes are subject to change based on additional information and continued developments in the hydrogen economy in Central and Southern California. The data compiled, analyzed, and evaluated within this report serves as the basis for pre-FEED and FEED evaluation for Angeles Link in Phase 2.

9. GLOSSARY

Alliance for Renewable Clean Hydrogen Energy Systems (ARCHES) – A public-private partnership to create a sustainable, statewide, clean hydrogen hub in California utilizing local renewable resource to produce hydrogen with the objective to fully decarbonize the regional economy, while prioritizing environmental justice, equity, economic leadership and workforce development.

Alternative Fuel Corridors (AFC) – Federal Highway Administration designated alternative fuel corridors to support installation of EV charging, hydrogen, propane, and natural gas fueling infrastructure at strategic locations along major national highways. These corridors are updated and redesignated on an annual basis by soliciting nominations from State and local officials. This recurring process responds to the rapidly evolving state of vehicle technology, increased market adoption, and installation of infrastructure related to the use of alternative fuels.[64]

Alternative Fuels Data Center (AFDC) – A joint effort between the United States Department of Energy (DOE) and the United States Department of Transportation (DOT) to establish a national network for alternative fueling and electric vehicle charging infrastructure along national highway network corridors.

California Public Utilities Commission (CPUC) – Regulates services and utilities, protects consumers, safeguards the environment, and assures Californians' access to safe and reliable utility infrastructure and services.[65]

Corridors – A linear geographic pathway where existing utilities are already installed or have the potential to be installed in the future. In the context of this report, corridors are pathways that may contain existing or future rights-of-way (see definition below) that have been identified for preliminary evaluation and the potential installation of hydrogen gas transmission lines.

Direct Land Rights – For purposes of this report, easements, licenses or other rights to use the surface of, and the space above and below land owned or controlled by a private individual or entity, a public entity or a public utility for the purpose of installing, operating, repairing, and maintaining pipelines and related facilities and equipment.

Disadvantaged Communities (DACs) - Areas disproportionately affected by environmental pollution and other factors that can lead to negative public health, concentrations of people that are of low income, high unemployment, low levels of

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[64] Alternative Fuel Corridors - Environment - FHWA. (n.d.-b). https://www.fhwa.dot.gov/environment/alternative_fuel_corridors/

[65] California Public Utilities Commission. (n.d.). What industries does the CPUC regulate? In California Public Utilities Commission. https://www.cpuc.ca.gov/-/media/cpuc-website/about-cpuc/documents/transparency-and-reporting/fact_sheets/cpuc_overview_english_030122.pdf

home ownership, high rent burden, sensitive populations, or low levels of educational attainment.

Federal Highway Administration (FHWA) - An agency within the U.S. Department of Transportation that supports State and local governments in the design, construction, and maintenance of the Nation's highway system (Federal Aid Highway Program) and various federally and tribal owned lands (Federal Lands Highway Program).[66]

Front-End Planning (FEP) - A critical process for uncovering project unknowns while also developing adequate scope definition and a structured approach for the project execution process. For infrastructure projects, the FEP process assists in identifying and mitigating risks stemming from issues such as right-of-way concerns, utility adjustments, environmental hazards, logistic problems, and permitting requirements. [67]

Front-End-Engineering and Design (FEED) - The process through which the engineering design of the system route identified during pre-FEED is advanced to 30% design level, which would support a Class 3 estimate.

Geographic Information Systems (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.

Hard-to-electrify sectors - Those sectors of the economy that are difficult or costly to switch from fossil fuels to electricity as a source of energy. These sectors include heavy industry, aviation, shipping, and long-distance road transport. These sectors account for a significant share of California's greenhouse gas emissions and pose a challenge for achieving the state's decarbonization goals.

High Consequence Areas (HCA) -Unusually sensitive environmental areas (defined in 49 CFR 195.6), urbanized areas and other populated places (delineated by the Census Bureau), and commercially navigable waterways.[68]

High Speed Rail (HSR) - Definition of high-speed rail is relative and varies from country to country. The U.S. Federal Railroad Administration uses a speed of 110 miles per hour as the threshold for its minimum high-speed designation.[69]

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[66] About FHWA. (n.d.). FHWA. https://highways.dot.gov/about/about-fhwa
[67] Infrastructure project SCOPE DEFINITION USING project definition rating index | request PDF. (n.d.-f). https://www.researchgate.net/publication/305788839_Infrastructure_Project_Scope_Definition_Using_Project_Definition_Rating_Index
[68] HL Im fact sheet. PHMSA. (n.d.-b). https://www.phmsa.dot.gov/pipeline/hazardous-liquid-integrity-management/hl-im-fact-sheet
[69] Environmental and Energy Study Institute (EESI). (n.d.). High speed rail: Benefits, costs, and challenges. EESI. https://www.eesi.org/briefings/view/high-speed-rail-benefits-costs-and-challenges

Horizontal Directional Drill (HDD) - Construction contractors attach steerable drill bits, reamers, tracking and monitoring devices and other tools to the end of a drill pipe string, then slowly drill a hole underneath an obstacle from one side to the other along a path that has been carefully evaluated, permitted, and designed by engineers and scientists.[70]

Matrix - A table that lists various evaluation criteria for determining the best route for a pipeline. In the context of this report, each matrix evaluates a specific segment of the overall ALP pipeline network.

National Highway System (NHS) - Consists of roadways important to the nation's economy, defense, and mobility.[71]

National Pipeline Mapping System (NPMS) - A dataset containing locations of and information about gas transmission and hazardous liquid pipelines and Liquefied Natural Gas (LNG) plants which are under the jurisdiction of the Pipeline and Hazardous Materials Safety Administration (PHMSA).

Non-discriminatory – In reference hydrogen pipeline infrastructure, this describes that it is accessible to all potential hydrogen end-users consistent with a published tariff. Accordingly, the term could be used interchangeably with the term "open access". When contracting with an open access, non-discriminatory pipeline system, customers have access to similar contracts. An alternative to this could be a "private carrier".

Open Access - Refers to a regulatory mandate to allow others to use a utility's transmission and distribution facilities to move bulk power from one point to another on a nondiscriminatory basis for a cost-based fee[72]. Accordingly, the term could be used interchangeably with the term "non-discriminatory". When contracting with an open access, non-discriminatory pipeline system, customers have access to similar contracts. An alternative to this could be a "private carrier".

Pipeline and Hazardous Materials Safety Administration (PHMSA) - 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.

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[70] Horizontal directional drilling HDD operations white Paper.pdf. (n.d.-d). https://www.api.org/-/media/APIWebsite/oil-and-natural-gas/primers/Horizontal%20Directional%20Drilling%20HDD%20Operations%20White%20Paper.pdf

[71] National Highway System. FHWA. (n.d.). https://www.fhwa.dot.gov/planning/national_highway_system/

[72] Auth, T. (n.d.-c). Glossary of Acronyms and other Frequently used terms. https://www.cpuc.ca.gov/news-and-updates/newsroom/glossary

Pivvot - A third-party cloud-based application that allows a pipeline route to be identified, studied, reviewed, and refined based on hundreds of data sources available within the software.

Private Carrier - Would agree to transport goods under particular circumstances and would contract with each customer - without the assumption that a similar contract will be available to the next customer.

Rights-of-Way (ROW) - For purposes of this report, Rights-of-Way refer to the surface of, and the space above and below, any public street, alley, bridge, or other route of public travel or utility transport, for which a municipality (city or county) can grant rights of use for the purpose of installing, operating, repairing, and maintaining a pipeline system and related facilities and equipment.

Route - A pathway that a pipeline system or segment may follow. In the context of this report, routes represent potential pathways for a pipeline from third-party production and storage of clean renewable hydrogen to the delivery point, or customer. Routes may vary in level of detail.

Segment - In the context of this report, a segment represents a potential portion of the Angeles Link pipeline system. Typically, a segment is referenced to discuss the engineering analysis and siting evaluation performed with respect to that specific length of pipeline.

United States Department of Energy (DOE) - Manages the United States' nuclear infrastructure and administers the country's energy policy.[73]

United States 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.

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[73] U.S. Department of Energy (DOE): Usagov. U.S. Department of Energy (DOE) | USAGov. (n.d.). https://www.usa.gov/agencies/u-s-department-of-energy

10. APPENDICES

Appendix A: Segment Attribute Glossary

Appendix B: Segment Matrices

Appendix C: Segment Mileage Summary Table

Table C.1. Approximate Segment Mileage

Segment	Phase 1 Preliminary Segment Mileage
Segment A	28
Segment B	46
Segment C	80
Segment D	8
Segment E	31
Segment F	153
Segment G	39
Segment H	92
Segment I	32
Segment J	60
Segment K	55
Segment L	10
Segment M	51
Segment N	78
Segment O	53
Segment P	51
Segment Q	123
Segment R	82
Segment S	9
Segment T	9
Segment U	7
Segment V	3
Segment W	5
Segment X	125
Segment Y	49
Total	**1,277**