PY2017 LOAD IMPACT EVALUATION OF AGGREGATOR DEMAND RESPONSE PROGRAMS: CBP AND AMP

2018 DRMEC Load Impact Workshop • May 4, 2018

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AGENDA

• Program Descriptions
• Modeling Approach
• Confidentiality
• Ex Post Impacts
• Ex Ante Impacts
• Key Findings
PROGRAM DESCRIPTION
Capacity Bidding Program (CBP)

- **IOUs:** PG&E, SCE, and SDG&E

- **Program Basics:**
  - Statewide aggregator-managed DR program
  - Operates May-Oct for PG&E and SDG&E and year-round for SCE
  - Customers must meet eligibility requirements to participate
  - Aggregators receive monthly capacity payments based on nominated load + energy payments based on kWh reductions during events
  - Capacity payment may be adjusted based on aggregated performance
  - If no events called, aggregators receive the monthly capacity payment according to nomination
  - Aggregators only receive energy payment if there are events
  - Aggregators pay incentives to participating customers based on their own agreements
  - Dual enrollment in energy-only DR program with a different notification type is allowed

- **Events:**
  - Triggered by IOU or CAISO market award
  - Day-ahead (DA) and day-of (DO) notice options
  - Event durations of 1-4, 2-6, and 4-8 hours in 2017 and forecast
  - Up to 30 event hours/month SCE and PG&E; 44 hours/month for SDG&E
  - 11 a.m. to 7 p.m. non-holiday weekdays
• **Program Changes:**
  
  ▪ **PG&E:**
    • Adding additional operating hours of 1pm-9pm on an optional basis.
    • Residential customers are now eligible for CBP starting 2018.
    • Day-Of (DO) product is being eliminated in favor of Day-Ahead (DA) only.
  
  ▪ **SCE:**
    • Trimming CBP offerings from 6 products to 2 products.
    • The operating hours are moving from 11am-7pm to 1pm-7pm.
    • Monthly event limit is set to a maximum of 5.
  
  ▪ **SDG&E:**
    • Reducing number of CBP products from 9 to 4:
      • DA 2-4 hours, 11am-7pm and 1pm-9pm
      • DO 2-4 hours, 11am-7pm and 1pm-9pm
    • Adding products with operating hours of 1pm-9pm.
    • Pending: changing the trigger from price and heat rate to price only.
• **IOUs**: SCE

• **Program Basics:**
  - 3rd party aggregators contract with IOUs
  - Aggregators create own DR programs and contract with customers
  - Operational months vary
  - Customers must meet eligibility requirements
  - System and local dispatch pre-integration; dispatch by Sub-LAP post-integration
  - Penalties for not delivering committed load reduction
  - Customers may dually enroll in other DR programs (CPP, DBP, OBMC)

• **Events:**
  - Triggered by IOU or CAISO market award
  - Only DO notification contracts in 2017
  - Number of events and hours varies for SCE
Program Changes:

- SCE’s AMP was discontinued at the end of PY2017.
  - Some accounts are expected to move into CBP in PY2018.
- AMP is no longer included in the ex-ante forecast as no IOUs are planning to offer it.
CUSTOMER-SPECIFIC REGRESSION APPROACH

• Program participants are very large commercial and industrial customers and they consume energy very differently from each other
  • Wastewater treatment
  • Large Office Buildings
  • Industrial Facilities

• Instead of pooling participants into a single group, we estimate individual models for each participant
  • A pooled model may be too “noisy” to isolate changes related to impacts

• This is a valid method for estimating the counter-factual without a matched control group, which is difficult to develop for these customers
CUSTOMER-SPECIFIC REGRESSION APPROACH

1. Develop a set of candidate models using building blocks set up in logical groups
   - ~35 Candidate Models
CUSTOMER-SPECIFIC REGRESSION APPROACH

2 Testing and optimization process that minimizes error and bias to select the best model for each participant

3 Model the actual load
Model the reference load
Calculate the impacts
CONFIDENTIALITY

• A lot of the impacts for PG&E and SCE continue to be confidential.

• Redactions are compliant with the 15/15 Rule \((PUC \ § \ 583 \ D. \ 14-05-016)\)
  • Fewer than 15 customers in a group or subgroup
  • One customer makes up more than 15\% of the total load in a group or subgroup

• Information is also redacted if there is only one aggregator in the group or subgroup \((General \ Order \ 66-C, \ Section \ 2.2(b) \ D.06-06-066)\)

• The purpose of the redactions is to protect customer and/or aggregator confidentiality

• SDG&E shows all program level impacts
  • This is a result of guidance from SDG&E attorneys concluding that program level impacts are not confidential.
**EX POST IMPACTS**  
Program Dispatch and Event Summary

<table>
<thead>
<tr>
<th>Program</th>
<th>IOU</th>
<th>Day-Ahead</th>
<th></th>
<th>Day-Of</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Number of event days</td>
<td>Hours of Availability</td>
<td>Actual Hours of Use</td>
<td>Number of event days</td>
</tr>
<tr>
<td>CBP</td>
<td>PG&amp;E</td>
<td>22</td>
<td>180</td>
<td>68</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>SCE</td>
<td>47</td>
<td>360</td>
<td>96</td>
<td>46</td>
</tr>
<tr>
<td></td>
<td>SDG&amp;E</td>
<td>20</td>
<td>264</td>
<td>69</td>
<td>9</td>
</tr>
<tr>
<td>AMP</td>
<td>SCE</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Confidential</td>
</tr>
</tbody>
</table>

- PG&E: Both products saw an increased number of events compared to 2016. Many events were focused on individual Sub-LAPs this year.
- SCE: DA events were down slightly compared to 2016 while DO dropped by over half as a result of Resolution E-4819 which added price triggers to CBP dispatch.
- SDG&E: DA saw an increase in the number of events while DO was relatively flat.
### EX POST IMPACTS

**Average Summer Event, Average Event Hour**

<table>
<thead>
<tr>
<th>Program</th>
<th>IOU</th>
<th>Day-Ahead</th>
<th></th>
<th>Day-Of</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Aggregate Impact (MW)</td>
<td>Nominated Capacity (MW)</td>
<td>Event Temp (°F)</td>
<td>Aggregate Impact (MW)</td>
</tr>
<tr>
<td>CBP</td>
<td>PG&amp;E</td>
<td>Confidential</td>
<td></td>
<td>91</td>
<td>21.8</td>
</tr>
<tr>
<td></td>
<td>SCE</td>
<td>Confidential</td>
<td></td>
<td>90</td>
<td>Confidential</td>
</tr>
<tr>
<td></td>
<td>SDG&amp;E</td>
<td>0.7</td>
<td>0.3</td>
<td>77</td>
<td>3.2</td>
</tr>
<tr>
<td>AMP</td>
<td>SCE</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Confidential</td>
</tr>
</tbody>
</table>

- PG&E: 2017 impact exceeded nominated capacity, whereas 2016 had fallen short.
- SCE: Overall CBP impact met nominated capacity, despite the DA 4-8 product falling short.
- SDG&E: CBP DO aggregate impacts fell short of nominated capacity, while DA exceeded it.
EX POST IMPACTS
Example Load Profiles and Impacts

SDG&E CBP Day-Ahead: Average Hourly Per-Customer Impact

PG&E CBP Day-Of: Average Hourly Per-Customer Impact

Average Summer Event Day 2017
EX POST IMPACTS
Utility System Peak Hour

<table>
<thead>
<tr>
<th>Program</th>
<th>IOU</th>
<th>Day-Ahead</th>
<th>Day-Of</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Aggregate Impact (MW)</td>
<td>Event Temp (°F)</td>
</tr>
<tr>
<td>PG&amp;E</td>
<td>SCE</td>
<td>4.6</td>
<td>105</td>
</tr>
<tr>
<td>SCE</td>
<td>Confidential</td>
<td>100</td>
<td>Confidential</td>
</tr>
<tr>
<td>SDG&amp;E</td>
<td>1.4</td>
<td>87</td>
<td>2.8</td>
</tr>
</tbody>
</table>

Results are for the 2017 utility system peak hour.

- PG&E’s CBP program has the highest overall impact among all programs at 29.6 MW.
- PG&E’s Peak: 09/01/2017 (HE 18); SCE’s Peak: 08/30/2017 (HE 17); SDG&E’s Peak: 09/01/2017 (HE 17)
## EX POST IMPACTS

### Statewide System Peak Hour

<table>
<thead>
<tr>
<th>Program</th>
<th>IOU</th>
<th>Day-Ahead</th>
<th></th>
<th>Day-Of</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Aggregate Impact (MW)</td>
<td>Event Temp (°F)</td>
<td>Aggregate Impact (MW)</td>
<td>Event Temp (°F)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PG&amp;E</td>
<td>6.0</td>
<td>106</td>
<td>30.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SCE</td>
<td>Confidential</td>
<td>104</td>
<td>Confidential</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SDG&amp;E</td>
<td>1.4</td>
<td>87</td>
<td>2.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AMP</td>
<td>SCE</td>
<td>-</td>
<td>Confidential</td>
</tr>
</tbody>
</table>

Results are for the 2017 statewide system peak hour.

- Product-level impacts range from 1.4 MW to 30.5 MW
- PG&E’s CBP program has the highest impact at 36.5 MW
- CAISO Peak: 09/01/2017 (HE16)\(^1\)

EX ANTE IMPACTS
Methodology

• Use customer-specific regression models from ex post analysis
• Predict per-customer weather-adjusted impacts for all subgroups
  ▪ Apply Utility and CAISO weather scenarios
• Use enrollment forecasts from IOUs to forecast aggregate impacts
  ▪ Enrollment was derived based on
    • 2017 ex post per-customer impacts
    • Contractual MW
    • Historical performance
## EX ANTE IMPACTS
Non-Residential Enrollment Forecast, Month of August

### Drivers

- **PG&E** forecasts steady CBP enrollment throughout forecast horizon. DO discontinued at end of PY2017.
- **SCE** forecasts an increase in enrollment for CBP DO beginning in 2018 due to elimination of AMP.
- **SDG&E** forecasts CBP DA and DO enrollment will increase 3% and 7% per year (2019-2022), respectively, due to program improvements. The forecast between 2022 and 2027 is flat.

### Number of Service Accounts

<table>
<thead>
<tr>
<th>Program</th>
<th>Utility</th>
<th>Notice</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
<th>2022</th>
<th>2023-2028 (each year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CBP</td>
<td>PG&amp;E</td>
<td>DA</td>
<td>700</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>700</td>
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<tr>
<td></td>
<td></td>
<td>DA</td>
<td>90</td>
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<td></td>
<td></td>
<td></td>
<td>90</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DO</td>
<td>1,250</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1,250</td>
</tr>
<tr>
<td></td>
<td>SCE</td>
<td>DA</td>
<td>69</td>
<td>71</td>
<td>+3%</td>
<td>73</td>
<td>+3%</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DO</td>
<td>171</td>
<td>183</td>
<td>+7%</td>
<td>196</td>
<td>+7%</td>
<td>209</td>
</tr>
</tbody>
</table>

### EX ANTE IMPACTS

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<tbody>
<tr>
<td>CBP</td>
<td>PG&amp;E</td>
<td>DA</td>
<td>700</td>
<td></td>
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<td></td>
<td>700</td>
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<td></td>
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<td></td>
<td></td>
<td>DO</td>
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<td></td>
<td></td>
<td></td>
<td>1,250</td>
</tr>
<tr>
<td></td>
<td>SCE</td>
<td>DA</td>
<td>69</td>
<td>71</td>
<td>+3%</td>
<td>73</td>
<td>+3%</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DO</td>
<td>171</td>
<td>183</td>
<td>+7%</td>
<td>196</td>
<td>+7%</td>
<td>209</td>
</tr>
</tbody>
</table>
# EX ANTE IMPACTS
Comparison of current and previous non-residential forecast

<table>
<thead>
<tr>
<th>Program</th>
<th>Utility</th>
<th>Notice</th>
<th>Accounts</th>
<th>Aggregate Impact (MW)</th>
<th>Accounts</th>
<th>Aggregate Impact (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CBP</td>
<td>PG&amp;E</td>
<td>DA</td>
<td>50</td>
<td>6.9</td>
<td>700</td>
<td>21.0</td>
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<tr>
<td></td>
<td></td>
<td>DO</td>
<td>611</td>
<td>13.6</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>SCE</td>
<td>DA</td>
<td>90</td>
<td>4.7</td>
<td>90</td>
<td>6.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DO</td>
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<td>45.1</td>
<td>1,250</td>
<td>23.1</td>
</tr>
<tr>
<td></td>
<td>SDG&amp;E</td>
<td>DA</td>
<td>70</td>
<td>0.9</td>
<td>69</td>
<td>0.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DO</td>
<td>199</td>
<td>5.1</td>
<td>171</td>
<td>3.2</td>
</tr>
</tbody>
</table>

Results are average event-hour impacts for August peak day in 2018; Utility Peak 1-in-2 weather conditions.

- CBP DA
  - PG&E increase – increased enrollment.
  - SCE increase – higher per-customer impacts.
  - SDG&E decrease – lower per-customer impacts.

- CBP DO
  - PG&E decrease – product not offered.
  - SCE decrease – smaller impacts per customer.
  - SDG&E decrease – fewer customers with lower per-customer impacts.
EX-ANTE IMPACTS
Residential CBP impact forecast

- Due to the expected influx of residential customers
  - PG&E: constant 4 MW aggregate load impact through the forecast horizon starting 2019
  - SCE: constant 3 MW aggregate load impact through the forecast horizon starting in 2023
KEY FINDINGS
Ex Post Analysis

On average event day

• Impacts relative to nominated capacity
  ▪ PG&E: CBP impacts exceeded nominated capacity.
  ▪ SCE: Overall CBP impact met nominated capacity, despite the DA 4-8 product falling short.
  ▪ SDG&E: CBP DO aggregate impact fell short of nominated capacity, while DA aggregate impact exceeded nominated capacity – a reversal from last year.

• Notice type
  ▪ DO products had higher enrollment and greater aggregate impact than DA products

• Comparison with 2016
  ▪ PG&E and SCE: Overall CBP enrollment and aggregate impacts were higher in 2017
  ▪ SDG&E: Overall CBP enrollment and aggregate impacts were lower in 2017

• AutoDR/TATI customers generally underperformed their load shed test results
On August 2018 peak day

- Enrollment forecast
  - PG&E: current CBP enrollment forecast for 2018 is higher than previous (given higher enrollment observed in 2017)
  - SCE: forecast is flat to LY
  - SDG&E: current CBP enrollment forecast for 2018 is lower than previous (given lower enrollment observed in 2017)

- Aggregate impacts
  - PG&E: CBP aggregate impacts are comparable at ~21 MW
  - SCE and SDG&E: CBP aggregate impacts decrease
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