LOAD IMPACT EVALUATION OF AGGREGATOR DEMAND RESPONSE PROGRAMS: CBP AND AMP
2017 DRMEC Load Impact Workshop • May 8, 2017
Kelly Marrin, Project Director

AGENDA

• Program Descriptions
• Ex Post Methodology
• Ex Post Impacts
• Ex Ante Methodology
• Enrollment Forecast
• Ex Ante Impacts
• Ex Post and Ex-Ante Comparison
• Key Findings
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
  - Participants must meet eligibility requirements
  - Participants receive monthly capacity payments based on nominated load + energy payments based on kWh reductions during events
  - Capacity payment may be adjusted based on performance
  - Participants receive monthly the capacity payment according to their nomination if no events called
  - 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 and 2-6 hours in 2016 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:
- Portfolios in process of integrating into CAISO wholesale energy market
  - PY2016 and PY2017 – transition years
  - IOUs proposed program changes – several approved in June 2016; changes begin in PY2017
    - PG&E CBP: Tariff changes to increase incentive levels
    - SCE CBP: Streamlining to two products, increasing capacity prices, reducing # of events
    - SDG&E: Changes to improve integration
  - IOUs filed advice letters proposing including energy price component to CBP heat rate trigger
    - Awaiting Commission resolution
Aggregator Managed Portfolio (AMP)

- **IOUs:** PG&E and SCE
- **Program Basics:**
  - 3rd party aggregators contract with IOUs
  - Aggregators create own DR programs and contract with customers
  - Operated May-Oct for PG&E and varies for SCE
  - Customers must meet eligibility requirements
  - PG&E: system and local products; local allows dispatch by Sub-LAP
  - SCE: 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, PDP, DBP, OBMC)
- **Events:**
  - Triggered by IOU or CAISO market award
  - Only DO notification contracts in 2016 and forecast
  - Up to 76 event hours/year for PG&E; varies for SCE
  - 11 a.m. to 7 p.m. non-holiday weekdays for PG&E; varies for SCE

**Program Changes:**
- PG&E: AMP was discontinued at end of PY2016
- SCE: CPUC Decision 16-06-029 authorized AMP to continue through PY2017
CONFIDENTIALITY

- A lot of the impacts for PG&E and SCE are confidential this year
- 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 new guidance from their 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>Day-Of</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Number of event days</td>
<td>Hours of Availability</td>
</tr>
<tr>
<td>CBP</td>
<td>PG&amp;E</td>
<td>16</td>
<td>180</td>
</tr>
<tr>
<td></td>
<td>SCE</td>
<td>57</td>
<td>360</td>
</tr>
<tr>
<td></td>
<td>SDG&amp;E</td>
<td>14</td>
<td>264</td>
</tr>
<tr>
<td>AMP</td>
<td>PG&amp;E</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>SCE</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

- PG&E: Number of 2016 event days were comparable to 2015
- SCE: 7 CBP DA events and 46 CBP DO events were called during winter months; number of 2016 CBP DO event days was more than double 2015 value
- SDG&E: ~1/3 as many event days in 2016 compared with 2015
**EX POST IMPACTS**

**Average Summer Event, Average Event Hour**

<table>
<thead>
<tr>
<th>Program</th>
<th>IOU</th>
<th>Aggregate Impact (MW)</th>
<th>Nominated Capacity (MW)</th>
<th>Event Temp (°F)</th>
<th>Aggregate Impact (MW)</th>
<th>Nominated Capacity (MW)</th>
<th>Event Temp (°F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CBP</td>
<td>PG&amp;E</td>
<td>Confidential</td>
<td>89</td>
<td>9.2</td>
<td>12.0</td>
<td>88</td>
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<tr>
<td></td>
<td>SCE</td>
<td>Confidential</td>
<td>92</td>
<td>Confidential</td>
<td>91</td>
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<td></td>
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<tr>
<td></td>
<td>SDG&amp;E</td>
<td>3.4</td>
<td>4.0</td>
<td>79</td>
<td>4.7</td>
<td>3.9</td>
<td>84</td>
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<td>AMP</td>
<td>PG&amp;E</td>
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<td>64.9</td>
<td>Confidential</td>
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<td>SCE</td>
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<td>-</td>
<td>-</td>
<td>Confidential</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- PG&E CBP and AMP aggregate impacts fell short of nominated capacity
- SCE CBP aggregate impact exceeded nominated capacity
- SDG&E CBP DA aggregate impact fell short of nominated capacity, while DO aggregate impact exceeded nominated capacity
- CBP DO aggregate impact were higher than DA impacts
- AMP aggregate impacts were higher than CBP impacts

**Example Load Profiles and Impacts**

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

**Average Summer Event Day 2016**

**PG&E AMP Day-Of: Average Hourly Per-Customer Impact**
EX POST IMPACTS
Utility System Peak Hour

<table>
<thead>
<tr>
<th>Program</th>
<th>IOU</th>
<th>Day-Ahead Aggregate Impact (MW)</th>
<th>Event Temp (°F)</th>
<th>Day-Of Aggregate Impact (MW)</th>
<th>Event Temp (°F)</th>
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</thead>
<tbody>
<tr>
<td>CBP</td>
<td>PG&amp;E Confidential</td>
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<tr>
<td></td>
<td>SCE Confidential</td>
<td>101</td>
<td>14.1</td>
<td>99</td>
<td>99</td>
</tr>
<tr>
<td></td>
<td>SDG&amp;E</td>
<td>9.3</td>
<td>7.6</td>
<td>97</td>
<td>97</td>
</tr>
<tr>
<td>AMP</td>
<td>PG&amp;E</td>
<td>-</td>
<td>-</td>
<td>78.0</td>
<td>97</td>
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<td>SCE</td>
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<td>-</td>
<td>Confidential</td>
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</table>

Results are for the 2016 utility system peak hour.

- Weather across all three utilities is similar, but slightly lower for PG&E's CBP
- PG&E’s AMP program has the highest impact at 78 MW
- PG&E’s Peak: 7/27/2016 (HE 18); SCE’s Peak: 6/20/2016 (HE 17); SDG&E’s Peak: 9/26/2016 (HE 17)

EX POST IMPACTS
Statewide System Peak Hour

<table>
<thead>
<tr>
<th>Program</th>
<th>IOU</th>
<th>Day-Ahead Aggregate Impact (MW)</th>
<th>Event Temp (°F)</th>
<th>Day-Of Aggregate Impact (MW)</th>
<th>Event Temp (°F)</th>
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</thead>
<tbody>
<tr>
<td>CBP</td>
<td>PG&amp;E Confidential</td>
<td>92</td>
<td>11.6</td>
<td>92</td>
<td>92</td>
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<tr>
<td></td>
<td>SCE Confidential</td>
<td>93</td>
<td>Confidential</td>
<td>92</td>
<td></td>
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<tr>
<td></td>
<td>SDG&amp;E</td>
<td>0.9</td>
<td>77.5</td>
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<td>-</td>
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<tr>
<td>AMP</td>
<td>PG&amp;E</td>
<td>-</td>
<td>-</td>
<td>78.3</td>
<td>97</td>
</tr>
<tr>
<td></td>
<td>SCE</td>
<td>-</td>
<td>-</td>
<td>Confidential</td>
<td></td>
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</tbody>
</table>

Results are for the 2016 statewide system peak hour.

- Impacts range from <1 MW to 78 MW
- PG&E’s AMP program has the highest impact at 78 MW
- CAISO Peak: 7/27/2016 (HE 17)
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
    - 2016 ex post per-customer impacts
    - Contractual MW
    - Historical performance

EX ANTE IMPACTS

Enrollment Forecast, Month of August

<table>
<thead>
<tr>
<th>Program</th>
<th>Utility</th>
<th>Notice</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
<th>2022-2027 (each year)</th>
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</thead>
<tbody>
<tr>
<td>CBP</td>
<td>PG&amp;E</td>
<td>DA</td>
<td>50</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>DO</td>
<td>611</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SCE</td>
<td>DA</td>
<td>30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>DO</td>
<td>814</td>
<td>1,250</td>
<td></td>
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<tr>
<td>SDG&amp;E</td>
<td>DA</td>
<td>70</td>
<td>70</td>
<td>+3%</td>
<td>72</td>
<td>+3%</td>
<td>74</td>
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<tr>
<td></td>
<td>DO</td>
<td>199</td>
<td>199</td>
<td>+10%</td>
<td>219</td>
<td>+10%</td>
<td>241</td>
<td>+10% 265 +10% 292</td>
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<tr>
<td>AMP</td>
<td>SCE</td>
<td>DO</td>
<td>Confidential</td>
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</table>

Drivers

- PG&E forecasts steady CBP enrollment throughout forecast horizon. AMP was discontinued at end of 2016.
- SCE forecasts no AMP accounts after 2017 and 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% per year (2019-2022) due to program improvements, and CBP DO will increase by another 7% per year (2019-2022) due to growth in TI program. The forecast between 2022 and 2027 is flat.
EX ANTE IMPACTS
Average Event Hour, August Peak Day 2017

<table>
<thead>
<tr>
<th>Program</th>
<th>Utility</th>
<th>Notice</th>
<th>Accounts</th>
<th>Per-Customer Impact (kW)</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>138.1</td>
<td>6.9</td>
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<td></td>
<td>DA</td>
<td>611</td>
<td>22.2</td>
<td>13.6</td>
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<td></td>
<td>SCE</td>
<td>DA</td>
<td>30</td>
<td>52.8</td>
<td>1.6</td>
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<tr>
<td></td>
<td>DA</td>
<td>814</td>
<td>36.1</td>
<td>29.3</td>
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<td>SDG&amp;E</td>
<td>DA</td>
<td>70</td>
<td>13.0</td>
<td>0.9</td>
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<td>DA</td>
<td>199</td>
<td>25.5</td>
<td>5.1</td>
<td></td>
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<tr>
<td></td>
<td>SCE</td>
<td>DA</td>
<td>Confidential</td>
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</tr>
</tbody>
</table>

• Overall, CBP DO 2017 ex ante impacts are higher than 2016 ex post impacts due to expected enrollment migration from AMP DO

EX ANTE IMPACTS
Comparison of current and previous 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>
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<td>1.2</td>
<td>30</td>
<td>1.6</td>
</tr>
<tr>
<td></td>
<td>DA</td>
<td>814</td>
<td>30.2</td>
<td>814</td>
<td>29.3</td>
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<tr>
<td></td>
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<td>122</td>
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<td>0.9</td>
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<td>DA</td>
<td>220</td>
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<td>SCE</td>
<td>DA</td>
<td>Confidential</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Results are average event-hour impacts for August peak day in 2017, Utility Peak 1-in-2 weather conditions.

• CBP DA
  ▪ PG&E decrease – lower enrollment expected
  ▪ SCE increase – higher per-customer impacts expected
  ▪ SDG&E decrease – lower per-customer impacts and lower enrollment expected
  ▪ CBP DO
  ▪ PG&E decrease – lower per-customer impacts expected
  ▪ SCE comparable between current and previous forecast
  ▪ SCE slight increase – higher per-customer impacts expected
KEY FINDINGS
Ex Post Analysis

On average event day
• Impacts relative to nominated capacity
  ▪ PG&E: CBP and AMP aggregate impacts fell short of nominated capacity
  ▪ SCE: CBP aggregate impact exceeded nominated capacity
  ▪ SDG&E: CBP DA aggregate impact fell short of nominated capacity, while DO aggregate impact exceeded nominated capacity
• Notice type
  ▪ DO products had higher enrollment and greater aggregate impact than DA products
• Program type
  ▪ AMP programs had significantly higher enrollment and greater aggregate impacts than CBP
• Comparison with 2015
  ▪ CBP enrollment and aggregate impacts were lower in 2016 than 2015 for all IOUs

KEY FINDINGS
Ex Ante Analysis

On August 2017 peak day
• Enrollment forecast
  ▪ PG&E and SDG&E: current CBP enrollment forecast for 2017 is lower than previous
  ▪ SCE: forecasts a significant increase in enrollment for CBP after 2017 when AMP ends
• Aggregate impacts
  ▪ PG&E and SDG&E: CBP aggregate impacts decrease
  ▪ SCE: CBP aggregate impacts increase
• While we see a fluctuation in per customer impacts across years, and across a single season, aggregate impacts are driven largely by nominated MW
Table Generator Guided Tour

PROJECT CONTRIBUTORS

**IOU Contributors**
- Gil Wong, PG&E
  - Overall Project Manager
  - GxF@pge.com

- Lizzette Garcia-Rodriguez, SDG&E
  - SDG&E Project Manager
  - LGarcia-Rodriguez@semprautilities.com

- Edward Lovelace, SCE
  - SCE Project Manager
  - Edward.Lovelace@sce.com

**AEG Contributors**
- Kelly Marrin
  - Project Director
  - kmarrin@appliedenergygroup.com

- Kelly Parmenter
  - Project Manager
  - kparmenter@appliedenergygroup.com

- Abigail Nguyen
  - Analysis Lead
  - anguyen@appliedenergygroup.com

- Anthony Duer
  - Senior Analyst
  - aduer@appliedenergygroup.com