| **DOCKETED** |
|---------------|-----------------|
| **Docket Number:** | 21-IEPR-03 |
| **Project Title:** | Electricity and Natural Gas Demand Forecast |
| **TN #:** | 240960 |
| **Document Title:** | Presentation - Peak Electricity Demand |
| **Description:** | 2. Nick Fugate |
| **Filer:** | Raquel Kravitz |
| **Organization:** | California Energy Commission |
| **Submitter Role:** | Commission Staff |
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| **Docketed Date:** | 12/16/2021 |
Peak Electricity Demand
California Energy Demand Forecast, 2021 - 2035
Nick Fugate, Energy Assessments
Use Cases

• Input to system and reliability modeling
• Monthly system peaks serve as a system-level benchmark for Resource Adequacy
• Detailed planning use cases outlined in Single Forecast Set agreement published in each IEPR

For IOU TAC areas, peak loads are derived from hourly load modeling
Hourly Load Model
The Hourly Load Model (HLM) appropriately reflects the contribution of BTM PV and other load modifiers to peak demand as the system peak hour moves later in the day.
HLM Approach

1. Estimate the ratio of “consumption” load in each hour to annual average hourly “consumption”
2. Apply estimated ratios to forecast of annual average hourly “consumption”
3. Adjust consumption load using hourly profiles for climate change impacts, EV charging, PV generation, BTM storage, residential TOU impacts, and AAEE
4. Calibrate to weather-normal base-year peak load
HLM Approach

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Updating Historical Consumption
PV in HLM Model Estimation

Consumption = System Load + Demand Response + PV

- System Load is recorded (CAISO)
- Demand Response impacts are estimated (IOUs)
- BTM PV generation was averaged over days and weeks
  - E3 metered generation study (2008-2012)
  - Does not always reflect historic generation
Simulating Historic PV Generation

- Simulated PV generation in the SDG&E planning area
  - NREL’s System Advisor Model (SAM)
  - Interconnection data categorized by tilt, orientation, location
- Compared results against known PV generation data (CSI)
- Compared results against average HLM profiles
Simulation vs Actual
Simulation vs HLM Averages

SDG&E - January 2016

SDG&E - January 2019
Updating Consumption Estimates

• For CED 2021
  • Staff used historic generation profiles developed by Kevala Analytics (similar approach, benched to metered data)

• Beyond CED 2021
  • Expand staff simulations to all forecast zones
  • Acquire additional data for benchmarking
  • Explore other applications
    • Update average PV profiles and rank order of hourly loads (HLM)
    • Develop distributions of hourly load profiles for specific forecast years
    • Improve peak load normalization
HLM Approach

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Load Modifiers
Behind-the-Meter PV

Peak Day Profile - Behind-the-Meter PV

TAC
- PGE
- SCE
- SDGE

Load Ratio

HOUR
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

0.00 0.05 0.10
Light-Duty EV

Peak Day Profile - Light Duty EV Charging

- TAC
- PGE
- SCE
- SDGE

Load Ratio vs. Hour
Medium/Heavy-Duty EV

Peak Day Profile - Medium/Heavy Duty EV Charging

HOUR

Load_Ratio

TAC
- PGE
- SCE
- SDGE

17
Residential Storage

Peak Day Profile - Residential Storage

Load Ratio

HOUR

TAC
- PGE
- SCE
- SDGE
Non-Residential Storage

Peak Day Profile - Non-Residential Storage

Load Ratio

HOUR

TAC
PGE
SCE
SDGE
Time-of-Use Rates

Peak Day Profile - Time-of-Use Rates

HOUR

Load Ratio

TAC

PGE

SCE
Energy Efficiency

Peak Day Profile - Additional Achievable Energy Efficiency

- TAC
- PGE
- SCE
- SDGE

Load Ratio

HOUR
Impact on Peak Day Profile

CAISO peak hour shifts from hour 17 (PST) to hour 19 by 2023
Impact on Net Peak Hour

Incremental load modifiers added over the forecast period have the cumulative effect of reducing CAISO net load in 2035 by 544 MW.

Mid baseline
Mid AAEE (Scenario 3)
Mid AAFS (Scenario 3)
HLM Approach

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4. Calibrate to weather-normal base-year peak load
Base Year Calibration
Weather Normalization Method

1. Data sources:
   • Hourly system loads by TAC (CAISO)
   • DR event impact estimates (IOUs / CAISO)
   • Hourly weather statistics

2. Estimate counter-factual daily peaks after adding DR impacts to recorded system load

3. Regress daily peaks against daily weather statistics and calendar effects using most recent three years of data

4. Use linear model to simulate daily peaks for historical weather years, including error term

5. Taking the maximum simulated value for each year, find the median
Additional Climate Considerations

Standard approach may underestimate normal 1-in-2 conditions

September 30 DAWG—staff proposed a modified approach, sampling recent years more frequently

Cal-Adapt Analytics Engine aimed at informing “weather-normal” estimates

Graphic: https://cal-adapt.org/
2021 Weather Normal Peaks

<table>
<thead>
<tr>
<th>Planning Area</th>
<th>CED 2019</th>
<th>CED 2020</th>
<th>CED 2021</th>
<th>CED 2021*</th>
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<tr>
<td>PGE</td>
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<td>20,826</td>
<td>20,794</td>
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<td>SCE</td>
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<td>23,364</td>
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<td>4,194</td>
<td>4,173</td>
<td>4,227</td>
<td>4,263</td>
</tr>
</tbody>
</table>

*Recent years given more weight during simulation

Prior to weighting adjustment, CED 2021 weather-normal peaks are similar to CED 2019 vintage
Draft Managed Peak Forecast
Mid / Mid AAEE / Mid AAFS:
- 1.1 percent long-term annual growth
- 432 MW increase over CED 2020 by 2023
- Reaches 22,576 MW by 2035
- AAEE reduces peak load by 1136 MW
- AAFS adds 550 MW to peak load
Coincident Peak Forecast – SCE

Mid / Mid AAEE / Mid AAFS:
- 0.7 percent long-term annual growth
- 712 MW increase over CED 2020 by 2023
- Reaches 25,188 MW by 2035
- AAEE reduces peak load by 1210 MW
- AAFS adds 234 MW to peak load
Mid / Mid AAEE / Mid AAFS:

- 1.1 percent long-term annual growth
- 120 MW increase over CED 2020 by 2023
- Reaches 4,634 MW by 2035
- AAEE reduces peak load by 223 MW
- AAFS adds 33 MW to peak load
CAISO Peak Forecast

Mid / Mid AAEE / Mid AAFS:
- 1.1 percent long-term annual growth
- 430 MW increase over CED 2020 by 2023
- Reaches 22,576 MW by 2035
- Coincidence factor grows from 94.6% in 2021 to 97.7% by 2030
Forecast vs Historical Peaks

CAISO - Monthly Peak Load

- MONTH
- MW

YEAR

- 2021
- 2022
- 2023
Next Steps

• Docket draft peak and hourly results
• Review peak forecast with IOUs / JASC
• Stakeholder comments due December 30
• Final forecast forms docketed (January)

January 26 Business Meeting – Proposed Adoption