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FORM 4 DEMAND FORECAST METHODS AND MODELS

2023 INTEGRATED ENERGY POLICY REPORT

SONOMA CLEAN POWER AUTHORITY

1 SERVICE AREA AND CUSTOMER BASE

Sonoma Clean Power Authority ("SCPA") currently serves as the default energy provider for all incorporated and unincorporated areas of Sonoma and Mendocino Counties except for the cities of Healdsburg and Ukiah which have their own municipal utilities.

Customers within the SCPA service area can opt-out of SCPA and receive service from Pacific Gas and Electric Company ("PG&E"), the local Investor-Owned Utility ("IOU"). SCPA does not serve customers who have opted out or Direct Access ("DA") customers.

SCPA serves all customer classes. Customer classes are broken down into the following load classes:

- Residential-
  - All residential rates
- Commercial-
  - A-1/B-1 – small general commercial
  - A-6/B-6 – small general time-of-use ("TOU") commercial
  - A-10/B-10 – medium general demand-metered commercial
  - Battery Electric Vehicle ("BEV") – commercial electric vehicle charging
- Industrial-
  - E-19-S/B-19-S – medium general demand-metered TOU secondary voltage
  - E-19-P/E-19-S – medium general demand-metered TOU primary voltage
  - E-19-T/B-19-T –medium general demand-metered TOU transmission voltage
  - E-20-S/B-20-S – maximum demands >1000kW secondary voltage
  - E-20-P/B-20-P – maximum demands >1000kW primary voltage
  - B-20-T – maximum demands >1000kW transmission voltage
- Streetlighting
  - SL – street/highway/outdoor area lighting rates
  - TC – traffic control rates
- Water Pumping
  - E-20-T – maximum demands >1000kW transmission voltage
- Agricultural
  - AG-1-A – single-motor installations with a connected load rated less than 35 hp and to all multi-load installations aggregating less than 15 hp or kW
  - AG-4-A – for customers with high annual operating hours and pumps of less than 35 horsepower
  - AG-A1-A-S – low to moderate operating hours and demand <35 kW
  - AG-A2-A-S – high annual operating hours and demand <35 kW
  - AG-B-A-S – low to moderate operating hours and demand of >=35

  AG-C-A-S – high annual operating hours and demand >=35 kW

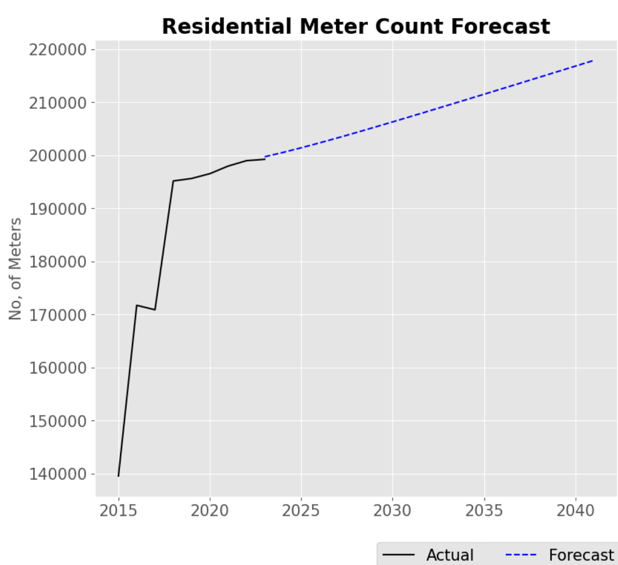
2 FORECASTING METHODOLOGY

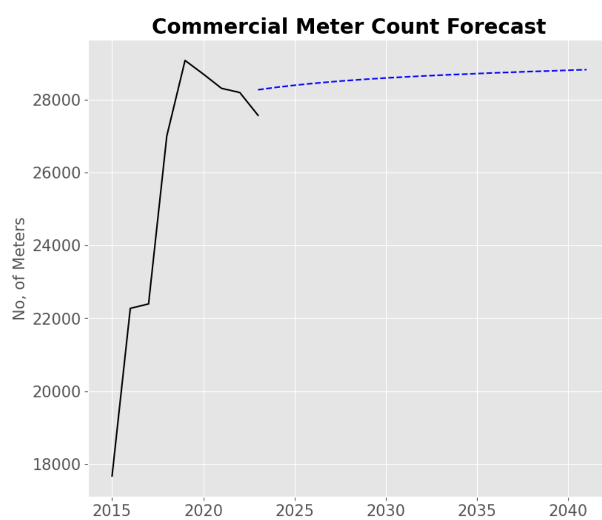
SCPA employs a statistical model for forecasting energy usage, Net Energy Metering (“NEM”) generation, and monthly peak load. This model is trained on hourly load, customer count, and weather data from January 2018 through December 2022. The trained model is validated against actual data for appropriate representation of monthly energy and peak demand.

For forward forecasting, SCPA runs the trained model with the 2023 to 2034 calendar against historical weather from 2007 to 2022. SCPA also applies a calibrated temperature scalar to reflect the impact of climate change between the analog year and forecast year. The distribution of these results is reviewed, and a representative weather year is selected for each month based on proximity to the median energy usage and demand. The forward model also incorporates trends in meter counts, NEM penetration, energy efficiency, electric vehicle (“EV”) adoption, and building electrification through heat pumps. Additional details on inputs, methodology, and normalization are included below.

2.1 Customer Counts

SCPA forecasts meter counts for residential, small commercial, large commercial (E19/E20), and street lighting / traffic control meters based on a model calibrated to recent trends in new meters, account migration, and service termination rates. Below are figures depicting historic meter trends for the residential and small commercial meter groups and SCPA’s forecast. This submission is based on SCPA’s mid scenario, which results in a 0.48%/year growth for residential meters, 0.1%/year growth in small commercial meters, and a 0.31%/year growth in large commercial meters. Lighting and traffic control meter counts are held constant.

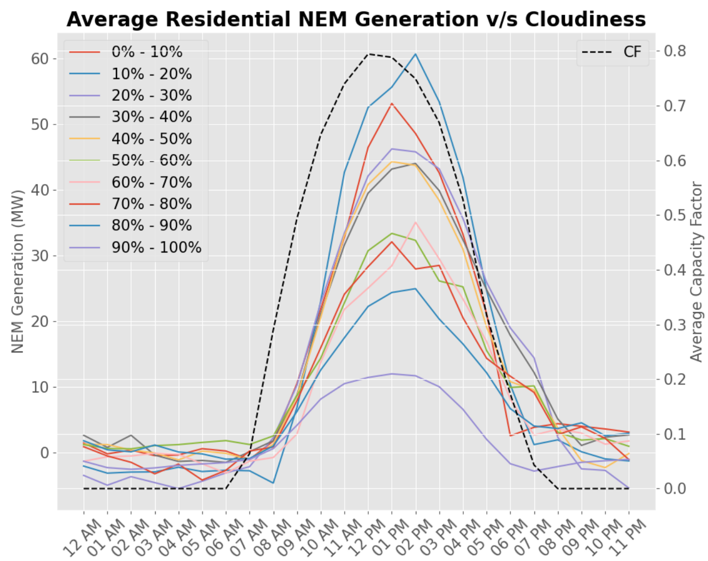




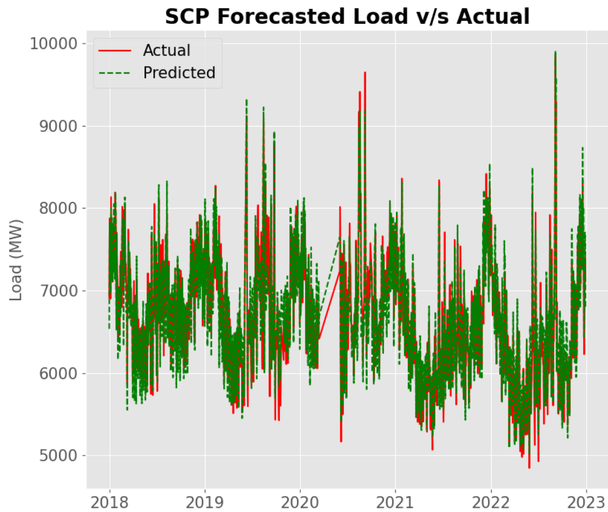
2.2 Load and Demand

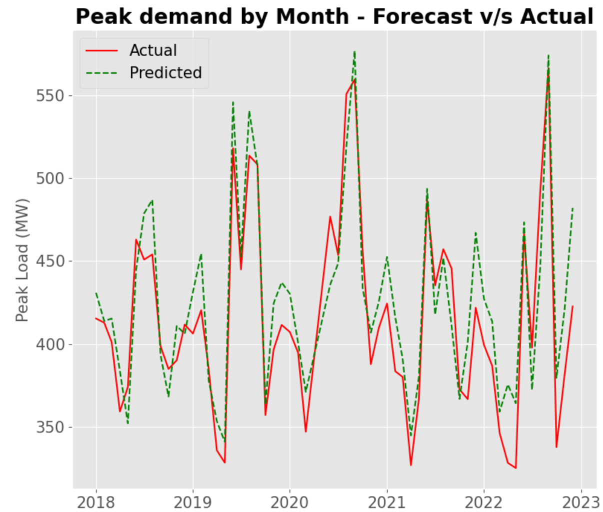
The SCPA energy forecast model discretely calculates energy usage for residential, small commercial, large commercial, and streetlighting / traffic control meters, along with associated NEM generation using hourly weather and installed capacity.

The estimated NEM generation is derived from an independent empirical model that correlates cloud cover and a capacity factor for a given datetime from National Renewable Energy Laboratory ("NREL") for cloud-free skies in Santa Rosa to inferred NEM generation (the difference in profiles of NEM and non-NEM accounts for a given customer class) per kilowatt ("kW") of installed capacity. Below is an illustration of how residential generation is empirically correlated to cloud cover for an average day. NEM capacity is extrapolated using the growth represented in the California Energy Commission's ("CEC") 2022 Integrated Energy Policy Report ("IEPR") forecast update for PG&E territory. Note that the capacity and energy/demand impact reported in Form 3 is incremental to the capacity online in January 2023.



The estimated NEM generation is used to adjust actual historical meter data. Per meter usage is then empirically correlated by customer class to heating and cooling degree days, rolling 3-day average temperatures, and adjusted for seasonality. Monday / Friday, Tuesday - Thursday, and weekend / North American Electric Reliability Corporation ("NERC") holidays are also forecasted separately. Proper statistical techniques such as a review of probability ("p")-values, blind tests, checking directionality of coefficients are used to validate statistical significance and minimize over-fitting in regression or classification models. The figure below compares the model results versus actuals during the training interval, showing that the model is successful at fitting both seasonal and daily fluctuations for both energy and monthly peak demand.





For generating the 2023 to 2034 load forecast, the trained model is fed the 2023 to 2034 calendar, historical climate-adjusted weather, and trends in meter counts and NEM capacity by customer class. The model outputs daily energy usage that is then adjusted for the load modifiers discussed in the Load Modifiers section. The hourly forecast is then created by applying normalized shapes by sector and day type and incorporating the output of the NEM generation model. The monthly peak from this hourly load forecast is directly used for the peak demand forecast. Please note that the peak reflects SCPA's peak, which may be different than the Utility Distribution Company ("UDC") coincident peak.

2.3 Reasonableness

SCPA tracks the actual settled CAISO T+55 data and invoiced retail sales against forecasts monthly. The comparison listed here is the 2021 IEPR submitted forecasts versus actual data.

Year	IEPR Forecast	Actual	% Forecast Error	Notes
2021	2,263 GWh	2,279 GWh	-0.7%	Error in forecast is within expected bounds of uncertainty for weather variability
2022	2,258 GWh	2,195 GWh	-2.8%	The last forecast did not anticipate additional DA departure in 2022, which occurred due to COVID usage allowing more headroom for DA expansion within the specified caps.
2021	455 MW	510 MW	+12%	Error in forecast is within expected bounds of uncertainty for weather variability
2022	456 MW	583 MW	+28%	SCPA's peak occurred during the September heatwave which was an extreme weather event not reflective of 1-in-2 conditions. As shown above, SCPA's model does reproduce this peak when fed ex-post weather and 2022 weather is now included in the stochastic dataset.

SCPA runs forecast sensitivities to weather. Different weather years can change annual energy load +9/-13% from forecast and annual peak +41%/-11% from forecast. As such, SCPA cannot expect to have a consistent 0% forecasting error since SCPA cannot accurately predict the weather far in advance. Therefore, SCPA instead uses a mid-case weather year for forecasting.

3 ADDITIONAL FORECAST DETAIL

3.1 Forecast Calibration Procedures

As described previously, historical data regarding energy consumption, peak demand, and weather forms the basis of all SCPA forecasting.

3.2 Economic and Demographic Data

SCPA is not required to fill out Form 2, Electric Forecast Input Assumptions including Economic and Demographic Variables, and therefore has no response to this specific item. SCPA does monitor Census Data, Sonoma County Economic Development Board data (which includes Moody's Analytics data on local employment and economy), and other Sonoma and Mendocino County local sources of information on housing and economy (such as local meetings, workshops, conferences, and subject area experts) to predict trends.

3.3 Historical Peak and Projected Peak Loads

See Section 2.2.

3.4 Energy and Peak Loss estimates

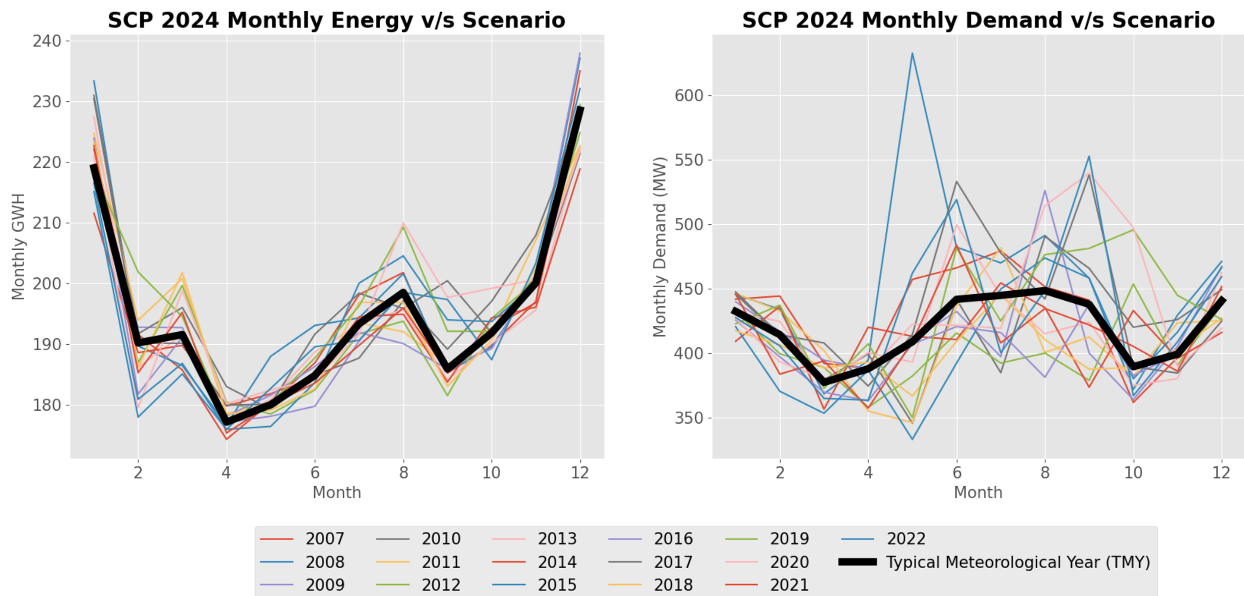
Form 1.3 reports losses. SCPA utilizes CAISO Settlement Quality Meter Data ("SQMD") to assess base load (without losses) and loss adjusted load (includes distribution losses). Historical trends in base load versus loss-adjusted load are used for distribution losses, which average 6.7%. Transmission losses of 3% that are assigned from the Resource Adequacy load forecast templates are used to develop the total losses reported in Form 1.3.

3.5 Estimates of Direct Access, CCA, and Other Departed Load

SCPA determines its customer account growth on a holistic basis, which includes customers departing due to opting out of SCPA or terminated accounts. SCPA's model does not anticipate any additional departure to Direct Access.

3.6 Weather Adjustment Procedures

SCPA normalizes its forecast for weather by running the trained load model on an extensive history of climate-adjusted weather (2007-2022) and selecting a representative weather year for each month based on its proximity to the median energy usage and demand. Below are plots showing the energy usage and demand for the Typical Meteorological Year ("TMY") year input (dark black line) versus the broader historical data set (color lines – each line is a different weather year). As discussed in the Section 2.2 below, the TMY does reproduce the high summer demand observed in 2019, 2020, and 2022 as those results are outliers compared to the broader historical dataset.



3.7 Hourly Load by Sub-area

SCPA is not required to fill out form 1.6b, System Hourly Loads, and therefore has no response for this item.

3.8 Climate Change

Increased temperatures, storms, and wildfires continue to be more intense because of the climate crisis. Public Safety Power Shutoff (“PSPS”) events are also more frequent because of increased wildfire risk. SCPA does not discretely forecast loss of load related to PSPS events, wildfire evacuations and damage, or flooding and storm evacuations or damage. SCPA also does not discretely forecast loss of load from rolling blackouts due to extreme temperatures across the CAISO and western grid.

SCPA uses weather data from 2007 onward for this forecast and will continue to refine the weather data years used as time goes on to account for climate change trends. SCPA uses historical trends in electricity use to capture increases in air conditioning and climate-related load increases.

SCPA has implemented a climate change adjustment to its analog weather data to represent expected increases in usage due to temperature increase. An adjustment factor of 0.046ºF per year is calibrated to annual local temperature trends since 1998. This factor is applied evenly across the year according to the number of years between the analog weather year and forecast year. SCP plans on further refining a technique for climate change adjustments by looking at seasonal temperature trends and looking at volatility of weather in addition to average trends.

3.9 Known Load Growth Projects

SCPA has no known load growth projects in our territory.

3.10 Other Load Modifier Impacts

The modeling of incremental NEM generation is described in Section 2.2. SCPA is leveraging the growth rates represented in Section 2.1, which are consistent with observed growth rates in SCPA's territory.

SCPA includes discrete demand modifiers for electric vehicle adoption, building electrification, and energy efficiency. SCPA's forecasts for energy usage from EV adoption and building electrification are built internally based on local characteristics (e.g., county EV sales, current residential gas usage, etc.) that are calibrated to match trends forecasted in the 2022 CARB Scoping report. SCPA's estimate for the impact of energy efficiency is based on its load share of the CEC's 2022 IEPR forecast. SCPA uses the CEC's hourly profiles in the 2022 IEPR forecast to convert annual energy estimates for load modifiers into hourly estimates. SCPA does not break down the electric efficiency and EV adoption modifiers into residential and non-residential, which is why SCPA is only reporting a total. For building electrification, SCPA's load modifier is specifically calibrated for residential electrification. SCPA has not yet implemented a non-residential load modifier for building electrification.

The modeling of incremental NEM generation is described in Section 2.2 above. SCPA is leveraging the growth rates represented in the 2022 IEPR forecast update, which are consistent with observed growth rates in SCPA's territory to project NEM growth into the future.

Although SCPA is seeing large growth in behind-the-meter ("BTM") storage, SCPA does not have reliable data to include its impact in its forecast for 2023 to 2034. SCPA anticipates characterizing BTM storage in future forecast updates.