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Form 4 Demand Forecast Methods and Models

Peninsula Clean Energy Authority

June 30, 2023

Overview of Electricity Demand Forecast Methods, Models, and Data

Peninsula Clean Energy has developed a load forecast to estimate future electricity demand using a linear regression model.

The load forecast is implemented in Python and relies on historic AMI data for Peninsula Clean Energy's San Mateo County customers since May 2017, historic interval data for City of Los Banos customers from January 2018 to April 2022, and historic AMI data for City of Los Banos Customers from April 2022. Long-term load growth factors are based on reasonable growth rates for number of accounts and usage per account based on historical trends and recommended by Peninsula Clean Energy's consultants.

Peninsula Clean Energy has developed a peak load forecast based on the 1-in-2 methodology recommended by the CEC and weather normalized historic load data since May 2017.

Definition of area for which forecast is developed

Peninsula Clean Energy's load forecast is developed for Peninsula Clean Energy's service area, which includes all cities in San Mateo County, and the unincorporated areas of San Mateo County, not including customers who are receiving electricity service through a direct access provider or who have opted out of CCA service. About 97% of eligible customers in San Mateo County are Peninsula Clean Energy customers. This rate has remained flat for the past five years and we assume it will continue in the future.

Peninsula Clean Energy began serving the City of Los Banos in April 2022. The participation rate for City of Los Banos customers is approximately 88%. This load forecast includes the actual usage by City of Los Banos beginning in April 2022, and assumes that participation rates for City of Los Banos customers have stabilized since the enrollment in April 2022.

Load forecasted for current and known future Direct Access customers is not included in this forecast, i.e. Direct Access load has been subtracted from the forecast.

Definition of customer classes

The forecast uses the 19 load profiles identified by Pacific Gas and Electric (PG&E):

- Small and medium commercial:
 - A1
 - A10
 - A6
 - BEV1
- Agricultural:
 - AG1A

- AG1B
- AG4A
- AG4B
- AG5A
- AG5B
- Large Commercial
 - E19P
 - E19S
 - BEV2
- Industrial
 - E20P
 - E20S
 - E20T
- Street Lighting:
 - LS1
- Residential
 - RES
- Traffic Control
 - TC1

Description of method for forecast components

Peninsula Clean Energy's load forecast is specific to each of the 19 load profiles or "profile types" identified above. The forecast is based on average hourly profiles for each profile type and varies by month and weekday/weekend. The forecast uses a simple weather normalization method by averaging historic data normalized for number of accounts. Growth in number of accounts is expected to be about 0.5% per year for residential and small and medium commercial accounts. Growth in per account usage is expected to be about 0.5% per year for commercial and residential accounts.

To forecast energy sales in the post-pandemic era, we exclude from our analysis historic data that is not consistent with the current energy sales trends. We determine the "exclusion period" for each load profile, and we distinguish between San Mateo County and Los Banos. For example, since San Mateo County commercial load significantly decreased as a result of the pandemic, we exclude historic data for commercial rate groups prior to Q3 2020. However, for the City of Los Banos commercial groups, the exclusion period is limited to April and May of 2020 (for most groups). For San Mateo County residential groups, we exclude historic data for March 2020 through March 2021 (when residential usage patterns were significantly higher than seen previously or since that period). Los Banos residential groups generally showed no change in usage due to the pandemic and no exclusion is performed for them. We don't exclude any data for agricultural or traffic/lighting groups in either territory.

In addition, we exclude from our analysis historic load data associated with customers who have departed to Direct Access. At this point, we do not expect additional departures to Direct Access. Peninsula Clean Energy has completed enrollment of customers in its service territory, and is not observing any additional opt-outs. At this point, we do not have immediate plans for new customer additions.

After making these adjustments to the historic data, we determine the average load shapes in the historic data by rate group, month, weekday or weekend, and hour of the day. We use assumptions of flat growth rates in account growth and consumption growth to scale the shapes over time. We then adjust the forecast to account for the modeled load modifiers of light-duty electric vehicles and behind-the-meter solar and storage systems. The modeling of these two load modifiers is discussed in more detail below in the “Additional Forecast Details” section, subsection “Known load growth projects and Other Load Modifier Impacts in Form 3”.

Peninsula Clean Energy uses a weather-normalized peak load model to forecast the hourly load for a given maximum daily temperature that is selected based on the CEC’s recommended 1-in-2 methodology.

Peninsula Clean Energy performs a second order polynomial regression on historic load (excluding the COVID exclusion periods and departures to Direct Access discussed above) to weather normalize historic hourly load to historic maximum daily temperature. We further remove weekends from the historic data since historically our peak load occurs on weekdays, and we expect that to continue in the future.

To implement the 1-in-2 methodology to forecast peak temperatures, Peninsula Clean Energy uses temperature data from NOAA dating back to 1971 for the Redwood City Station. We determine the median (50% exceedance, or “1-in-2”) peak monthly temperature for each month. We also determine the median minimum monthly maximum daily temperature (minimum of daily Tmax). We use the forecast temperature to calculate the peak load using our weather-normalized peak load model, using both the median monthly minimum and maximum daily Tmax. For winter months, we find that the minimum Tmax is the better predictor of the monthly peak load, i.e., our peak load occurs on the coldest day of the month in winter months. We calculate the expected peak load for each month, for each hour of the day. Then we incorporate the account growth forecast. We further adjust the peak forecast using the average hourly profile of our load modifiers for weekdays for each month.

Currently Peninsula Clean Energy’s load forecast is based on a regression method which is a type of simple econometric model. Peninsula Clean Energy is interested in increasing the sophistication of its load forecasting by incorporating economic forecasts and customer behavior modeling. Peninsula Clean Energy will continue to develop its load forecast and provide updates on its status. Peninsula Clean Energy does not utilize sophisticated aggregate econometric methods.

Peninsula Clean Energy is continually striving to improve our load forecasting methodology. We hope to expand our modeling of load modifiers to extend to building electrification and medium/heavy duty EV charging. We further hope to improve our forecasts of behind-the-meter solar and storage by reviewing historic data to isolate the impacts of existing rooftop solar generation. Forecasting EV charging and demand response is challenging and is an area that we are striving for improvement.

Challenges in load forecasting also stem from limited relevant historic data. With the recent COVID-19 pandemic, load patterns have significantly changed, increasing forecast uncertainty. As time progresses, we collect additional post-COVID data that helps improve forecast accuracy in the post-COVID regime.

Discussion of the reasonableness of differences between historical and forecasted growth patterns

Peninsula Clean Energy considers the changes in forecasted growth patterns to be reasonable considering the available data and recent trends due to the coronavirus pandemic. Peninsula Clean Energy performs a quarterly load evaluation and forecast update which is used for internal planning and budgeting purposes. Peninsula Clean Energy will continue to monitor customer demand and update the forecast as appropriate.

Report of past performance of the forecasting method

The table below provides a comparison of previous forecasts to actual annual peak and energy volume demand. Values reported in the table below do not include distribution losses. Actual values are summarized from initial (“T+8”) billing-quality meter settlements provided by Peninsula Clean Energy’s meter data management service provider. In general, the forecast performs reasonably well considering the relatively short period of historical data available.

Year	Forecast	Forecast Annual Energy (GWh)	Actual Annual Energy (GWh)	Forecast Peak Load (MW)	Actual Peak Load (MW)
2018	Submitted to PG&E for ERRA forecast, Feb 2017	3,675	3,525	658	624
2019	Submitted to PG&E for ERRA forecast, Feb 2018	3,609	3,563	702	675
2020	Submitted to PG&E for ERRA forecast, Feb 2019	3,462	3,442	561	625
2020	Updated May 2020 (includes pandemic adjustment)	3,455	3,442	618	625
2021	Submitted to PG&E ERRA forecast, Sep 2020	3,304	3,334	562	576
2022	Submitted to PG&E ERRA forecast, Sep 2021	3,630	3,385	623	689
2023	Submitted to PG&E ERRA forecast, Feb 2022	1,451 (Jan-May)	1,411 (Jan-May)	568 (Jan-May)	556 (Jan-May)

Peninsula Clean Energy considers the submitted forecast to be reasonable considering the available data and recent trends in economics and demographics. Although the submitted forecast does not explicitly account for factors such as energy prices, demand-side management technology and programs, state policy trends or climate change, Peninsula Clean Energy considers the forecast to be reasonable in terms of those factors. Peninsula Clean Energy will continue to monitor customer demand and update the forecast as appropriate.

Additional Forecast Detail

Forecast calibration procedures

Peninsula Clean Energy's load forecast is based on a relatively short period of historical data (May 2017 through January 2023, with exclusions for COVID periods). Because of the relatively short period of observed data, none of the historic data is reserved for model testing and calibration. Instead, all of the historic data is used to develop the regression coefficients.

Peninsula Clean Energy performs load evaluation and forecast updates quarterly. During these updates, the most recent historical data is added to the regression.

Historical Peak and Projected Peak Loads

As discussed above in more detail, Peninsula Clean Energy uses historic AMI data to determine historic peak loads by customer class. Peninsula Clean Energy implements the 1-in-2 temperature forecast method recommended by the CEC and uses that temperature forecast to forecast peak load based on weather-normalized load patterns in Peninsula Clean Energy's service territories. See the section "Description of Forecast Components" for more details on Peak Load forecasting methods.

Energy and Peak Loss Estimates

Peninsula Clean Energy assumes a distribution loss factor of 6.5%. The historic loss factors varies by time of day and season, but on average has been about 6.5%. Given the relatively short period of observed data, Peninsula Clean Energy chooses to use a constant estimate of the loss factor. As we accumulate additional data, we may choose to increase the sophistication of our forecast loss factor. Peninsula Clean Energy does assumes a loss factor of 2.5% for transmission losses and 0.5% for UFE losses, based on the standard values used in the Resource Adequacy program administered by the CPUC.

Estimates of Direct Access, Community Choice Aggregation, and other Departed Load

As noted above, Peninsula Clean Energy will began serving City of Los Banos customers in April 2022 and finished enrolling customers in this territory in December 2022. Peninsula Clean Energy does not anticipate load growth by additional service territory expansion at this time.

As noted above, Peninsula Clean Energy excludes historical load data associated with customers who have departed to Direct Access from our analysis. At this point we do not expect additional departures to Direct Access.

Weather Adjustment Procedures

Peninsula Clean Energy's load forecast averages historic usage per account profiles by month for the observed time period of May 2017 through January 2023, excluding COVID periods specific to each load profile. By averaging monthly profiles between different years, there is a simple weather normalization incorporated into the load forecast. At this time, Peninsula Clean Energy's energy load forecast does not explicitly incorporate meteorological data.

Peninsula Clean Energy's peak load forecast does incorporate meteorological data, as described above. Data from the Redwood City Station (USC00047339) is used, specifically the maximum daily temperature. In order to implement the 1-in-2 temperature estimate, we calculate the median of the

maximum daily temperature by month. We also perform a second order regression between peak daily load and maximum daily temperature to determine a peak load to temperature relationship. Using this regression model, we calculate the expected peak load for the 1-in-2 temperature estimate. This peak load forecast is performed for total Peninsula Clean Energy load, including Los Banos load in April 2022 and later.

Climate Change

Climate change will play an important role in future energy consumption patterns. Peninsula Clean Energy incorporates the effects of climate change by only using recent weather data for our 1-in-2 peak temperature forecast. We choose to use the most recent 50 years of weather data, despite having access to records of older data. While using less data reduces statistical robustness of the forecast, we believe that it more accurately reflects likely future weather patterns than using older data.

Known load growth projects and Other Load Modifier Impacts in Form 3

Peninsula Clean Energy is not reporting any load growth projects in Form 3.

Peninsula Clean Energy forecasts two groups of load modifiers: light-duty EV charging and behind-the-meter solar plus storage installations. We have developed a long-term forecast for both of these load modifiers. In addition, we incorporate impacts of a small load modifying demand response program that we are running.

For EV charging, we are using policy-based forecasts of growth in the EV population based on CARB's [Advanced Clean Cars II Regulation](#). We assume charging profiles based on our fleet characteristics and rate schedule using [NREL's EVI Pro-Lite Tool](#).

For BTM resources, we assume future installations in our service territory consistent with rooftop solar assumptions in [NREL's Cambium model](#). We assume a ratio of solar:storage consistent with historic installations in our service territory. We model the dispatch of the BTM storage equipment using the characteristics of our service territory, our rate schedule, and the [NREL System Advisor Model tool](#).

We have one load modifying demand response program currently active with Sunrun. This program is an aggregation of BTM storage resources, which are discussed in more detail below.

We calculate the incremental impacts of these load modifiers relative to 2022. We then adjust the baseline energy sales forecast with the load modifiers forecast to obtain our load forecast net of load modification. The peak load forecast is similarly adjusted to account for the incremental impacts of load modifiers on the peak day. We do not assume different load modifier behavior on the peak day versus other weekdays, since we assume that light-duty EV charging patterns and rooftop solar are largely independent of peak day versus other average days in each month.

Peninsula Clean Energy has provided load modification estimates associated with its current active program with Sunrun in Form 3. The Sunrun program is a residential program and is currently limited to single family home owners and multi-family building owners. Any residential owner within Peninsula Clean Energy's service area is eligible to participate, including those who are not Peninsula Clean Energy customers.

Peninsula Clean Energy's load modification program with Sunrun consists of solar plus storage installations on participant's homes that will be configured to discharge the storage to provide load modification on weekdays during the four-hour peak window (either 4pm to 8pm or 5pm to 9pm).

Peninsula Clean Energy's contract with Sunrun requires 1,500kW of load modification from 2023 – 2031. Sunrun and Peninsula Clean Energy continue to deploy residential solar+storage systems to reach this level of capacity and expect to achieve full load modification capacity by 2024. We report the incremental capacity relative to 2022 in Form 3.

The installed systems will displace peak demand based on the discharge of the batteries. Peninsula Clean Energy's peak load has historically occurred on weekdays between 4pm and 9pm, and Peninsula Clean Energy expects the timing of these peaks to continue in the future. Therefore, the load modification from this program is expected to be coincident with Peninsula Clean Energy's peak demand for the foreseeable future. The load modification estimates have been incorporated into Peninsula Clean Energy's peak demand forecast on Form 1.3.

The forecasted load modification energy and peak load effects do not take into account factors such as price elasticity, fuel prices, market conditions or relevant rate schedules. As the program continues, if we determine that such factors are having a significant effect on program performance, we will update the forecast as appropriate.

The program began in summer of 2020, and we are monitoring program performance. We will continue to monitor program performance and update our forecast based on available data.

Peninsula Clean Energy is only providing load modification forecast for programs currently active. At this time, we are not providing load modification forecasts for programs in development. Furthermore, we do not provide forecasts for load modifying programs administered by the IOUs. Any future programs we develop will be consistent with federal, state, and local policies.