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Form 4 - Demand Forecast Methods and Models for San José Clean Energy

Geography

San José Clean Energy (SJCE) is a single jurisdiction community choice aggregator operated by the City of San José that has provided electricity service to municipal, commercial, industrial, and residential accounts within the jurisdiction of the city since 2019.

Customer Classes

SJCE customer classes include residential, commercial, industrial, agricultural, streetlights and traffic lights. **Table 1** below maps the IEPR reported sectors, customer class groupings used for forecasting, and rate groups.

Table 1: SJCE Customer Classes

IEPR Sector Grouping	SJCE Customer Class	SJCE Rate Group[1]
Residential	Residential	Res
Commercial	Small Commercial	A1, A6, BEV1, BEV2
	Medium/Large Commercial	A10, E19P, E19S
Industrial	Industrial	E20P, E20S, E20T
Agricultural	Agricultural	AG
Street Lights	Street Lights	LS1
Traffic Lights	Traffic Lights	TC1

Data, Methods and Models

SJCE's most recent long-term demand forecast process uses statistical models based upon historical monthly net electricity demand and meter count data by SJCE customer class, historical weather data for the City of San José, and economic and demographic data specific to the City of San José or the San José-Sunnyvale-Santa Clara MSA.

Demand Data

SJCE's recent long-term forecast process used historical monthly demand and meter count data for the period of April 2019 to December 2022. Note that SJCE began full service to residents and commercial businesses in 2019, therefore historical meter data is limited. **Figure 1** and **Figure 2** below illustrate SJCE's total monthly energy and peak demand history, respectively.

[1] https://sanjosecleanenergy.org/commercial-rates/#rates

Figure 1: SJCE Monthly Energy Demand

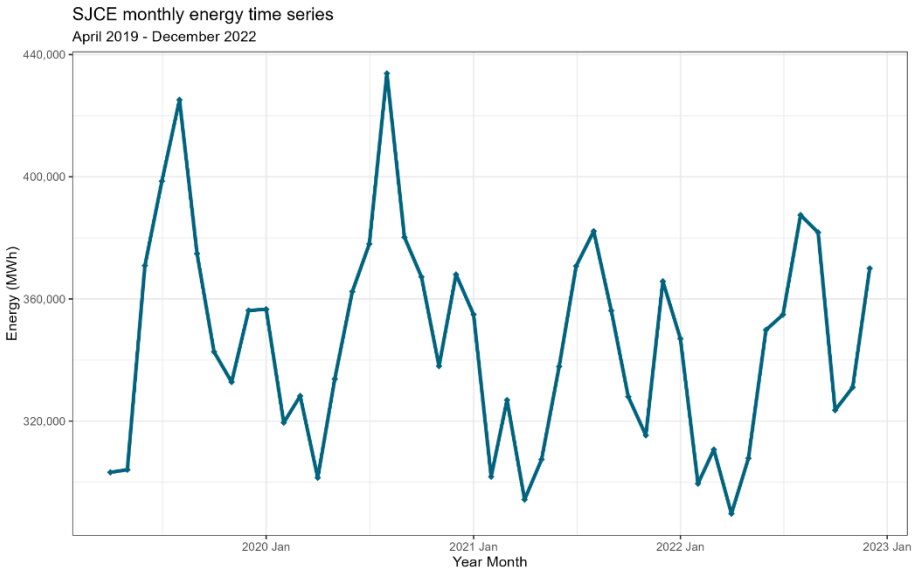
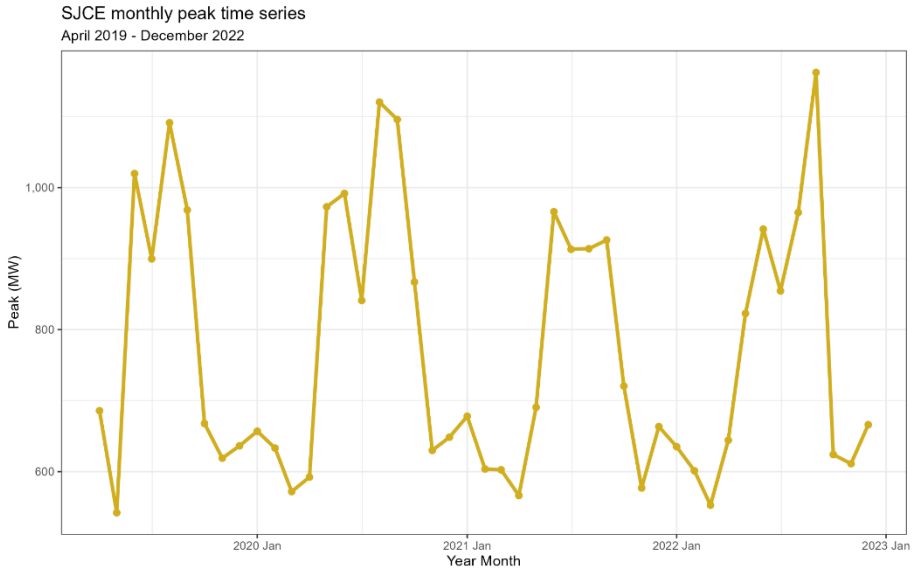


Figure 2: SJCE Monthly Peak Demand



Weather Data, Weather Normalization, and Climate Change

20 years of historical weather data was collected from the San José International Airport weather station, KSJC, to use in weather sensitive forecasting models. Monthly averages were calculated using 10 years of weather data to generate normalized weather patterns for the monthly forecasts. 10-year averages were selected to account for more recent trends in warming due to climate change. **Figures 3** and **4** compare historical monthly cooling and heating degree days (CDD/HDD) against 10 and 20-year averages. The figures show that 10-year average CDDs are higher in summer months and lower in winter months compared to 20-year averages reflecting the warmer average daily temperatures in more recent history.

Figure 3: KSJC Monthly CDD Comparison

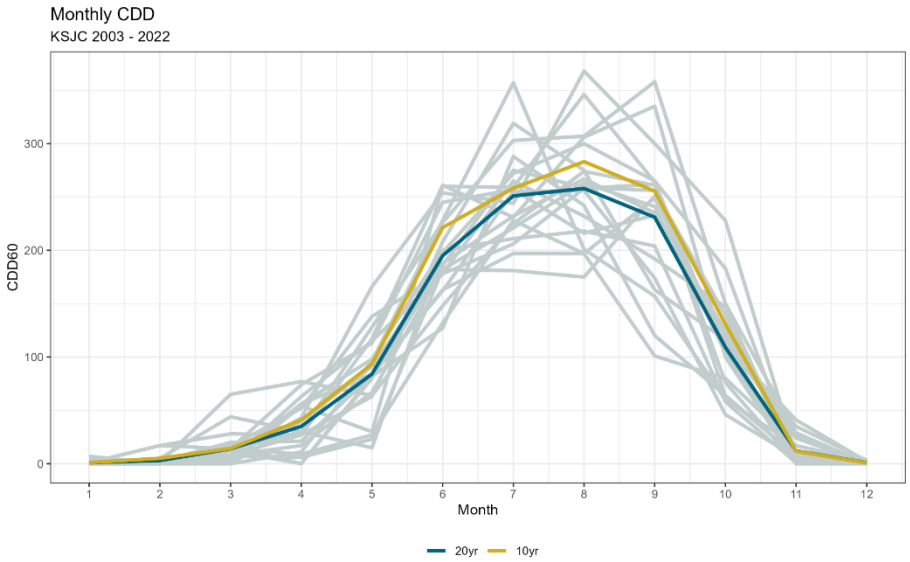
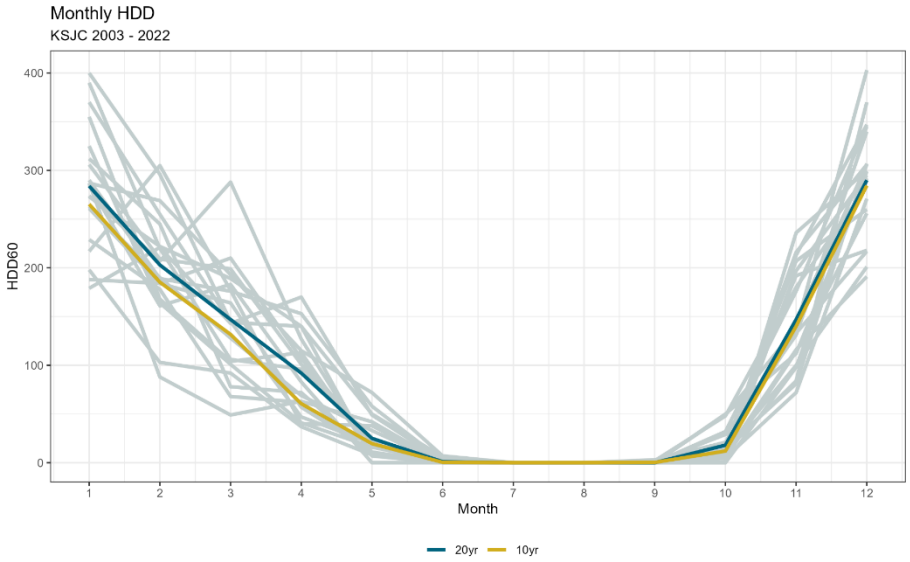


Figure 4: KSJC Monthly HDD Comparison



Economic and Demographic Data

Historical economic and demographic data was collected from the FRED online database and the US Census. [2] Monthly economic and demographic forecasts were developed using historical trends, household and commercial/industrial floorspace projections from the City of San José Planning Division and economic projections from the March 2023 UCLA Anderson Forecasts for

[2] https://fred.stlouisfed.org

California.[3,4] The primary economic and demographic drivers used in SJCE's forecasts are total population, total households, commercial/industrial floorspace, and sector specific employment.

Methods and Models

Seven monthly net energy forecast models were developed by customer class grouping: residential, small commercial, medium/large commercial, industrial, agricultural, streetlights, and traffic lights.

Residential

The residential energy demand forecast was generated using an econometric model specified to estimate net energy demand per residential meter as a function of CDD, HDD, estimates of persons per household for the City of San José, seasonal dummy variables, and additional dummy variables to account for the impacts of the COVID-19 pandemic. The forecast for residential energy demand per meter was generated using the normal weather assumption and projections of persons per household. The total residential energy demand forecast was then derived by multiplying the forecasted energy per meter by the total number of projected residential meters. Residential meters were forecasted to grow at a similar rate as the total household projection for the City of San José.

Small Commercial

The small commercial energy demand forecast was generated using an econometric model specified to estimate net energy demand per small commercial meter as a function of CDD, HDD, small commercial employment share, seasonal dummy variables, and additional dummy variables to account for the impacts of the COVID-19 pandemic.[5] Once the model was estimated a forecast of small commercial energy demand per meter was generated using the normal weather assumption and projections of the small commercial employment share. The total small commercial energy demand forecast was then derived by multiplying the forecasted energy demand per meter by a projection of the total small commercial meters. The forecast for total small commercial meters was developed using projections of commercial floorspace by the City of San José Planning Division and an assumption for commercial floorspace per building (as proxy for floorspace per meter) from EIA's 2018 Commercial Building Energy Consumption Survey, approximately, 16,000 sq. ft. per meter. [6]

Medium/Large Commercial

The medium/large commercial energy demand forecast was generated using an econometric model specified to estimate net energy demand per medium/large commercial meter as a function of CDD, seasonal dummy variables, and dummy additional dummy variables to account for the impacts of the COVID-19. Once the model was estimated a forecast of medium/large commercial energy demand per meter was generated using the normal weather assumptions. The total medium/large commercial energy demand forecast was then derived by multiplying the forecasted energy demand per meter by a forecast of the total medium/large commercial

[3] https://www.anderson.ucla.edu/about/centers/ucla-anderson-forecast
[4] https://www.sanjoseca.gov/your-government/departments-offices/planning-building-code-enforcement/planning-division/development-data/activity-highlights-five-year-forecast
[5] Small commercial employment share for SJCE was calculated as employment in leisure and hospitality sectors plus retail employment as a share of total commercial employment. Total commercial employment excludes employment in the industrial sectors: manufacturing, construction, and resource extraction.
[6] https://www.eia.gov/consumption/commercial

meters. The forecast of total medium/large commercial meters was developed using same process described above for small commercial meters.

Note that HDD was not included in this model due to finding little statistical significance during testing. It seems reasonable that larger commercial building customers rely more heavily on gas for heating in cooler months and therefore electricity demand for this group is less responsive to HDD, but this assumption will need further evaluation as building electrification efforts continue to develop. Specific economic drivers were excluded from the model specification also due to finding little statistical significance. This result could be attributed to the impact of the COVID-19, trends in remote work for office workers, and a lack of a long historical energy demand data for testing model fit. For example, prior to 2020 it would seem reasonable to assume that increased office worker employment would lead to increased electricity demand for large offices but now that many office workers have options for remote work, the linkage between employment and energy demand may have been dampened. This assumption will continue to be evaluated as trends in remote work evolve and more historical demand data is collected.

Industrial

The industrial net energy demand forecast was generated using an econometric model specified to estimate total net energy demand for industrial customers as function of CDD, industrial employment, total industrial meters, seasonal dummy variables, and dummy variables to account for the impacts of the COVID-19.[7] The forecast was generated using the normal weather assumption and projections of industrial employment and meters. The industrial meter forecast was developed using a historical estimate of industrial floorspace per meter and projections of total industrial floorspace from the City of San José Planning Division.

Agricultural and Lighting

The agricultural net energy demand forecast is a fixed value based on the average of the most recent months of historical demand data, while the streetlight and traffic light forecasts were generated using independent exponential smoothing models using season and trend where applicable. The agricultural and lighting classes are not expected to deviate significantly from recent history.

Peak and Hourly

Hourly load forecasts were produced by shaping the monthly energy forecasts. Hourly shaping factors were developed by month and typical temperature week for the residential, small commercial, large/medium commercial, and industrial sectors. As such the load shapes reflect at least one hot week and one cool week in each month for each sector. The monthly energy forecasts were then dispersed by the forecasted load shapes. Hourly agricultural and street/traffic lighting loads were based on monthly averages.

Forecast Comparison

The limited historical data set along with the impacts of the COVID-19 pandemic make comparisons with previous forecasts difficult, but it appears that the current SJCE forecast is a reasonable expectation given the modeling approach and recent trends in the economic and demographic drivers that were used to develop the forecast. As seen in **Figures 1** and **Figures 2** previously, monthly energy and peak demand levels have been reduced after 2020 and maintained a similar trend through 2022 even when accounting for the most recent extreme summer weather. This reduction in demand appears to align with post-COVID-19 changes to

[7] Industrial employment for SJCE is the sum of manufacturing; transportation, warehouse, and utilities; and total government employment.

remote work habits; the recent estimates of declining population in Bay Area communities such as the City of San José as seen in the most recent census data; and the expected slowdown in the typical population growth trends over the next decade.[8,9] Given these current trends the residential and commercial energy demand forecasts, which account for approximately 90 percent of SJCE's customer demand, are modest.

Load Modifiers

Since SJCE's forecast for 2023 was based upon statistical models using historical load data from 2019 to 2022, the impacts of load modifiers such as energy efficiency, electric vehicles, and residential time of use rates were assumed to be captured in the historical data and carried forward through the forecast period in Forms 1.1b and 1.3. These and other potentially significant load modifiers such as building electrification and future large load projects will be evaluated in future forecasting efforts.

Other Load Modifier Impacts in Form 3

SJCE includes the annual energy and coincident peak demand impacts of demand modifiers on forecasts provided in Form 1.1b and Form 1.3 in four primary areas: (1) Energy Efficiency, (2) Light-Duty EV Installations, (3) Caltrans Electrification, and (4) Data Centers. Although these demand modifier impacts are not embedded in the numbers in Forms 1.1b and 1.3, we do provide supplemental tables in Forms 1.1b and 1.3 with the totals of the load modifiers in each year from Form 3.

Energy Efficiency

SJCE began administering CPUC energy efficiency programs in late 2022. More details on those estimates are described below:

- Units selected: Sites – Each project will consist of slightly different energy efficiency measures aimed at optimizing facility reductions. Therefore, our metric will be the number of sites/facilities that are upgraded each year.
- First year values:
    - Residential: 250 sites for a total of 33 MWh energy reduction and 0.0039 MW peak demand reduction. This estimate has been updated since the 2021 IEPR filing.
    - Commercial: 154 sites for a total of 9,085 MWh energy reduction and 1 MW peak demand reduction. This estimate has been updated since the 2021 IEPR filing.
- The program is currently planned to run for three years, ending at the end of 2024. Work is expected to continue beyond 2024 with similar energy savings amounts being produced each year. The commercial program is estimated to ramp down the number of annual sites beginning in 2028 and decreasing further in 2032.
- Demand impacts are based on SJCE's forecasted energy efficiency programs for 2022-2024 and plans to extend programs as authorized into the following years.
- Forecasted programs utilize CPUC-approved workpapers to estimate average site savings and average site demand reductions and the CEDARS Cost-effectiveness Tool (CET) to calculate annual gross savings and gross demand reductions.
- The number of sites in both residential and commercial sectors are based on a market

[8] https://www.census.gov/data/tables/time-series/demo/popest/2020s-state-total.html
[9] As discussed by the chief demographer at the California Department of Finance at the CEC's most recent workshop on California's economic outlook - https://www.energy.ca.gov/event/workshop/2023-01/commissioner-workshop-californias-economic-outlook

assessment to determine achievable savings potential.

Energy efficiency estimates provided are only for SJCE's program, but SJCE customers can participate in energy efficiency program from PG&E and BayREN as well. The impacts of other programs are not reflected in SJCE's IEPR filing.

Light-Duty EV Installations:

Units Selected:

Battery Electric Vehicles (BEV) – Light Duty Battery Electric Vehicles in San José were selected as the unit. SJCE is including all BEV counts in Residential as this is expected to account for most registrations. However, the energy forecasted for these vehicles is split between residential and commercial to account for workplace charging and future 'middle of the day' charging incentives. It's likely that some of these vehicles are in fact passenger vehicles being used by businesses as part of their light duty fleet. SJCE currently does not have this level of granularity, but future data sources will allow for a more accurate representation between the various sectors.

First Year Values:

Although it's anticipated that there are over 35,000 BEVs and 12,000 Plug-in Hybrid Vehicles (PHEV) in San José today, the load for vehicles purchased through the end of 2022 is assumed to already be accounted for in the existing load forecast (Forms 1.1 and 1.3). Therefore, the first-year values are only from EV purchases made in 2023, which are incremental to the rest of the forecast. The number of BEVs and associated energy use impacts are forecasted on a cumulative basis from 2023.

Forecast Methodology:

SJCE used publicly available data from the CEC's New ZEV Sales Dashboard, which relies on the Department of Motor Vehicles vehicle registration information, to analyze historical EV (BEV + PHEV) adoption trends in Santa Clara County. EV sales for San José were derived by applying San José's share of Santa Clara County's population to the county wide EV sales data. SJCE used San Jose's average growth in new EV sales and projected this out to 2032, at which point new EV sales would make up most of the new annual vehicle's sales in the region and would no longer grow at the same rate. Consistent with current trends, SJCE assumes that 25% of new EV sales are PHEVs and 75% are BEVs. Because the numbers reported are cumulative, SJCE also accounts for vehicle retirements on a regular basis, with a majority of EV retirements occurring after 15 years of use.

SJCE calculated the additional MWh by using usage data of EV adopters over the last 4 years to calculate the average increase in monthly load after the purchase of the EV. An annual load increase of 3.73 MWh per vehicle was calculated which equates to 10,000-12,000 miles driven, in line with California's average milage per year. PHEVs were assumed to charge for only 25% of trips. This usage was applied to the expected number of new EV sales minus the vehicles expected to retire.

Peak Demand Impact was calculated by applying the hourly shape of the PGE 2021 Additional Transportation Electrification Scenario to SJCE's annual energy forecast for Light Duty EVs. The additional MW reported are coincident with SJCE's annual forecasted peak.

Caltrans Electrification / Data Centers:

These figures were provided to SJCE directly by the entities associated with the increased load for each of these categories.