Southern California Edison
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DATA REQUEST SET E D - S C E - 2 1

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Question 21.1a: On 6/4, SCE explained that they use a third-party provider to disaggregate DER forecasts data from the IEPR to the circuit level. SCE then aggregates the forecast DER data back to the substation level. Please provide more information about the third-party provider, their tools, and the DER adoption propensity model used by SCE to conduct this analysis; how does the model work? Specifically, what are the assumptions to DER adoption, and how are the results communicated to SCE (e.g., by 8760 load or DER savings shape, by average or peak DER by season in MW, impact to coincident circuit peak, etc.)?

Response to Question 21.1a:
SCE would like to acknowledge first that there was miscommunication about SCE's use of third-party tool in the June 4th discussion.

For clarification, SCE does not utilize a third-party provider to disaggregate the Integrated Energy Policy Report (IEPR) Forecast, nor does a third-party tool exist for demonstration. SCE is in the process of developing a suite of tools as part of SCE's Long-Term Planning Tool (LTPT) to support advancement of the distribution planning process.

In terms of the Distributed Energy Resources (DER) disaggregation, SCE developed the disaggregation methodologies separately for each type of DER. SCE has presented the methodologies including input and data sources at the Distribution Forecasting Working Group (DFWG) meetings, as part of the Distribution Resources Plan (DRP) Proceeding Track 3. SCE includes its DER disaggregation methodologies below.

SCE's DER Disaggregation Methodologies Used for 2018 DSP (2017 to 2018 Distribution Planning Cycle)

<u>Electric Vehicles</u>

Data Inputs

SCE leveraged different data sources for disaggregating the system-level Electric Vehicle forecast from CEC's 2016 IEPR demand forecast. SCE gathered actual adoption data as well as macroeconomic and demographic information. The primary data sources include: EV adoption data at ZIP code level provided by Electric Power Research Institute ("EPRI"), household characteristics from the American Community Survey (ACS) by U.S. Census Bureau (at ZIP code level), a mapping of ZIP codes to circuits created by SCE's Geospatial Analysis team, and SCE's internally developed EV Load Shape.[1]

SCE's internal EV load shape is developed to determine hourly energy forecast. Major assumptions include where EV owners typically charge, when EV owners start to charge, how long the duration of charging time is, and which residential rate class EV owners belong to.

Methodology to disaggregate annual CEC's IEPR forecast to SCE circuit level

SCE disaggregates the annual CEC 2016 IEPR EV load forecast based on its own propensity model. The main steps are described below:

Step 1: Scored each ZIP code -- In this step, key indicators of EV adoption were identified. By using the historical EV adoption and demographic and socio-economic data, regression analysis was performed. Education level and time to work were statistically significant and were chosen to be the propensity indicators. Then regression results were utilized to determine weights for each propensity indicator and estimate EV potential for each Zip code.

Step 2: Obtained CED Forecast -- For the 2018 DSP, SCE was directed to utilize the 2016 IEPR California Energy Demand Update (CEDU) mid demand baseline forecast of Electric Vehicles (EV).

Step 3: Allocated 2016 CEC IEPR forecast to ZIP Code based on relative ZIP Code propensity from step 1.

Step 4: Mapped ZIP Code to Circuit based on Circuit Mileage within ZIP Code.

Step 5: Used Ratios from Step 4 to apply CEC Forecast to the Circuit Level.

Peak Impact Determination

In order to generate the circuit level hourly EV load forecast, SCE's internal system-level EV load shape is multiplied to the annual EV forecast at circuit level.

The peak EV impact is created by matching the hourly EV load forecast with the estimated circuit peak time for future years.

<u>Energy Efficiency</u>

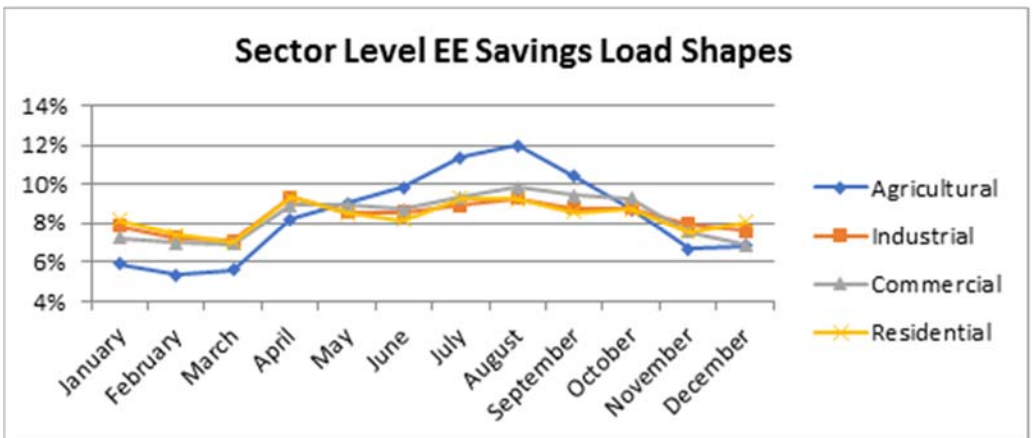
Data Inputs

In order to develop a model to disaggregate a system level Energy Efficiency (EE) forecast to a Circuit level forecast, SCE leveraged three main data sources to estimate future adoptions/savings of EE.

1) CEC's 2016 IEPR AAEE Forecast

a. For the 2018 DSP, SCE was directed to utilize the 2016 Integrated Energy Policy Report (IEPR) California Energy Demand Update (CEDU) low mid forecast for Additional Achievable Energy Efficiency (AAEE)[2].
b. SCE used AAEE sector level AAEE forecasts[3]
    1. Residential
    2. Commercial
    3. Industrial
    4. Agriculture

2) Database for Energy Efficient Resources (DEER) sector level System Hourly (8760) Load Shapes[4]. To assure the sector level load shapes represented SCE EE Programs, SCE used 2017 EE measure level savings to the sector level and applied the saving to a load shape. This process in essence, calculated a weighted average load shape by sector as depicted in the graphic below.



3) SCE Customer and Circuit Data

a. Circuit Energy Usage by Sector[5]
    1. Residential
    2. Commercial
    3. Industrial
    4. Agriculture

Methodology to disaggregate annual CEC's IEPR forecast to SCE circuit level

Due to lack of circuit level EE forecasts, SCE disaggregates system level AAEE forecast using proportional scaling models. There are two main steps:

Step 1: Service Accounts (akin to a customer cite) annual energy use data (GWh) were extracted from SCE Customer Database (CDB). The circuit level energy use is then grouped into Sectors (Residential, Commercial, Industrial, and Agriculture), and a percentage of total annual sector energy use calculated.

Example:

> For simplicity, lets assume that Circuit X contains all Residential Customers, and those Residential Customers on Circuit X consume 16 GWh of electricity annually. All of SCE's Residential (system) customers consume 279,000 GWh of electricity. 16/279,000 = .0057%

Step 2: Step 2 builds on Step 1 by using the percent sectoral energy use and multiplying the sectoral percentage to the AAEE sectoral EE savings.[6]

Example

> Building on the example in Step 1 calculation of percent of total Residential energy use (.0057%), Step 2 applies the Residential AAEE EE forecast to said percentage. Lets assume that total AAEE Residential EE savings is 95,000,000 KWh. For circuit X .0057% * 95,000,000 KWh = 5,415 KWH in Residential EE energy savings.

Peak Impact Determination

In order to estimate the circuit level hourly EE forecast, DEER2017 hourly sector level load shapes were used. SCE's simply, multiplied a unitized hourly sector level DEER load shape to annual EE sector level forecast. The result effectively took an annual energy forecast (GWh), Step 2, and transformed the energy into Hourly (8760) savings for use in distribution system planning.

The peak EE impact is created by matching the hourly EE load forecast with the estimated circuit peak time for future years.

<u>Solar PV</u>

Data Inputs:

1) SCE
    a. List of SCE territory zip codes
    b. Customer average annual energy usage by each zip code
2) CEC
    a. 2016 IEPR PV MW forecast for SCE territory
3) ACS (American Community Survey)
    a. Education: % of bachelor's degree or higher of each zip
    b. Median income of each zip
    c. Ownership: % of households to own their properties
    d. House type: % of single-family houses of each zip
4) NREL: Rooftop suitability for PV installation

Methodology to disaggregate Residential IEPR forecast to SCE circuit:

Circuit level disaggregation methodology consists of 6 main steps.
1) Clustered SCE zip code into 4 clusters based on the four key propensity indicators (income, ownership percentage, annual energy usage, and PV potential).

2) A Bass Diffusion approach is then utilized to calculate the growth rate for each of the clusters based on the historical adoption in each cluster
3) Forecast adoption by ZIP code.
4) Calculate allocation factors based on the ratio of ZIP code adoption to total adoption (sum of all ZIP code adoption)5) Allocate IEPR's PV forecast to ZIP codes based on the allocation factors.
6. Allocate the Zip code PV forecast to circuits proportional to the number of customer service account on the circuit

Methodology to disaggregate Non-Residential IEPR forecast to SCE circuit:

SCE allocates the non-residential portion of the IEPR system level PV forecast proportional to each circuit's non-residential energy usage.

Methodology to generate 8760 shape:

SCE used PVWatts[7] to generate average annual PV 8760 shape and applied the same percentage shape to each circuit to generate the initial hourly PV energy for each circuit.

Peak Impact Determination

The 2018 DSP provides a forecast of installed capacity at each of the distribution circuits. Distribution Engineering performs additional dependability analysis and applies additional dependability factors to each circuit to generate the final 8760 hourly PV forecast analysis to determine the amount of this capacity which is coincident to circuit loading.

<u>Load Modifying Demand Responses ("LMDR")</u>

Demand Response resources that are integrated and dispatched directly by the CAISO market are referred to as "supply-side" DR, while "load modifying" DR is outside of the CAISO market and directly controlled/dispatched at SCE's discretion. D.14-03-026 adopted the following bifurcation definitions: "Load Modifying demand response is a resource that reshapes or reduces the net load curve. Supply Resource demand response is a resource that is integrated into the CAISO energy markets." Only Load Modifying Demand Response (LMDR) forecast is included in CEC's IEPR Demand Forecast as a load reducer.

Data Inputs

For the 2018 DSP, SCE was directed to utilize the 2016 Integrated Energy Policy Report (IEPR) California Energy Demand Update (CEDU). The CPUC Load Impact Protocol[8] report serves as the foundation for the IEPR's LMDR forecast.

In order to develop the model to disaggregate LMDR, SCE leveraged different data sources to gather installed savings data as well as historical energy usage. The primary data sources included historical DR participation, active SCE customers, a mapping of customers to the grid, and customer demographic information.

SCE's LMDR load shape is derived from the CPUC Load Impact Protocol models.

Methodology to disaggregate CEC's IEPR annual system level forecast to SCE's circuit level

Every customer who participates in an LMDR program is either 1) moved from their standard tariff onto an LMDR tariff or 2) assigned an LMDR profile in SCE's billing system. In exchange for load shifting and responding to SCE price signals, LMDR participants receive bill credits or incentives on their monthly SCE bill. This billing arrangement allows us to directly map existing LMDR customers' load impacts to the circuit to which they belong to.

The residual MW from the 2016 IEPR forecast, above existing LMDR contributions, are disaggregated using SCE's propensity model. The propensity model is used to score and rank each service account in SCE's territory based their likelihood of enrolling in an LMDR program. The residual MWs are then assigned to the ranked list of service accounts individually until the aggregated total for both existing and residual load impacts matches the IEPR LMDR forecast (at the system level).

Peak Impact Determination

In order to estimate the circuit level hourly LMDR forecast, SCE's Load Impact protocol-based load shape is multiplied to the annual LMDR forecast by circuit.