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FORM 4 DEMAND FORECAST METHODS AND MODELS

2021 INTEGRATED ENERGY POLICY REPORT

SONOMA CLEAN POWER AUTHORITY

1 SERVICE AREA AND CUSTOMER BASE

Sonoma Clean Power Authority ("SCPA") currently serves as the default utility 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 go back to the local Investor-Owned Utility ("IOU") Pacific Gas & Electric Company ("PG&E"). SCPA does not serve customers who have opted out or customers that are Direct Access ("DA").

SCPA serves all customer classes which 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
  - All Agricultural ("Ag") rates
  - 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
  - E-20-T/B-20-T – maximum demands >1000kW transmission voltage
- Streetlighting
  - SL – street/highway/outdoor area lighting rates
  - TC – traffic control rates

2 FORECASTING METHODOLOGY

SCPA employs a statistical model for forecasting energy usage, Net Energy Metering ("NEM") generation, monthly peak load, and the impact of departure of customers to DA in 2022. This model is trained on hourly load, customer count, and weather data from November 2017 (after enrollment of Mendocino County and the October 2017 wildfires) through March 2021. 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 weather from 2007 to 2020. The distribution of these results is reviewed, and a 1-in-2 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, and electric vehicle ("EV") adoption. Additional detail on inputs, methodology, and normalization are included below.

2.1 Customer Counts

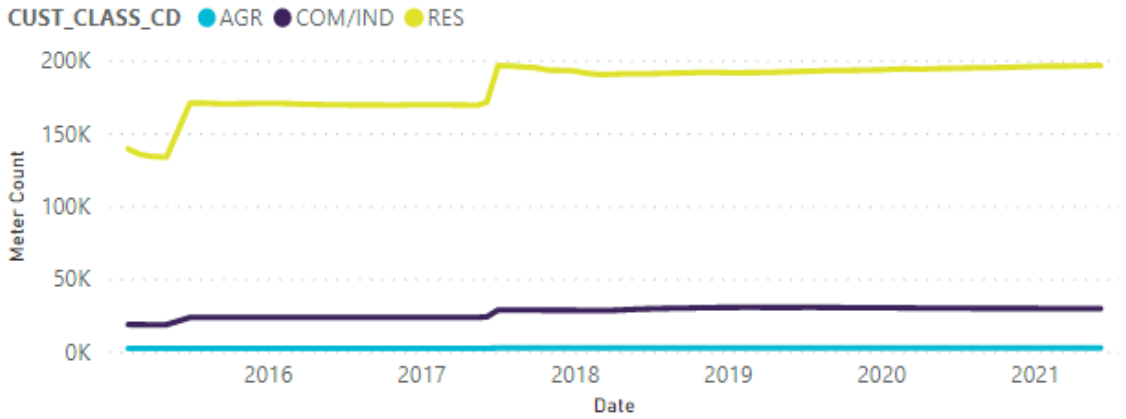
The first step in SCPA's forecast methodology is to forecast customer counts using trends for each load class. Historical opt-out and participation rates, and California Independent System Operator ("CAISO") settled meter counts.

SCPA began serving customers in May 2014 and has served Sonoma and Mendocino counties in the following phases:

- Phase 1 – May 1, 2014, began serving commercial and industrial customers and a random selection of 5,000 residential customers in unincorporated Sonoma County, the cities of Cotati, Santa Rosa, Sebastopol, Sonoma, and the town of Windsor
- Phase 2 – December 1, 2014, added the remaining residential customers in the jurisdictions listed above
- Phase 3 – June 1, 2015, added all customers in the cities of Cloverdale, Petaluma, and Rohnert Park
- Phase 4 – June 1, 2017, added all customers in unincorporated Mendocino County and the cities if Fort Bragg, Point Arena, and Willits

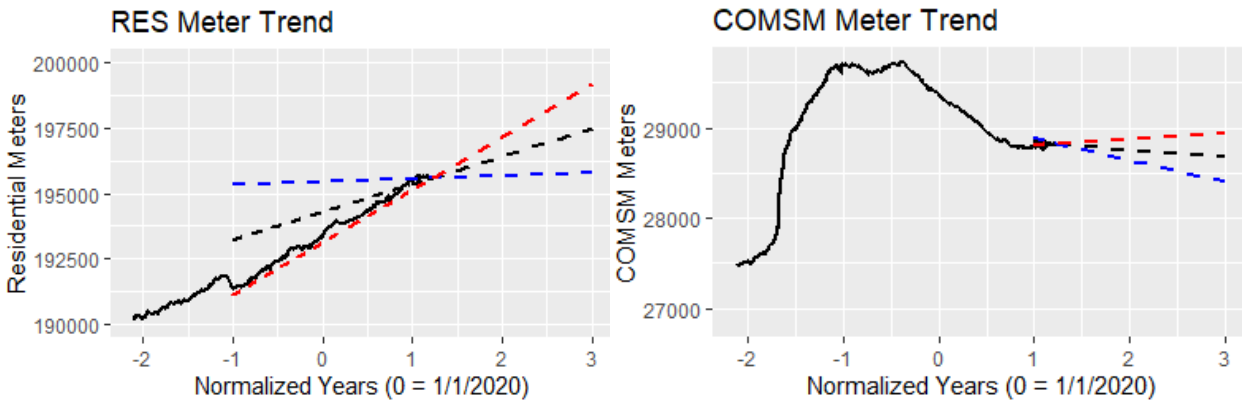
Figure 1 below shows the historical number of customer accounts for residential, commercial/industrial, and agricultural.

Figure 1: Historical number of customers



SCPA discretely extrapolates meter counts for residential, small/medium commercial, large commercial/industrial (E19/E20), agricultural and street lighting / traffic control meters based on recent trends. Figure 2 depicts historic meter trends for the residential and small/medium commercial meter groups with low (blue), mid (black), and high (red) forecast scenarios. This submission is based on the mid scenario, which assumes a 0.60%/year growth for residential meters, a -0.36%/year decline in small commercial meters, and a -1.41%/year decline in industrial meters. Lighting and traffic control meter counts are held flat.

Figure 2- Historic and project meter trends

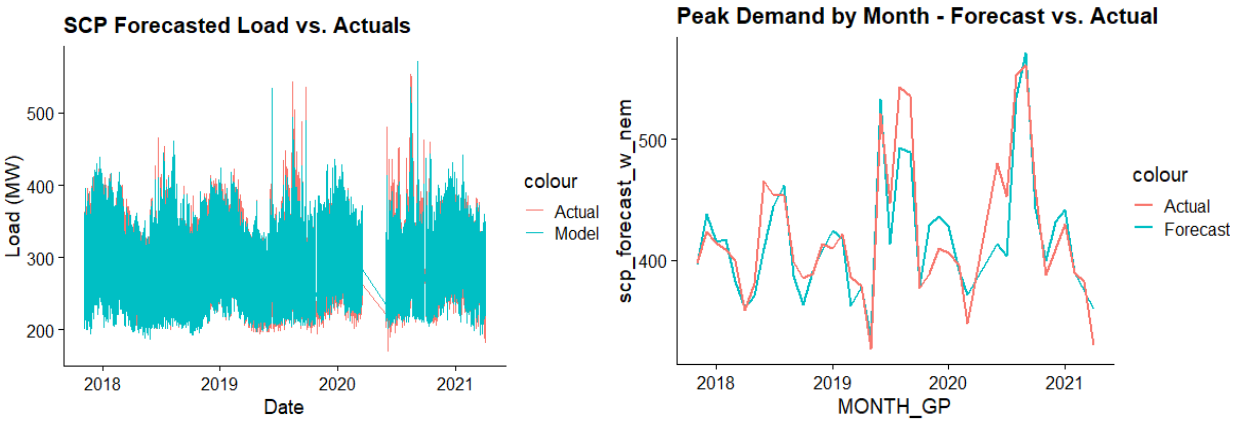


2.2 Load and Demand

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

Per meter usage (without NEM resources) is empirically correlated by customer class to heating and cooling degree days, rolling 3-day average temperatures, and adjusted for seasonality. Monday and Friday, Tuesday through Thursday and weekend/North American Electric Reliability Corporation ("NERC") holidays are also forecasted separately. Proper statistical techniques are used to validate statistical significance and minimize over-fitting in regression or classification models (review of p-values, blind tests, and checking directionality of coefficients). Figure 3 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.

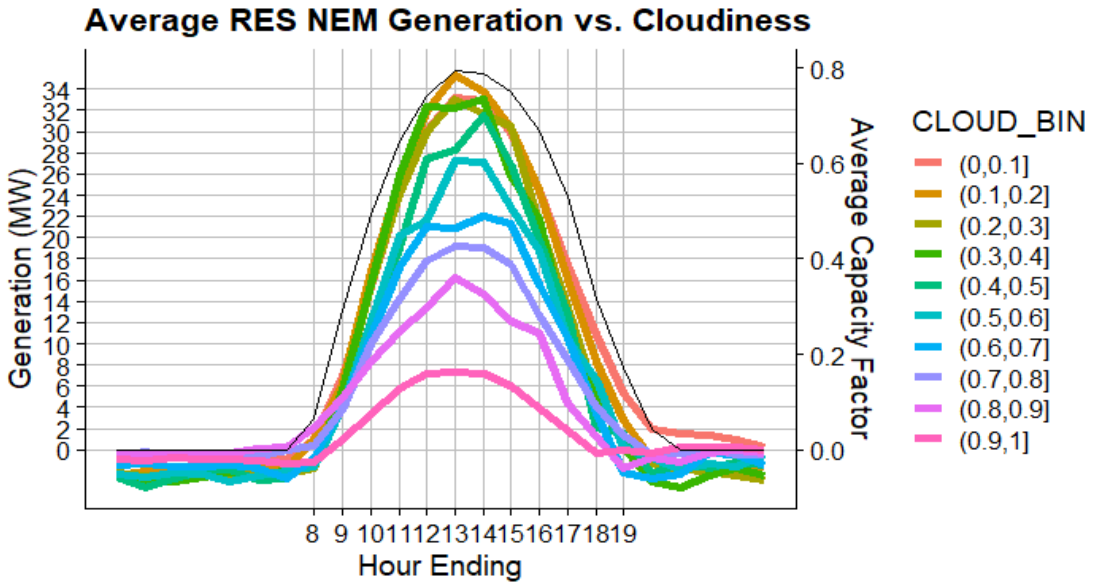
Figure 3- Forecast model vs actuals



The estimated NEM generation is used to adjust actual historical meter data. The estimated NEM generation is derived from an independent empirical model that correlates territory-weighted 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. Figure 4 illustrates how residential NEM generation is empirically correlated to cloud cover for an average day. NEM capacity is extrapolated using the growth represented in the CEC's 2020 Integrated Energy Policy Report update for PG&E territory (TN #236989). Note that the capacity and energy/demand impact reported in Form 3 is incremental to the capacity online in May 2021.

Figure 4- Residential NEM solar vs cloud cover



For generating the load and demand forecast, the trained model is fed the calendar year, historical weather, and trends in meter counts and NEM capacity by customer class.

The model outputs daily energy usage that is then adjusted for the DA departure and the load modifiers discussed in Section 3.10, below. An 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.

2.3 Reasonableness

SCPA tracks the actual settled CAISO T+55 data and invoiced retail sales against forecasts monthly. While SCPA's forecast methodology and assumptions remain fixed, SCPA's forecast utilizes the most recent data available. Therefore, the forecast results change monthly with updated CAISO settlements. The comparison listed here is the 2017 and 2019 IEPR submitted forecasts versus actual data. SCPA submitted the IEPR forecast for the first time in 2017 and therefore has no forecasts for comparison prior to 2017. Since the 2019 submitted IEPR forecast, SCPA has obtained actual data for 2019 and 2020. Note that because IEPR is submitted every 2 years, SCPA was unable to adjust forecasts to account for observations and events that occurred between submissions, such as wildfires and COVID-19. The IEPR forecast versus actual comparison is shown below in Table 1.

Table 1: IEPR forecast vs actual data

	Year	IEPR Forecast	Actual	% Forecast Error	Notes
Retail Sales (MWh)	2017	2,402,538	2,380,562	-0.91%	
	2018	2,573,714	2,409,427	-6.38%	Unexpected load departure of: 1. Homes & businesses lost to October 2017 wildfires 2. Large "super-user" residential customers load decline and departure
	2019	2,459,737	2,360,421	-4.00%	The forecast error is primarily attributable to the installation of a new large-scale fuel cell project at one of SCPA's highest energy user sites, another of SCPA's highest energy users closing their site, PSPS events, and Kincade fire evacuations of approximately 38% of SCPA's customers
	2020	2,469,816	2,343,097	-5.13%	Notes from 2019 apply to 2020 as well except fire evacuations were due to Walbridge & Meyers and Glass Fire evacuations. In addition, the changes in electricity use due to COVID were not known at the time of forecasting
Peak Load (MW)	2017	524	580	10.66%	September 1st record setting peak of 110 degrees at Charles M Schulz-Sonoma County Airport weather station. Historic average high temp is 84 degrees.
	2018	522	450	-13.82%	Unexpected peak load departure of: 1. Homes & businesses lost to October 2017 wildfires 2. Large "super-user" residential customers load decline and departure
	2019	469.6	519.7	10.67%	Higher than expected August peak day.
	2020	472.8	564.7	19.44%	While annual electricity use dropped from forecast in 2020, the peak load increased. This was due to a summer "Heat Storm" that was a 1-in-35-year event paired with more people at home using inefficient air conditioners during COVID conditions.

SCPA runs sensitivities of forecast to weather. Different weather years can change annual energy load +/- 2% from forecast and annual peak +24%/-8% from forecast. As such, SCPA could not 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 and the unaccounted-for energy ("UFE"). 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.

PG&E provided SCPA the customer list and aggregate hourly profile of customers anticipated to switch to DA in 2021 and 2022. SCPA used this data to train a model that estimates the demand for these customers given weather conditions. The same Typical Meteorological Year ("TMY") was used as input to this model to determine the energy and resulting demand impact from removing these customers. Other than departing DA customers, SCPA is not aware of any specific customers that plan to opt out.

3.6 Weather Adjustment Procedures

SCPA uses heating and cooling degree days, rolling 3-day average temperatures, cloud cover, humidity, and adjustments for seasonality.

Table 2 shows the weather stations used and the weighting used within the forecast.

Table 2- Weather stations and weighting

city_id	city	temp_weight	humidity_weight	cloud_cover_weight
1	SANTA ROSA	0.579	0.579	0.592
2	SONOMA	0.082	0.082	0.093
3	UKIAH	0.071	0.071	0.050
4	CLOVERDALE	0.064	0.064	0.064
5	FORT BRAGG	0.045	0.045	0.039
6	PETALUMA	0.159	0.159	0.162

SCPA normalizes its forecast for weather by running the trained load model on an extensive history of weather (2007-2020) and selecting a representative weather year for each month based on its proximity to the median energy usage and demand. Figures 5 and 6 plot the energy usage and demand for the representative weather year input (dark black) versus the broader historical data set (each non-black line is a different weather year). The model reproduces the high summer demand observed in 2017, 2019, and 2020, but those results are outliers compared to the broader historical dataset.

Figure 5- Monthly energy use for weather year

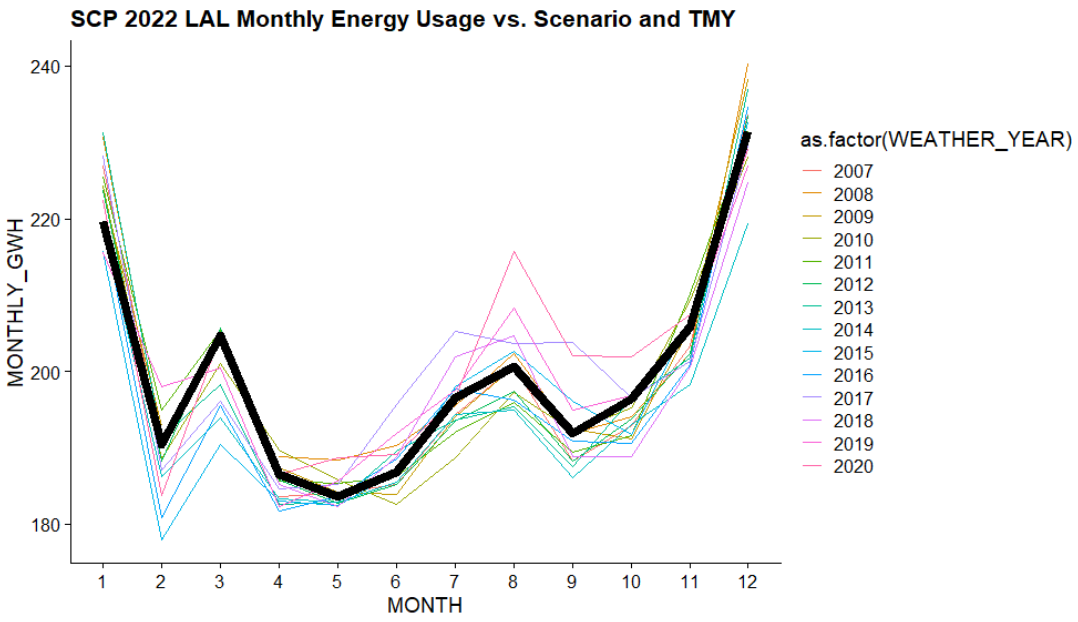
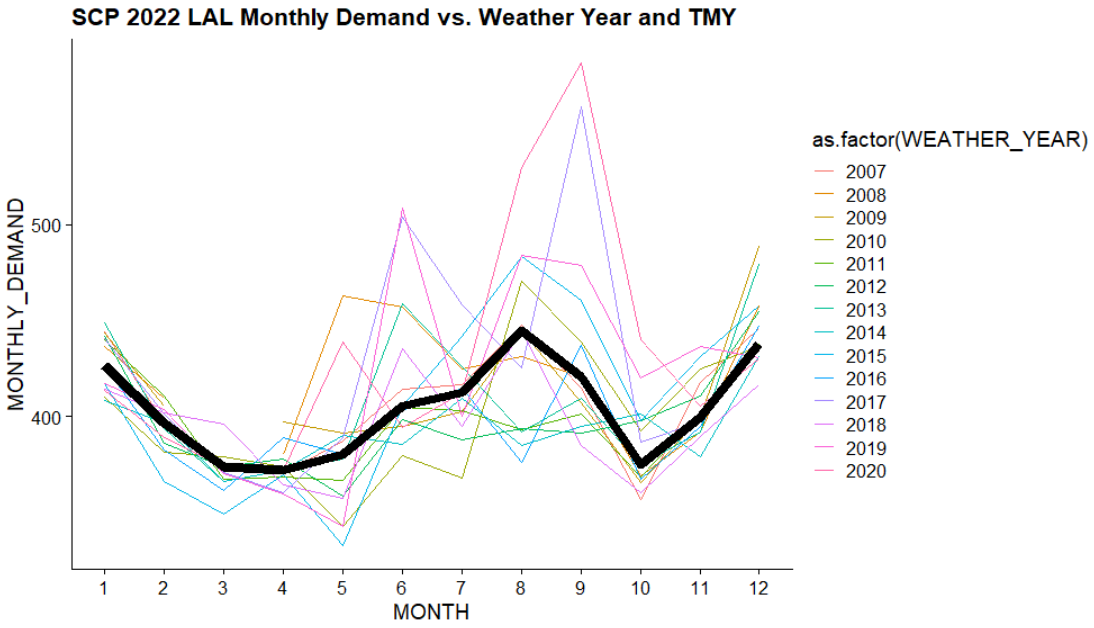


Figure 6- Monthly peak demand for weather year



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.

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 the 2020 IEPR update, which are consistent with observed growth rates in SCPA's territory.

The only discrete demand modifier included in SCPA's forecast outside of the trained model is an increase in usage due to adoption of EVs. SCPA forecasted increased energy usage from EVs by applying its PG&E territory load share to the annual growth in energy usage from residential and commercial light duty electric vehicles ("LDEV") represented in the 2020 IEPR update for PG&E territory. The usage was converted to an hourly profile using a shape derived from the California Public Utilities Commission's ("CPUC") Clean System Power tool used in the 2020 Integrated Resource Planning ("IRP") process. The energy and demand impact from LDEV growth reported in Form 3 is incremental to EVs currently registered as of May 2021.

Demand-side battery storage is currently being implemented and assessed in SCPA territory. SCPA will forecast hourly charging and discharging each year as further data is available.