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Form 4: Demand Forecast Methods and Models

Presented below is a summary of the methodology underlying the long-term forecast of electric energy for the San Diego Gas & Electric Company ("SDG&E") service territory.

SDG&E uses a combination of econometric and statistically adjusted end-use models ("SAE") to develop forecasts of electric customers, sales, system energy requirements and system peak demand. In general, the forecasting models integrate input assumptions regarding demographic and macroeconomic concepts, weather, energy prices, building and appliance standards and saturations, energy efficiency programs, and other factors affecting electricity consumption, such as new or changing technologies.

Electricity consumption is modeled in the following sectors and categories: Residential, Small/Medium Nonresidential, Agriculture and Water Pumping, Large Nonresidential, Street Lighting and Electric Vehicles.

The residential class is modeled as the product of per-customer-usage and the number of customers. Usage per customer is modeled using the residential SAE model and incorporates equipment efficiency and saturation trends along with billing days, real electric prices, weather, seasonal and real personal income to forecast energy sales. Residential sales are adjusted to account for energy efficiency & standards impacts and self-served load (primarily from photovoltaic systems).

Small/medium non-residential electric sales are modeled as the product of per-customer-usage and the number of customers. Usage per customer is modeled using the commercial SAE model and incorporates equipment efficiency and saturation trends along with billing days, real electric prices, weather, seasonal and economic employment conditions to forecast energy sales.

Small/medium non-residential electric sales are adjusted to account for energy efficiency & standards impacts and self-served load (from both solar and non-solar).

Agriculture is forecasted as an individual sector based primarily on customer counts and recent energy usage trends. An econometric model was used to forecast the agriculture class on a usage per customer basis using an estimation period of 2014 through 2018. The model was fitted using monthly binary variables and historical rain data. Photovoltaic was included for the estimation of agriculture consumption and was later subtracted off forecast to determine reported sales.

Street lighting is forecasted as an individual sector based primarily on customer counts and recent energy usage trends. A three-year average (2016-2018) usage per customer was applied to forecasted customers to come up with a lighting sales forecast.

Large non-residential customer groups such as military and manufacturing are forecasted individually based on recent energy usage trends.

System peak demand is modeled using historical hourly demand information along with trends in heating, cooling and base load, heating degree days, cooling degree days, and cloud cover. Hourly demand estimates are adjusted for trends in demand response, self-served load from non-PV generation, PV and electric vehicles. This methodology was used to account for the recent trend of peak-shifting to later in the day.

The hourly forecast is based on the resulting control totals from the energy and peak forecast. Hourly loads provide an 8760 (8784 leap year) shape to the forecast period and incorporates hourly PV generation, electric vehicle consumption, demand response, and additional achievable energy efficiency.

Class energy consumption and system peak are further broken down into categories of private supply (self-served load), direct access and utility-procured energy (bundled service).

The energy forecast is disaggregated into bundled service and direct access service. The amount of direct access load reflects the California Public Utilities Commission's Decision (D.10-03-022) for limited reopening of Direct Access (DA) to nonresidential customers, in annual migration periods from 2010 through 2013. Since the last migration period ended in 2013, the forecast of total DA sales for 2019 is tied to 3,562 GWH cap provided in decision D.10-03-022.

In April 2019, the CPUC issued a draft decision (R.19-03-009) in the rulemaking to implement California Senate Bill 237 (SB 237), increasing the DA cap. SDG&E's share of the authorized DA cap increase is approximately 380 GWh. There will be two years of migration, each with an increase of approximately 190 GWh, to reach the new DA cap by 2021. The forecast of total DA sales for 2020 and 2021-2030 are tied to 3752 GWh and 3942 GWh, respectively.

The economic assumptions are based on a blend of the latest available forecasts from Global Insight, Inc. (April 2019 Regional forecast for San Diego) and Moody's Economy.com (April 2019 Regional Forecast for San Diego). Numerical values for key assumptions are presented in IEPR Form 2.1.

SDG&E uses various weather concepts in the sales forecast development process, including heating-degree days, cooling-degree days and relative humidity. The three weather stations that represent SDG&E's service area are Lindbergh Field, Marine Corps Air Station (MCAS) and El Cajon. Peak weather scenarios were developed from statistical analysis of historical weather data for the last 30 years.

Electric Vehicle Forecast:

The electric vehicle forecast is based off historical EV on-road registrations as provided by IHS/Polk data[1] and internal growth forecast estimates that considered the CEC's 2018 high EV adoption scenario. SDG&E has transportation electrification projects in progress and planned for the future that will increase EV adoption in the forecast horizon. SDG&E uses multiple EV charging load shapes: time-of-use, non-time-of-use, Power Your Drive charging profiles and public charging profiles in order to create the kWh estimates for the hourly load forecast. The resulting load is aggregated to the annual totals.

Non-PV Self-Served Load:

SDG&E witnessed rapid growth in non-PV self-served load from the early 1980s through the mid-2000s. From 2007 to 2013, SDG&E saw relatively constant non-PV self-served load. A structural shift occurred in 2014, and there was a significant decrease in non-PV installed capacity within the SDG&E service territory, as well as a noticeable decrease in self-served load. The forecast anticipates that no major non-PV projects will be added to the system within the forecast period and has therefore determined that non-PV self-served load will see no growth over the next 10 years. A three-year historical average was used to develop the non-PV self-served load forecast.

PV Self-Served Load:

Over the past 10 years, SDG&E has experienced exponentially increasing solar installation, with year-over-year growth reaching as high as 50 percent. SDG&E believes the California Energy Commission (CEC) has accurately accounted for this trend in its high-scenario

[1] Proprietary IHS/Polk Data (Dec 2018).

PV forecast. SDG&E has adopted the CEC's high-scenario for the 2019 IEPR installed PV capacity forecast. SDG&E has a representative sample of solar generation meters which are used to derive hourly capacity factors. These historical capacity factors were used to create an average shape and applied to the CEC high-scenario PV forecast to obtain estimates of PV generation.

Battery Storage:

Battery storage is still in its early stages of adoption in SDG&E service territory. SDG&E has relied on Bloomberg's 2018 Long-Term Energy Storage Outlook to obtain a basis for installed capacity projections and made the following adjustments: Bloomberg forecasted statewide installed capacity of battery storage out to 2050. SDG&E determined its allocation of statewide installed capacity by applying the percentage of statewide peak load attributed to SDG&E. SDG&E adjusted Bloomberg's annual growth rates upward in the near years to more closely align with actual growth rates as seen in SDG&E's service territory to date, but the installed capacity at the forecast horizon remains the same.

The impact of battery storage on system peak is based on the 2017 SGIP Advanced Energy Storage Impact Evaluation prepared by Itron. This study states the following: "PBI projects delivered a CAISO system peak demand reduction approaching 4 MW during the top hour (representing 7% of the 57 MW of rebated PBI capacity)." SDG&E has adopted this 7% as its estimation for discharge of total battery storage installed capacity at system peak.

Form 6: Demand-Side Methodology

Committed and uncommitted energy efficiencies and standards are incorporated in the forecasts produced by the models. Efficiencies and standards are reflected in model parameters such as residential unit-energy-consumption (UEC) and commercial energy-use-intensities (EUI). Efficiencies and standards included in the models for years subsequent to 2018 were developed by analyzing the Energy Efficiency Potential and Goals Study 2018 and Beyond as prepared for the CPUC[2] and by incorporating efficiencies from standards, behavioral programs, equipment, and naturally occurring market adoption (NOMAD) and end-of-use decay for measures.

There are two types of Demand Response (DR) impacts, non-dispatchable and dispatchable. Non-dispatchable program impacts are incorporated in the demand forecast, dispatchable program impacts are not. The dispatchable program impacts will be passed onto the resource planners, who will incorporate them in the 2019 IEPR resource plan. The source of the values for both dispatchable and non-dispatchable demand response programs is the Executive Summary of the 2018 SDG&E Measurement and Evaluation Load Impact Reports filed with the CPUC, April 1, 2019, in compliance with D-08-04-050.

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[2] http://www.cpuc.ca.gov/General.aspx?id=6442452619