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Chapter: 2

PREPARED DIRECT TESTIMONY OF

GREGORY TEPLOW

ON BEHALF OF SOUTHERN CALIFORNIA GAS COMPANY

AND SAN DIEGO GAS & ELECTRIC COMPANY

(WEATHER DESIGN AND RESIDENTIAL FORECAST)

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CHAPTER 2

PREPARED DIRECT TESTIMONY OF GREGORY TEPLOW

(WEATHER DESIGN AND RESIDENTIAL FORECAST)

I. PURPOSE

The purpose of my prepared direct testimony is to: (1) present the weather design used in the forecasts of the weather-sensitive market segments, and (2) present the average temperature year, cold temperature year, peak day, and peak month gas demand forecasts for the Triennial Cost Allocation Proceeding (TCAP) period, years 2020 through 2022, for Southern California Gas Company's (SoCalGas) and San Diego Gas & Electric Company's (SDG&E) residential markets.

II. SOCALGAS WEATHER DESIGN

This section discusses the temperature assumptions that underlie the forecasts for gas demand for SoCalGas' temperature-sensitive market segments and presents the temperature design values for average year and cold year weather. This section also discusses the temperature design values used to forecast peak day gas demand for the temperature-sensitive market segments.

A. SoCalGas Average Year and Cold Year Weather Design

Temperature variations can cause significant changes in winter gas demand due to space heating, principally in the residential and commercial markets. Recognizing this, the gas demand forecasts are prepared for two temperature designs—average and cold—to quantify changes in demand due to cold weather. SoCalGas creates these temperature designs using the concept of a

Heating-Degree-Day (HDD),[1] a measure of the coldness of a month or year. One HDD is accumulated, daily, for each degree that the daily average temperature is below 65 degrees Fahrenheit (°F).

The Average Year and Cold Year scenarios are calculated and defined in terms of HDD. In this TCAP, the simple average of the calendar-year HDD totals for the 20-year period from 1998 through 2017 has been calculated to arrive at the Average Year HDD value of 1,320 HDD. The Cold Year HDD value is calculated according to the criterion that it is expected to be exceeded with an average frequency of once out of every 35 years. Based on this criterion, the Cold Year HDD value is calculated as 2.025 standard deviations more than the Average Year HDD. The resulting Cold Year HDD value is 1,594 HDD. In this TCAP, the standard deviation has been calculated using an approach that compensates for the annual HDD values for the years 2014-2017 in SoCalGas' service territory being dramatically lower than in any preceding year going back to 1950. Ignoring this warm weather and using a typical standard deviation calculation[2] for HDD based on the 20-year period 1998-2017 produces a number that is excessively large,[3] leading to an unrealistically high Cold Year HDD value. Instead, the

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[1] For SoCalGas, daily values of system-wide average temperatures are calculated from a six-zone temperature monitoring procedure. From this daily system average temperature data, a corresponding daily value of Heating Degrees (HD) is computed from the formula, HD = max{0, 65-T}, where T is the daily system average temperature. For each calendar month, the accumulated number of HD is determined, upon which an annual total is calculated. Accumulated values of HD for a specified number of days (>1) are called Heating-Degree-Days (HDD).

[2] The typical calculation for the standard deviation is:

$$standard\ deviation = \sqrt{\frac{1}{n-1}\sum_{i=1}^{n}(x_i - \bar{x})^2}$$

[3] A typical standard deviation calculation for the 20 years before the change to the current warm weather regime (years 1994-2013), results in a standard deviation of 145.5. The same calculation for the most recent 20 years (years 1998-2017), results in a standard deviation of 236.4, an increase of 62%. Using this

standard deviation proposed for this TCAP is calculated based on an HDD dataset that controls for the switch to the warm weather regime that began in the year 2014. In this dataset, the annual HDD values for the years 2014-2017 have been adjusted higher to account for a shift in the level of annual HDD[4] and then combined with the unadjusted, actual annual HDD values for the preceding years 1998-2013. The standard deviation calculation has been performed using this adjusted dataset.[5] Finally, this standard deviation estimate is multiplied by 2.025, as previously described, and added to the Average Year HDD value to arrive at the Cold Year HDD value of 1,594 HDD.

Monthly rounded HDD for the Cold Year and Average Year Designs are shown below in Table 1.[6]

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approach would therefore imply that, on an annual basis, cold weather had become much more volatile since 2013.

[4] A regression with a time trend and a dummy variable for the years 2014-2017 has been used to estimate the shift in the level of annual HDD that occurred in 2014. A dummy variable takes the value one for some observations to indicate the presence of an effect or membership in a group and zero for the remaining observations. Estimating the effect of the dummy variable gives an estimate of that effect or the impact of membership in that group. A dummy variable is used here to estimate the average effect on annual HDD of a given year having membership in the group of years 2014-2017. The dataset is SoCalGas system-wide annual HDD for the years 1998-2017. The regression equation is:

$$HDD_t = \alpha + \beta * t + \beta_{2014-2017} * D_{2014-2017} + \varepsilon$$

where $D_{2014-2017}$ is a dummy variable for the years 2014-2017 and $\beta_{2014-2017}$ is the corresponding dummy coefficient. This regression equation estimates average HDD over the period 1998-2017 controlling for time trends in HDD and the warm weather regime of years 2014-2017. It's important to note that p-value for the estimate of $\beta_{2014-2017}$ is 0.11% indicating an extremely low probability that membership in the group of years 2014-2017 had no effect on annual HDDs.

The dummy variable's estimated effect, $\beta_{2014-2017}$, is subtracted from the actual annual HDD data for years 2014-2017 to adjust the data to remove the level shift.

[5] The resulting standard deviation is 135.1.

[6] The monthly values for Average Year HDD were calculated as the arithmetic average of the respective month's 20 years of observed monthly HDD. The monthly values for the Cold Year HDD were calculated by multiplying a proportion for each calendar month times the Cold Year HDD annual value. The proportion for each calendar month is that month's HDD total relative to the annual HDD total based on the Average Year data.

Table 1
SoCalGas Heating Degree Days Weather Design

Month	Cold Year 1-in-35 Design	Average Year 1-in-2 Design[7]
January	323.3	267.8
February	276.4	228.9
March	207.5	171.8
April	149.1	123.5
May	59.7	49.4
June	14.5	12.0
July	2.6	2.1
August	2.2	1.8
September	5.6	4.6
October	40.0	33.1
November	165.5	137.1
December	347.6	287.9
	1,594	1,320

B. SoCalGas Peak Day Temperature Designs

SoCalGas plans and designs its system to provide continuous service to its core (retail and wholesale) customers under an extreme peak day event.[8] The extreme peak day design criterion is defined as a 1-in-35-year event;[9] this corresponds to a system average temperature of 40.3°F, or 24.7 HD, on a peak day. Although the gas demand for most of SoCalGas' noncore retail markets is not HDD-sensitive, the noncore commercial segment does exhibit a small but statistically significant HDD load sensitivity. For such SoCalGas noncore markets, SoCalGas

[7] SoCalGas also refers to the Average Year HDD data (monthly or annual) as a "1-in-2" design because the average or expected value has the characteristic that there is a 50% (*i.e.*, 1-in-2) chance of observing a larger value.
[8] The temperature SoCalGas uses to define a peak day is determined from an analysis of the annual minima of SoCalGas' daily system-average temperatures. These temperatures are used to estimate a probability model for the annual minimum daily temperature. The extreme peak day temperature value is determined from a calculation using this estimated model such that the chance we would observe a lower value than this extreme peak day temperature is 1/35 or about 2.86%.
[9] System planning criterion ordered by CPUC decision D.02-11-073.

uses a less extreme, but more frequent, 1-in-10-year likelihood peak day temperature[10] of 42.0°F, or 23.0 HD.

III. SOCALGAS RESDENTIAL GAS DEMAND FORECASTS (2020 – 2022)

SoCalGas is the principal distributor of natural gas in Southern California, providing retail and wholesale customers with transportation service, and for some customer classes, commodity procurement and storage service. Among SoCalGas' customer groups, residential customers comprise the greatest number of customers and, within the core market, the bulk of demand for natural gas. The forecast of natural gas demand for these residential customers follows.

A. SoCalGas Forecasted Residential Customer Growth

Active residential meters averaged 5.5 million in 2017, an increase of about 0.775% from the 2016 average. SoCalGas uses econometric and statistical techniques to develop forecasts of residential meter counts. As provided in Chapter 5 (Guo) and replicated in Table 2 below, during the TCAP period of 2020 through 2022, SoCalGas' active residential customer base is expected to grow at an average annual rate of 0.89%, reaching nearly 5.8 million active meters by 2022. A small sector of the residential class, master meters (including sub-metered customers), is forecasted to decline at a steady 0.65% annual rate.[11]

Table 2

SoCalGas Active Residential Meters (annual averages)

	2020	2021	2022	3-Year Avg. 2020-2022
Residential	5,663,352	5,714,082	5,766,159	5,714,531

[10] System planning criterion ordered by CPUC decision D.02-11-073.
[11] This decline reflects the fact that all units in new multi-family construction or conversions are now required to have individual meters.

B. SoCalGas Forecasted Annual Residential Gas Demand

Over the TCAP period, SoCalGas expects a reduction in gas demand for residential customers. Temperature-adjusted residential demand is projected to decline from 238,159 Mdth in 2020 to 230,889 Mdth in 2022, a decrease of about 7,270 Mdth or 1.54% per year. This forecast reflects the demand reductions from SoCalGas' Advanced Metering Initiative (AMI) described in Commission Decision (D.) 10-04-027, as well as the effects of SoCalGas' energy efficiency programs. Table 3 provides the annual throughput forecasts for the residential market using the HDD conditions discussed in Section II.

Table 3

SoCalGas Residential Throughput (Mdth) Average and 1-in-35 Cold Temperature Year

		2020	2021	2022	3-Year Avg. 2020-2022
Residential	Average Temp Year	238,159	234,857	230,889	234,635
	1-in-35 Cold Temp Year	261,905	258,692	254,739	258,445

C. SoCalGas Residential Peak Day and Peak Month Demand

As discussed in Section II, the extreme peak day design criterion, which is defined as a 1-in-35 annual event, corresponds to a system average temperature of 40.3°F. For peak month planning, December demand is used because December has generally been the coldest month in SoCalGas' service territory based on more than 20 years of weather records. Tables 4 and 5 below show the forecasted residential peak day demand and cold design-temperature-year peak month demand.

Table 4

1-in-35 Annual Likelihood (40.3°F System Avg. Temperature) Peak Day Demand in Mdth/day

	2020	2021	2022	3-Year Avg. 2020-2022
Residential	2,437	2,419	2,395	2,417

Table 5

Cold Design Temperature Year: Peak Month Demand (Mdth)

	2020	2021	2022	3-Year Avg. 2020-2022
Residential	39,817	39,328	38,727	39,291

IV. SDG&E WEATHER DESIGN

This section discusses the temperature assumptions that underlie the forecasts for gas demand for SDG&E's core market segments and presents the temperature design values for average year and cold year weather. This section also discusses the temperature design values that are used to forecast the peak day gas demand for SDG&E's temperature-sensitive market segments.

A. SDG&E's Average Year and Cold Year Weather Design

As with SoCalGas, the core demand forecasts for SDG&E are prepared for two temperature designs —average and cold—to quantify changes in space heating demand due to weather. HDD for SDG&E are defined similarly as for SoCalGas but use a daily system-average temperature calculated from a weighted-average of three weather station locations in SDG&E's service territory.

The Average and Cold Year scenarios for SDG&E are calculated using the same methodologies used for SoCalGas. SDG&E's service territory experienced a similar switch to a warm weather regime beginning in the year 2014. To address this, the SDG&E Cold Year scenario was calculated using the same approach as for SoCalGas. The resulting Average Year HDD value is 1,246 HDD and the resulting Cold Year HDD value is 1,515 HDD.

Monthly HDD values[12] are shown in Table 6.

Table 6
SDG&E Heating Degree Days Weather Design

Month	Cold Year 1-in-35 Design	Average Year 1-in-2 Design
January	307.5	252.9
February	264.1	217.2
March	214.2	176.2
April	151.3	124.5
May	65.2	53.6
June	15.2	12.5
July	0.9	0.8
August	0.1	0.1
September	1.4	1.1
October	28.8	23.7
November	146.5	120.5
December	319.8	263.0
	1,515	1,246

B. SDG&E's Peak Day Temperature Designs

SDG&E plans and designs its system to provide continuous service to its core customers under an extreme peak day event.[13] The extreme peak day design criterion is defined as a 1-in-35 annual event; this corresponds to a system average temperature of 42.8°F Fahrenheit or 22.2 HD on a peak day.

[12] The monthly values for Average Year HDD were calculated as the arithmetic average of the respective month's 20 years of observed monthly HDD. The monthly values for the Cold Year HDD were calculated by multiplying a proportion for each calendar month times the Cold Year HDD annual value. The proportion for each calendar month is that month's HDD total relative to the annual HDD total based on the Average Year data.

[13] The temperature SDG&E uses to define a peak day is determined from an analysis of the annual minima of SDG&E's daily system-average temperatures in order to estimate a probability model for the annual minimum daily temperature. The extreme peak day temperature value is determined from a calculation using this estimated model such that the chance we would observe a lower value than this extreme peak day temperature is 1/35 or about 2.86%.

V. SDG&E RESDENTIAL GAS DEMAND FORECASTS (2020-2022)

SDG&E is a combined gas and electric distribution utility serving the population of San Diego and the southern portions of Orange County. For SDG&E, residential customers comprise the greatest number of customers and, within the core market, the bulk of demand for natural gas. The forecast of natural gas demand for these residential customers follows.

A. SGD&E Forecasted Residential Customer Growth

Active residential meters averaged 850,136 in 2017, an increase of about 0.57% from the 2016 average. The forecasts of residential meter counts for SDG&E are developed using the same econometric and statistical techniques described earlier for SoCalGas. As provided in Chapter 5 (Guo) and replicated in Table 7 below, during the TCAP period, SDG&E's active residential customer base is expected to grow at an average annual rate of 0.74%, reaching nearly 880,694 active meters by 2022.

Table 7

SDG&E Active Residential Meters (Annual Averages)

	2020	2021	2022	3-Year Avg. 2020-2022
Residential	867,507	874,002	880,694	874,067

B. SDG&E Forecasted Annual Residential Gas Demand

Over the TCAP period, SDG&E expects decreased gas demand for residential customers. Temperature-adjusted residential demand is projected to drop from 31,721 Mdth in 2020 to 30,856 Mdth in 2022, a decrease of about 865 Mdth or -1.37% per year. This forecast reflects demand reductions from SDG&E's integrated gas and electric energy efficiency programs. Table 8 provides the annual throughput forecasts for the residential market using the HDD conditions discussed in Section IV.

Table 8

SDG&E Residential Throughput (Mdth) Average and 1-in-35 Cold Temperature Year

		2020	2021	2022	3-Year Avg. 2020-2022
Residential	Average Temp Year	31,721	31,394	30,856	31,323
	1-in-35 Cold Temp Year	34,759	34,418	33,845	34,341

C. SDG&E's Retail Peak Day and Peak Month Demand

As discussed in Section IV, the extreme peak day design criterion, which is defined as a 1-in-35 annual event, corresponds to a system average temperature of 42.8°F. For peak month planning, December demand is used since December has generally been the coldest month in SDG&E's service territory based on more than 20 years of weather records. Tables 9 and 10 below show the forecasted retail core peak day demand and cold design-temperature-year peak month demand.

Table 9

1-in-35 Annual Likelihood (42.8°F System Avg. Temperature) Peak Day Demand in Mdth/day

	2020	2021	2022	3-Year Avg. 2020-2022
Residential	298	295	291	294

Table 10

Cold Design Temperature Year: Peak Month Demand (Mdth)

	2020	2021	2022	3-Year Avg. 2020-2022
Residential	5,080	5,030	4,946	5,019

This concludes my prepared direct testimony.

VI. QUALIFICATIONS

My name is Gregory Teplow. My business address is 555 West Fifth Street, Los Angeles, California, 90013-1011. I am employed by SoCalGas as a Forecasting Advisor. I am responsible for the preparation of the weather designs for SoCalGas and SDG&E and the natural gas demand forecasts for the residential markets of SoCalGas and SDG&E. I have worked in SoCalGas' Regulatory Affairs Department in the areas of demand forecasting and weather analysis since I became employed by SoCalGas in May 2014.

I received a Bachelor's degree in Economics from Pomona College and a Master's Degree in Economics from the University of Washington. My employment outside of SoCalGas has been focused on data analysis. I worked for Countrywide Financial as an analyst examining employee compensation structures. I also worked as actuarial technician for Unitrin Specialty Lines Insurance (now Kemper Specialty) analyzing loss and severity data for the company's personal automobile insurance customers.

I have previously submitted testimony before the Commission.