FORM 4 DEMAND FORECAST METHODS AND MODELS

2019 INTEGRATED ENERGY POLICY REPORT

SONOMA CLEAN POWER AUTHORITY

1   SERVICE AREA AND CUSTOMER BASE

Sonoma Clean Power (SCP) 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 SCP service area have the ability to opt-out of SCP and go back to the local Investor Owned Utility (IOU) Pacific Gas & Electric Company (PG&E). SCP does not serve customers who have opted out or customers that are Direct Access (DA).

SCP serves all customer classes which are broken down into the following load classes:

- RES- all residential
- A-1- small general commercial
- A-6- small general time of use (TOU) commercial
- A-10- medium general demand-metered commercial
- E-19-S- medium general demand-metered TOU secondary voltage
- E-19-P- medium general demand-metered TOU primary voltage
- E-19-T -medium general demand-metered TOU transmission voltage
- E-20-S- maximum demands >1000kW secondary voltage
- E-20-P- maximum demands >1000kW primary voltage
- E-20-T- maximum demands >1000kW transmission voltage
- AG- agricultural
- TC- traffic control
- SL- street/highway/outdoor area lighting

2   FORECASTING METHODOLOGY

2.1   Customer Counts

The first step in SCP's forecast methodology is to forecast customer counts using trends for each load class. Historical opt-out and participation rates, CAISO settled meter counts, and U.S. Census Bureau historical population increases for Sonoma and Mendocino counties combined with Sonoma County Economic Development Board housing stock and employment data is used to forecast the number of customer meters for each load class.

SCP 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- Dec 1, 2014 added the remaining residential customers in the jurisdictions listed above

- Phase 3- Jun 1, 2015 added all customers in the cities of Cloverdale, Petaluma, and Rohnert Park

- Phase 4- Jun 1, 2017 added all customers in unincorporated Mendocino County and the cities if Fort Bragg, Point Arena, and Willits

Figure 1 below shows the number of customer accounts through each phase. Note that in October 2017, the Wine Country fires destroyed thousands of structures which resulted in a loss of approximately 4,800 accounts (noting that the actual closing of these accounts occurred over several months).

Figure 1: Historical number of customers
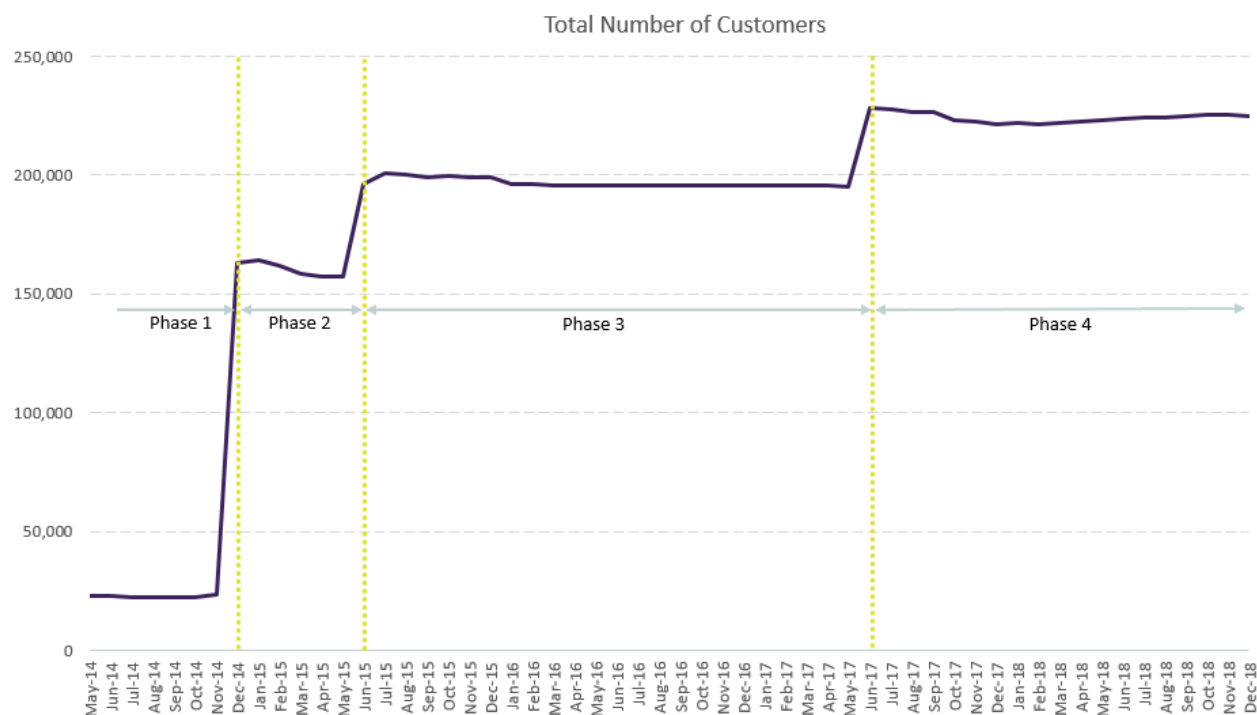
The customer counts listed on Form 7.2 are the average throughout the year. 2014 through 2018 represent actual data, and 2019 through 2030 are forecasts. Opt-outs, closed accounts, and phasing-in of customers varies the total customer count throughout the year.

2.2 Annual Retail Electricity Sales

The load forecast on Form 7.2 includes actual recorded historical data for 2014-2018 and forecasts forward through 2030. SCP's load forecast uses actual recorded historical data in order to forecast forward using the following process:

1. Forecast number of customer meters
   a. Establish historical steady-state opt-out and participation rates (excluding the first couple months following a phase-in) for each customer type listed in Section 1.
   b. Use U.S. Census Bureau historical population and housing data for Sonoma and Mendocino counties combined with the Sonoma Economic Development Board data to establish housing unit increases.

c. Develop fire rebuild estimates to forecast the number of returning customer meters that were destroyed during the October 2017 wildfires.

d. Use observed economic and industry trends for non-residential sector growth.

2. Forecast kWh/meter profile:

a. Establish historical (2015-2018) kWh/meter profiles using actual recorded kWh and the quantity of meters for each customer type for each hour. See Figure 2.

Figure 2: Historical kWh/meter per month
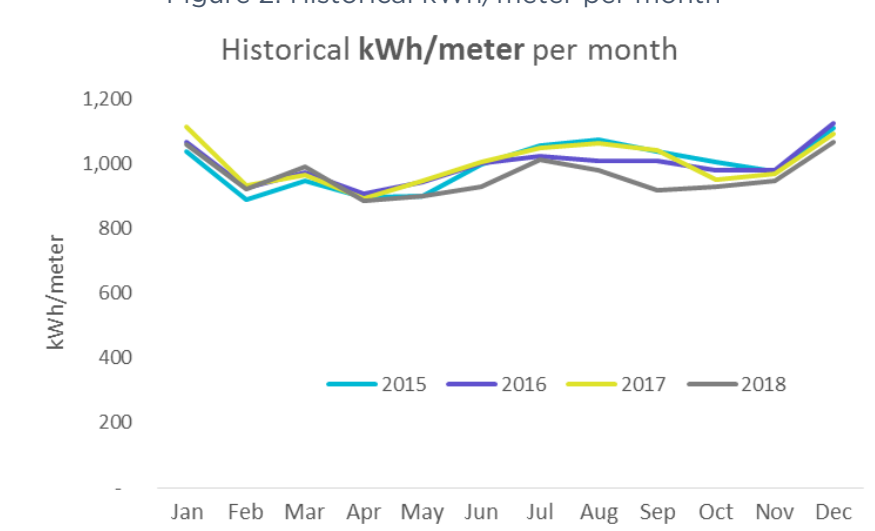
b. Choose a representative kWh/meter profile for each load class and month based on historical kWh/meter averages, weather, extreme natural events, economic and behavioral shifts.

i. Assess weather data from the Schulz-Sonoma County Airport (Santa Rosa, CA) weather station to determine a weather normalization for the forecast utilizing normal Heating Degree Day (HDD) and Cooling Degree Days (CDD) as provided by the National Oceanic and Atmospheric Administration (NOAA).

3. Calculate kWh profile

a. Multiply the total forecasted quantity of meters (#1 above) by the kWh/meter profile (#2 above) to arrive at a base profile for each customer type.

b. Incorporate additional factors to the base profile that impact load over the planning horizon.

i. Adjust for departed or new load due to economic, regulatory, or industry trends.

ii. Forecast efficiency and building electrification trends. These numbers will be refined in future planning processes as more data is available on SCP program uptake.

iii. Forecast additional behind-the meter (BTM) solar capacity using yearly capacity increase trends reported for Sonoma and Mendocino counties from California Distributed Generation Statistics http://www.californiadgstats.ca.gov/charts/

iv. Forecast for electric vehicles using observed uptake as a result of SCP's programs and market trends.

2.3   Peak Demand

Peak demand is forecasted utilizing the same methodology as described above for the annual retail electricity sales forecast.

The maximum coincident total load is determined for each month based on the hourly load profiles for each load class. Note that the maximum total load for each load class may not occur at the total coincident load hour. SCP reports on the load of each load class at the coincident peak load hour.

Figure 3 shows the historical monthly coincident peak per number of meters.

Figure 3: Historical coincident peak kWh/meter per month
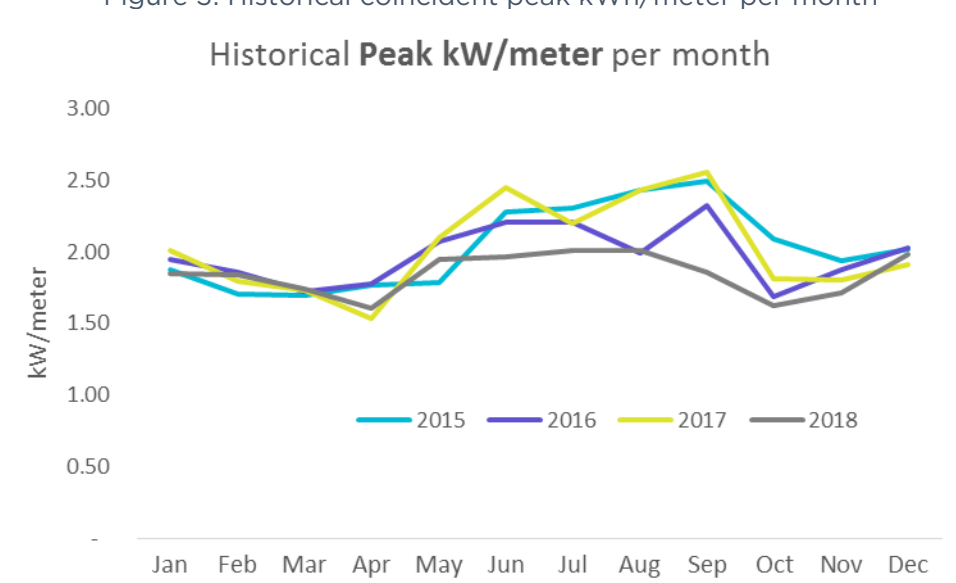
Weather data from the Schulz-Sonoma County Airport (Santa Rosa, CA) weather station is assessed to determine a weather normalization for the forecast utilizing the monthly maximum dry bulb temperature.

2.4   Key forecast model structural equations, Data for dependent and independent variables

SCP based on the methodology described previously. SCP forecasts for each load class with varying considerations. Table 1 details the variables that are considered for each load class forecast.

Table 1: Forecasting components by load class

RES	A1, A6, A10	E19	E20	Ag	TC, SL
Historical averages of load and profile Weather Fire rebuild Housing stock and population data Efficiency trends EV trends BTM solar trends Departed Load from cannabis legalization	Historical averages of load and profile Weather Efficiency trends BTM solar trends EV trends Economic and Industry trends	Most recent historical load and profile Efficiency trends BTM solar trends EV trends Economic and Industry trends	Most recent historical load and profile Efficiency trends BTM solar trends EV trends Relationships with customers	Historical averages of load and profile BTM solar trends	Most recent historical load and profile based on observed efficiency retrofits

SCP recognizes that there are limited data points given the relatively short history of recorded data for SCP, therefore loads as they relate to the components in Table 1 will be refined in the future as more data points are established.

2.5 Sources and Methods used for DER

SCP is not required to fill out Forms 1.7a-1.7c, therefore SCP has no response for this specific item.

In general, SCP uses California Distributed Generation Statistics to forecast trends in BTM solar PV growth specific to Sonoma and Mendocino Counties and uses a generic hourly profile and losses established by the National Renewable Energy Laboratory PVWatts® Calculator for Santa Rosa, CA.

SCP uses internal SCP program historical performance and goals (See Section 3.9) in conjunction with statewide policy to determine long-term adoption of DERs and smart technology. This includes Title 24 building codes regarding energy efficiency and solar for residential new construction, SB1477 regarding low emission technology for space and water heating, and messaging from the Governor's office regarding electric vehicle goals.

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

As continued efficiency and BTM solar installations occur in SCP territory, the afternoon peak is expected to shift more and more into the evening as electric

vehicles are returning to residences to be charged. The impacts of building electrification, BTM storage, and demand response programs will be assessed each year as data becomes available.

2.6 Reasonableness

SCP tracks the actual settled CAISO T+55 data and invoiced retail sales against forecasts on a monthly basis. While SCP's forecast methodology and assumptions remain fixed, SCP's forecast utilizes the most recent data available and therefore the results change monthly with updated CAISO settlements. The comparison listed here is the 2017 IEPR submitted forecast versus actual data. SCP submitted the IEPR forecast for the first time in 2017 and therefore has no forecasts for comparison prior to 2017. Since the 2017 submitted IEPR forecast, SCP has obtained actual data for 2017 and 2018. Note that because IEPR is submitted every 2 years, SCP was unable to adjust the 2018 forecast to account for known load/peak/customer decline due to the loss of approximately 4,800 accounts from the October 2017 wildfires and higher than anticipated Mendocino County opt-outs. The IEPR forecast versus actual comparison is shown below in Table 2.

Table 2: 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 (see Section 3.5)
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 (see Section 3.5)
Total Customers	2017	215,764	212,733	-1.40%	Unexpected customer departure of: 1. Homes & businesses lost to October 2017 wildfires 2. Higher than anticipated Mendocino opt-outs
	2018	229,419	223,579	-2.55%	Unexpected customer departure of: 1. Homes & businesses lost to October 2017 wildfires 2. Higher than anticipated Mendocino opt-outs 3. Large "super-user" residential customers departure (see Section 3.5)

3   ADDITIONAL FORECAST DETAIL

3.1   Forecast Calibration Procedures

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

3.2   Economic and Demographic Data

SCP is not required to fill out Form 2, therefore has no response to this specific item. SCP does utilize 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 to predict trends (such as local meetings, workshops, conferences, and subject area experts).

3.3   Historical Peak and Projected Peak Loads

SCP is not required to fill out Form 1.3 to report peak loads of sectors or customer classes, therefore SCP has no response for this item.

3.4   Energy and Peak Loss estimates

SCP is not required to fill out Forms 1.2, 1.3, or 1.4, therefore SCP has no response for this item.

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

SCP has established that there is a subset of residential customers that use significantly more electricity than normal residential customers ("super-users" that use 7x- 300x the normal residential customers). These "super-users" tend to either be mobile home parks or residences on EV or Time-of-Use (TOU) residential rates that appear to be conducting non-residential functions within the home (such as cannabis cultivation). SCP investigated these "super-users" and determined that they make up less than 1% of SCP residential customers, but more than 10% of residential load. SCP has identified that a significant portion of these customers returned to PG&E, closed accounts, or reduced their load drastically in 2018 from previous years. The decrease in load from these customers is significant and there is no reason to believe this load will return to SCP. SCP forecasts a permanent loss of this load.

SCP's forecast is also inclusive of load departure due to the October 2017 wildfires.

3.6   Weather Adjustment Procedures

SCP utilizes hourly meteorological data from the Schulz-Sonoma County Airport (Santa Rosa, CA) weather station provided by NOAA.

SCP analyzes historical HDD and CDD against normal HDD and CDD (as provided by NOAA) to forecast load for a normal year. SCP builds forecasts on an hourly basis, so the monthly coincident peak can be derived by the maximum hourly load in any given month. SCP does utilize historical monthly maximum dry bulb temperature to calibrate and assess the reasonableness of the forecasted peak.

Figures 4 and 5 show the historical recorded HDD and CDD plotted against the normal.

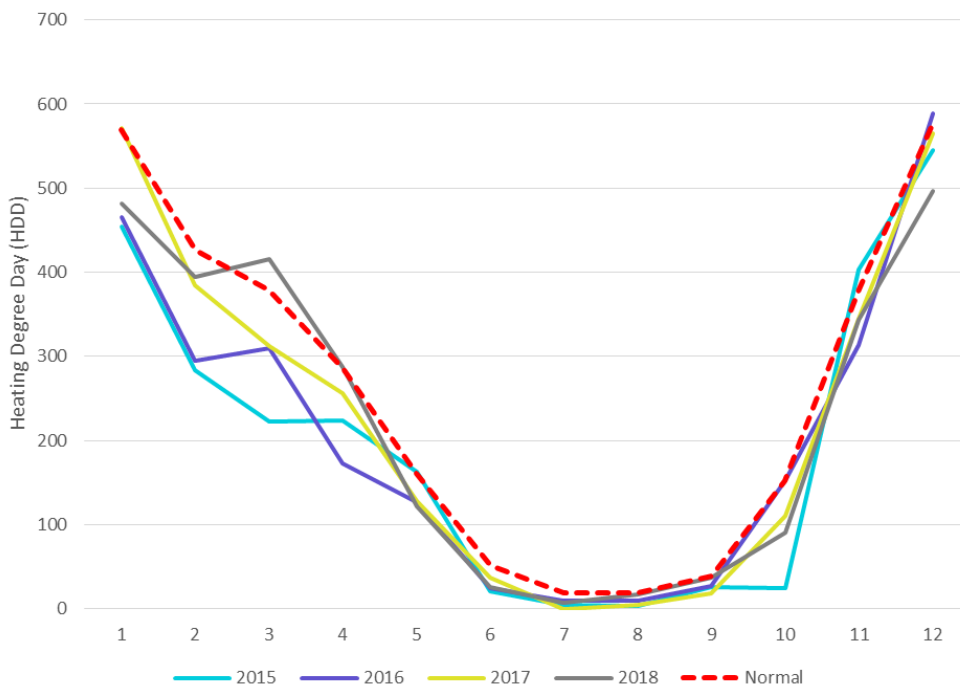### Figure 4: Santa Rosa Heating Degree Days
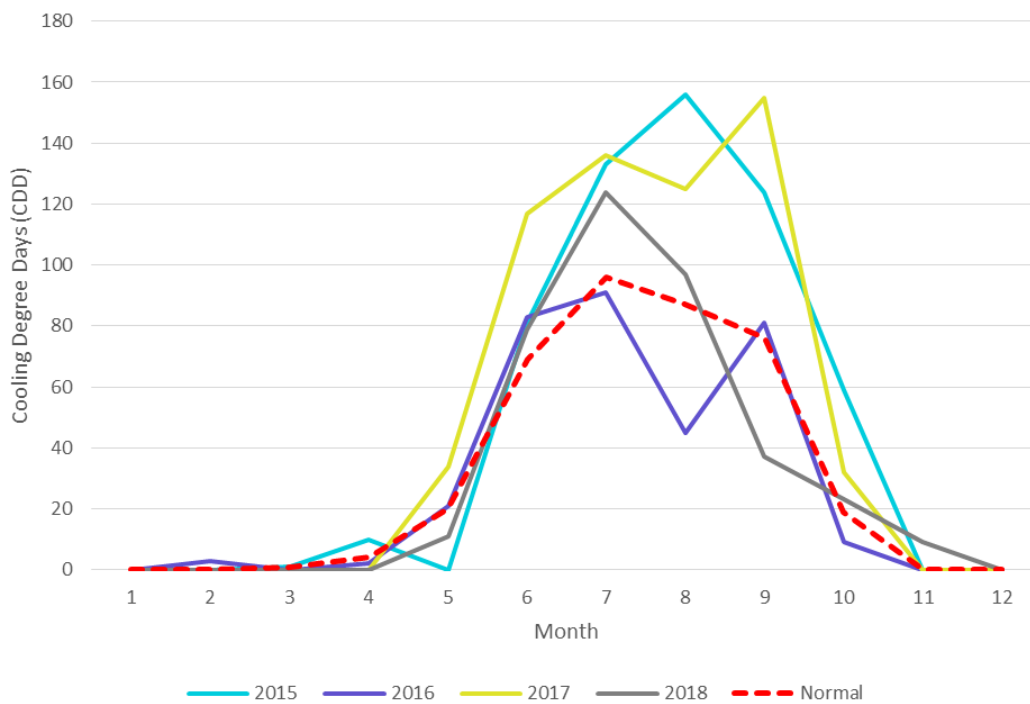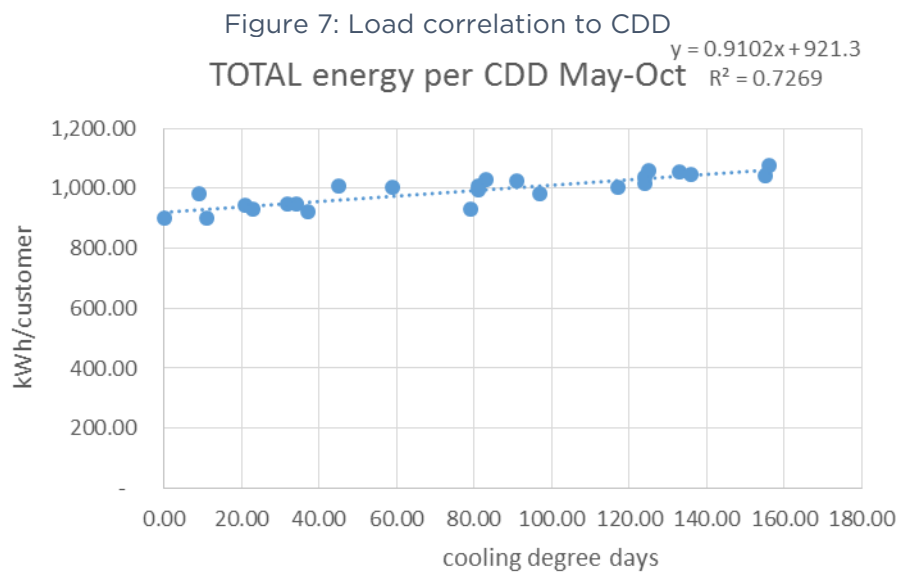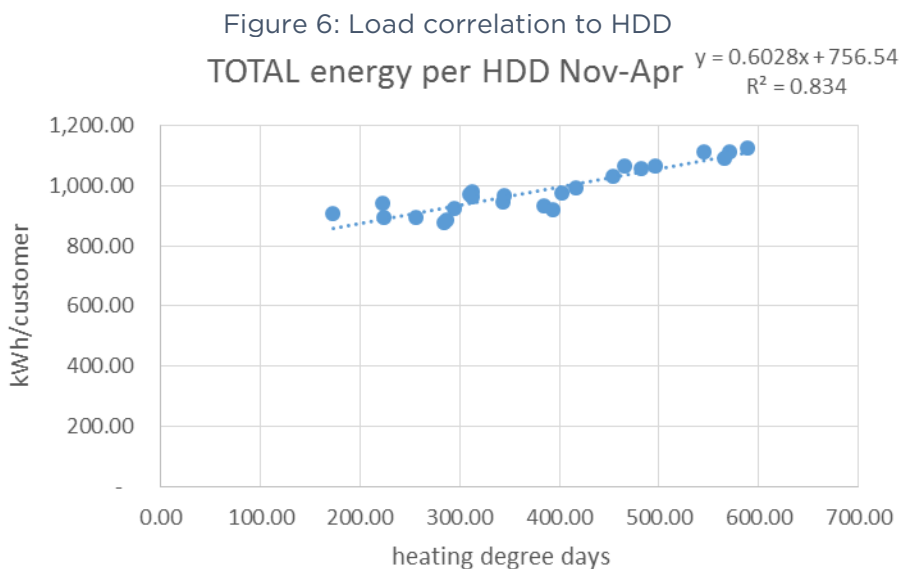
Heating Degree Days

Figure 5: Santa Rosa Cooling Degree Days

Cooling Degree Days

Figures 6 and 7 show the load correlation to degree days for winter and summer months and the corresponding Coefficient of Determination (R^2). SCP recognizes that there are limited data points given the relatively short history of recorded data for SCP, therefore the correlation fitted equations and normalization procedures are currently used for reference and will be refined in the future as more data points are established.

Figure 6: Load correlation to HDD

TOTAL energy per HDD Nov-Apr $y = 0.6028x + 756.54$
$R^2 = 0.834$

Figure 7: Load correlation to CDD

TOTAL energy per CDD May-Oct $y = 0.9102x + 921.3$
$R^2 = 0.7269$

As discussed previously, the initial peak load forecast is developed from the forecasted hourly load and coincident maximum load for each month. This base forecasts is compared against historical peaks and correlation to the monthly maximum dry bulb temperature. Figure 8 shows the historical monthly maximum dry bulb temperature and Figure 9 shows the correlation of monthly peak load to monthly maximum temperature. SCP recognizes that there are limited data points given the relatively short history of recorded data for SCP, therefore the correlation

fitted equations and normalization procedures are currently used for reference and will be refined in the future as more data points are established.

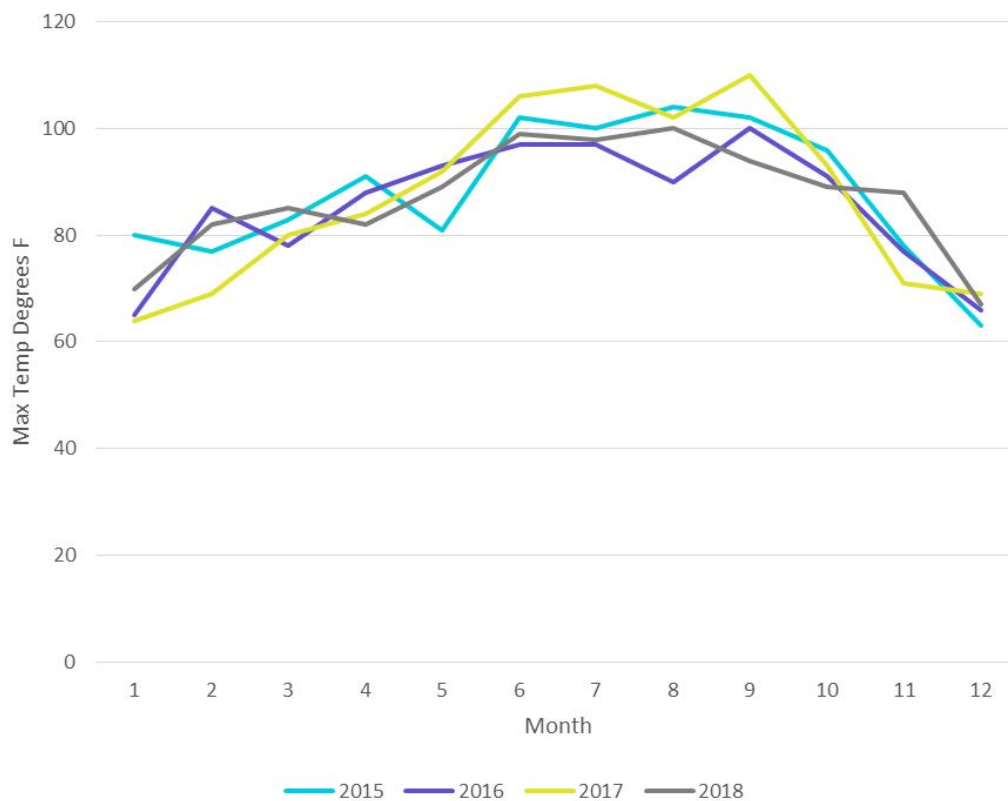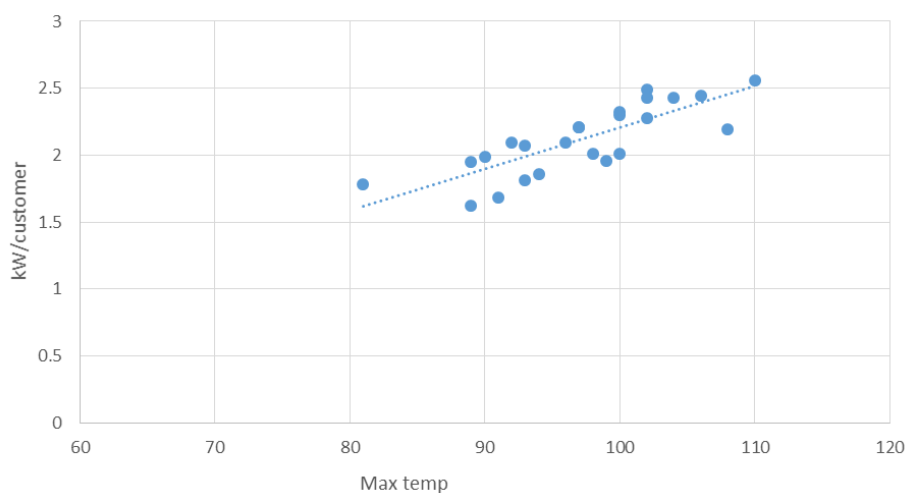Figure 8: Historical monthly maximum dry bulb temperature

Figure 9: May-Oct Peak correlation to monthly max temp

$y = 0.031x - 0.8928$
$R^2 = 0.6508$

SCP is not required to fill out Form 1.5, therefore SCP has no response to this specific item.

3.7 Hourly Load by Subarea

SCP is not required to fill out form 1.6b, therefore has no response for this item.

3.8 Local Private Supply Estimates

SCP is not required to fill out forms 1.7a through 1.7c, therefore has no response for this item.

3.9 Energy Efficiency and Demand Side Management

SCP currently operates customer programs which are designed to reduce load, shift load, or integrate with renewable resources and increase system reliability. SCP does not currently duplicate or compete with PG&E's customer programs.

The following programs are aimed at reducing load and are considered in SCP's forecast:

- The Advanced Energy Rebuild (AER) Program is a unique program created in partnership with PG&E and the Bay Area Air Quality Management District (BAAQMD) to incentivize those rebuilding their homes after the October 2017 fires to do so in an energy efficient and carbon-free manner. While these homes will represent a significant reduction in load over their pre-fire equivalents, SCP expects to see a gradual increase in residential customer load as these homes come online.
- SCP provides a net energy metering program called NetGreen with approximately 4,400 BTM solar customers. Both residential and non-residential customers take advantage of this program.
- SCP has partnered with the County of Sonoma and the Sonoma County Water Agency to provide Do-It-Yourself Energy and Water Saving Toolkits that include energy and water efficiency devices for homes such as LED lightbulbs, low-flow devices, weather-stripping at almost all of the libraries in SCP's territory.
- SCP has a program to provide free assistance to commercial customers with energy audits or in planning and implementing energy efficiency upgrades.
- SCP was awarded a grant from the CEC to promote energy efficiency and fuel substitution technologies. The goal of the grant is to deploy energy efficiency in a total of 300,000 square feet of customer space and reduce energy usage by 10% in participating residential projects and 20% in participating commercial projects.

The following programs are aimed at shifting load and are considered in SCP's forecast:

- A Commercial and Industrial Battery Storage Pilot Program was implemented to assist commercial customers in reducing their demand charges through battery storage.
- GridSavvy is a grid reliability platform with the capability of automatically dispatching technologies such as electric vehicle chargers, heat pumps, thermostats and stationary batteries to both increase and decrease load on a fast signal. The goal of GridSavvy is to achieve Proxy Demand Response participation in 2020, Non-Generating Resource participation in 2024 and qualified System Resource Adequacy in 2030. Currently there are over 600 customers that are participating in GridSavvy's first offering.

3.10 Climate Change and Electrification

Although SCP is not a UDC, transportation and building electrification are considered in forecasts.

Since 2016, 1250 electric vehicles have been sold or leased through SCP's Drive EV electric vehicle program. SCP also provides Free Residential Level 2 Charging Stations to its customers. This program resulted in the shipment of 2,622 (as of March 25, 2019) electric vehicle charging stations.
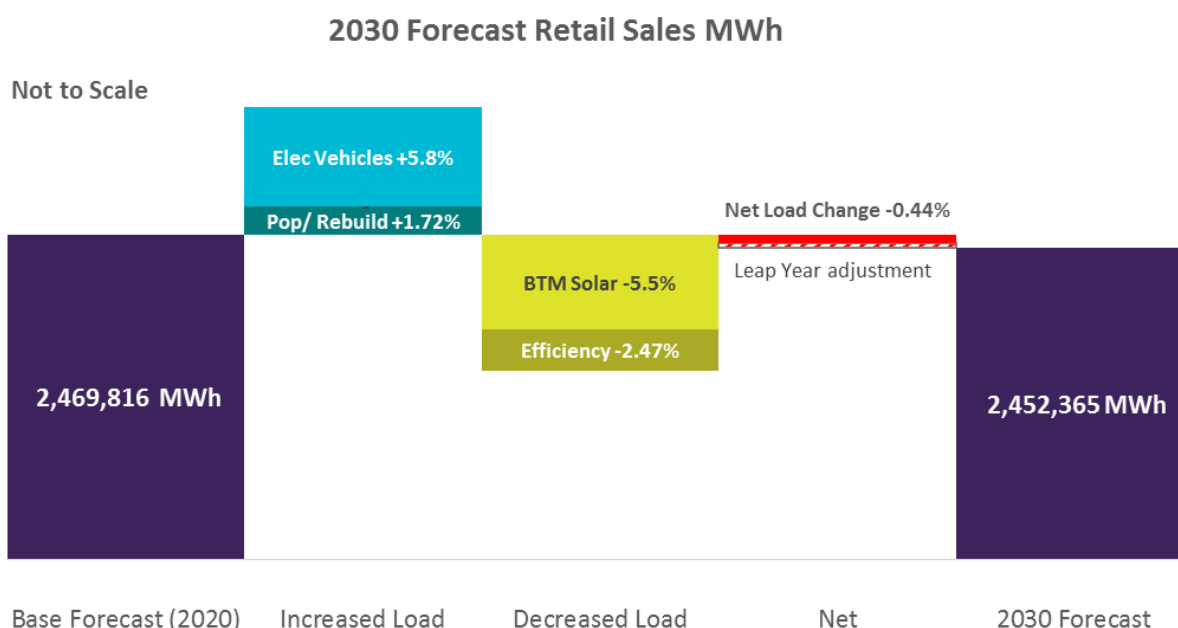
SCP's goal is to achieve 10,000 EVs in Sonoma and Mendocino counties by 2020 and 100,000 by 2030. As of October 2018 *(latest data from DMV[1])*, there are 8,222 registered EVs and plug-in hybrids for Sonoma and Mendocino counties.

SCP utilizes electric vehicle charging profiles presented in the California Energy Commission's *Staff Report - California Plug-In Electric Vehicle Infrastructure Projections 2017-2025* docketed 3/16/18.

4   Planning horizon forecast

SCP's load is expected to remain relatively stable through the planning horizon with a 0.44% decrease in load (after adjusting for the 2020 leap year). See Figure 10 for the forecast load changes from 2020 to 2030. The 2020 "Base" year forecast load increases by 1.72% from population and rebuilding and by 5.8% from electric vehicles. This increase in forecast load is offset by a projected decrease in load of 2.47% from energy efficiency and 5.5% from BTM solar.

Figure 10: Planning Horizon load forecast

2030 Forecast Retail Sales MWh

Not to Scale

- Elec Vehicles +5.8%
- Pop/ Rebuild +1.72%
- BTM Solar -5.5%
- Efficiency -2.47%
- Net Load Change -0.44%
- Leap Year adjustment

2,469,816 MWh

2,452,365 MWh

Base Forecast (2020) Increased Load Decreased Load Net 2030 Forecast

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[1] https://www.dmv.ca.gov/portal/dmv/detail/pubs/media_center/statistics