Load Impact Evaluation:

*PG&E’s SmartAC™ Program*

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DRMEC Spring Workshop

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Presentation Outline

1. Program Description
2. *Ex-post* Methodology
3. *Ex-post* Load Impacts
4. *Ex-ante* Methodology
5. Enrollment Forecast
6. *Ex-ante* Load Impacts
1. SmartAC™ Program Description

- Direct load control AC cycling program for residential customers
- Participants receive one-time incentive, can opt-out of events
- Events up to 6 hours per day (May – October):
  - CAISO market awards
  - System or local area emergencies for PG&E capacity
  - Limited testing for a maximum of 100 hours per year
- Serial Number Events: random sample of full territory based on factory programmed serial number
- Sub-LAP Events: all customers within a called sub-LAP based on sub-LAP addressing
- SmartAC integrated into CAISO wholesale market in PY2018
- 105,000 enrolled (May 2019), 12,800 dually enrolled SmartRate
2. Ex-post Methodology: sub-LAP Events

- Approach: *matched control group* + difference-in-differences
- Propensity Score Matching
- Two-Stages of Matching:
  1) First stage uses billing data and other characteristics to narrow down set of potential control customers
  2) Second stage produces 1-to-1 matches using interval load data and other characteristics
- Separate regressions used to examine distribution of load impacts across customer subgroups (e.g., CARE status, NEM)
2. Ex-post Methodology: Serial Events

- Simpler than the sub-LAP method because the withheld serial group serves as a randomly determined control group.
- All groups were called for one of the two serial events (7/27), so we needed to conduct matching for that event.
- The 8/15 serial event (with serial group 2 withheld) is the basis for our sub-group analyses.
### 3. Ex-post Load Impacts: Events

<table>
<thead>
<tr>
<th>Date</th>
<th>Hours</th>
<th>Reason</th>
<th>SmartRate Event?</th>
<th>Sub-LAPs/Serial Groups Dispatched</th>
<th># Customers Dispatched</th>
</tr>
</thead>
<tbody>
<tr>
<td>24-Jul</td>
<td>4 to 7 p.m.</td>
<td>Market Award</td>
<td>Yes</td>
<td>PGF1, PGKN, PGZP</td>
<td>21,809</td>
</tr>
<tr>
<td>25-Jul</td>
<td>3 to 6 p.m.</td>
<td>Market Award</td>
<td>No</td>
<td>PGF1, PGKN, PGZP</td>
<td>25,313</td>
</tr>
<tr>
<td>27-Jul</td>
<td>4 to 7 p.m.</td>
<td>System-wide test</td>
<td>No</td>
<td>All</td>
<td>100,857</td>
</tr>
<tr>
<td>14-Aug</td>
<td>4 to 7 p.m.</td>
<td>Market Award</td>
<td>Yes</td>
<td>PGEB, PGNB, PGP2, PGSB, PGSI</td>
<td>46,192</td>
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<tr>
<td>15-Aug</td>
<td>4 to 7 p.m.</td>
<td>System-wide test</td>
<td>No</td>
<td>Except Serial Group 2</td>
<td>87,476</td>
</tr>
<tr>
<td>16-Aug</td>
<td>5 to 8 p.m.</td>
<td>Market Award</td>
<td>Yes</td>
<td>PGF1, PGKN, PGZP</td>
<td>21,660</td>
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<tr>
<td>26-Aug</td>
<td>3 to 6 p.m.</td>
<td>Market Award</td>
<td>Yes</td>
<td>PGF1, PGKN, PGNC, PGNP, PGSI, PGST, PGZP</td>
<td>53,727</td>
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<tr>
<td>27-Aug</td>
<td>3 to 5 p.m. (PGNC only)</td>
<td>2 to 5 p.m.</td>
<td>Market Award</td>
<td>Yes</td>
<td>PGF1, PGKN, PGNC, PGNP, PGSI, PGST, PGZP</td>
</tr>
<tr>
<td>13-Sep</td>
<td>3 to 6 p.m. (PGNB only)</td>
<td>5 to 8 p.m.</td>
<td>Market Award</td>
<td>Yes</td>
<td>PGNB, PGP2, PGSB</td>
</tr>
<tr>
<td>25-Sep</td>
<td>3 to 6 p.m.</td>
<td>Market Award</td>
<td>No</td>
<td>PGEB, PGP2, PGSB</td>
<td>31,997</td>
</tr>
</tbody>
</table>
3. Ex-post Load Impacts

Summary of All Events

- Overall Results: 0.04 - 0.59 kWh/customer/hour
- Serial events tend to have higher load impacts
- First two events experienced a system dispatch problem
- Load impacts are correlated with temperature
- Events not completely comparable: variation in sub-LAPs and hours called
3. **Ex-post Load Impacts**

Serial Group Event Day

84,476 customers called (serial group 2 withheld)

4-7 p.m.

Peak of 59.1 MWh/hour during hour 2 of event (5-6 p.m.)

Hour 3 has a lower load impact because the load control signal ended at 6:30 pm.

Post-event snapback peaks at 24.7 MWh/hour
3. **Ex-post Load Impacts By Subgroups**

- 2-way devices perform much better than 1-way
- Load impact increases with AC usage intensity
- SmartAC-only customers outperform dually enrolled
- Detached residences outperform shared-wall
- CARE / non-CARE and NEM / non-NEM are not statistically significantly different

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**Average 4-6 p.m. Load Impacts by Subgroup**

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- Load impact increases with AC usage intensity
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- CARE / non-CARE and NEM / non-NEM are not statistically significantly different
4. **Ex-ante Methodology**

- *Ex-ante* load impacts developed from *ex-post* load impacts from serial events in PY2017 and PY2019; PY2019 events get twice the weight as PY2017 (no serial events in PY2018)
- Estimate the effect of weather conditions on per-customer load impacts
- Combined estimates with weather scenarios to simulate per-customer load impacts for each:
  - Weather scenario (*e.g.* CAISO 1-in-2 on an August peak day)
  - Event Hour (restricted to resource adequacy window from 4-9 p.m.)
  - Customer-type (SmartAC-only vs. Dually Enrolled)
4. *Ex-ante* Methodology (2)

- *Reference loads* were developed for each month, LCA, and enrollment segment (SmartAC-only and dually enrolled) using:
  - Non-event days: Non-holiday weekdays
  - Parameters obtained from regressions of per-customer hourly usage as a function of weather (CDD60) and load shape variables
  - *Ex-ante* weather data and day-type characteristics (e.g. temperatures on a CAISO 1-in-2 August peak day)

- Per-customer reference loads and load impacts were scaled using PG&E’s forecast enrollments (by month, year, and dual enrollment status)
5. Enrollment Forecast

- Declining ~9% / year
- PG&E intends to minimize marketing efforts to back-fill attrition
6. Ex-ante Load Impacts

2020 Aggregate Hourly Loads and Load Impacts for PG&E 1-in-2 July Peak Day: All SmartAC™ customers

- RA window: 4-9 p.m.
- Average RA window load impact: 47.9 MWh/hour
- Percent Load Impact: 21 percent
6. Ex-ante Load Impacts

2020 Aggregate Load Impacts over RA Window by Month and Weather Scenario

- Peak month is July for PG&E Weather scenarios and CAISO 1-in-10
- Peak month is June for CAISO 1-in-2
- PG&E 1-in-10 July Peak Month: 58 MWh/hour
- October: Lowest Load Impacts
Recommendations

- Serial group events are valuable for building ex-ante forecasts
- Continued replacement of old one-way devices with two-way devices would increase program load impacts
Questions?

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