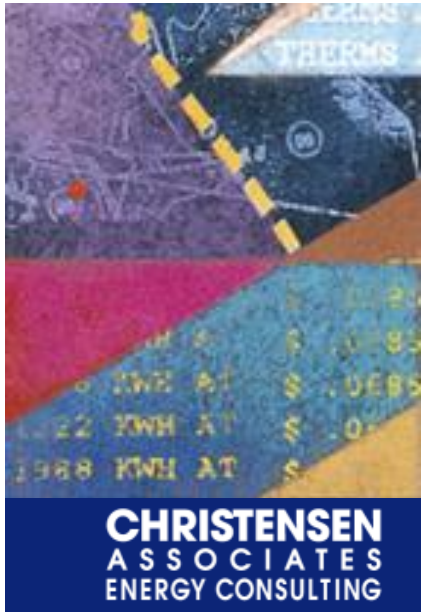


# Load Impact Evaluation: *PG&E's SmartAC™ Program*

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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

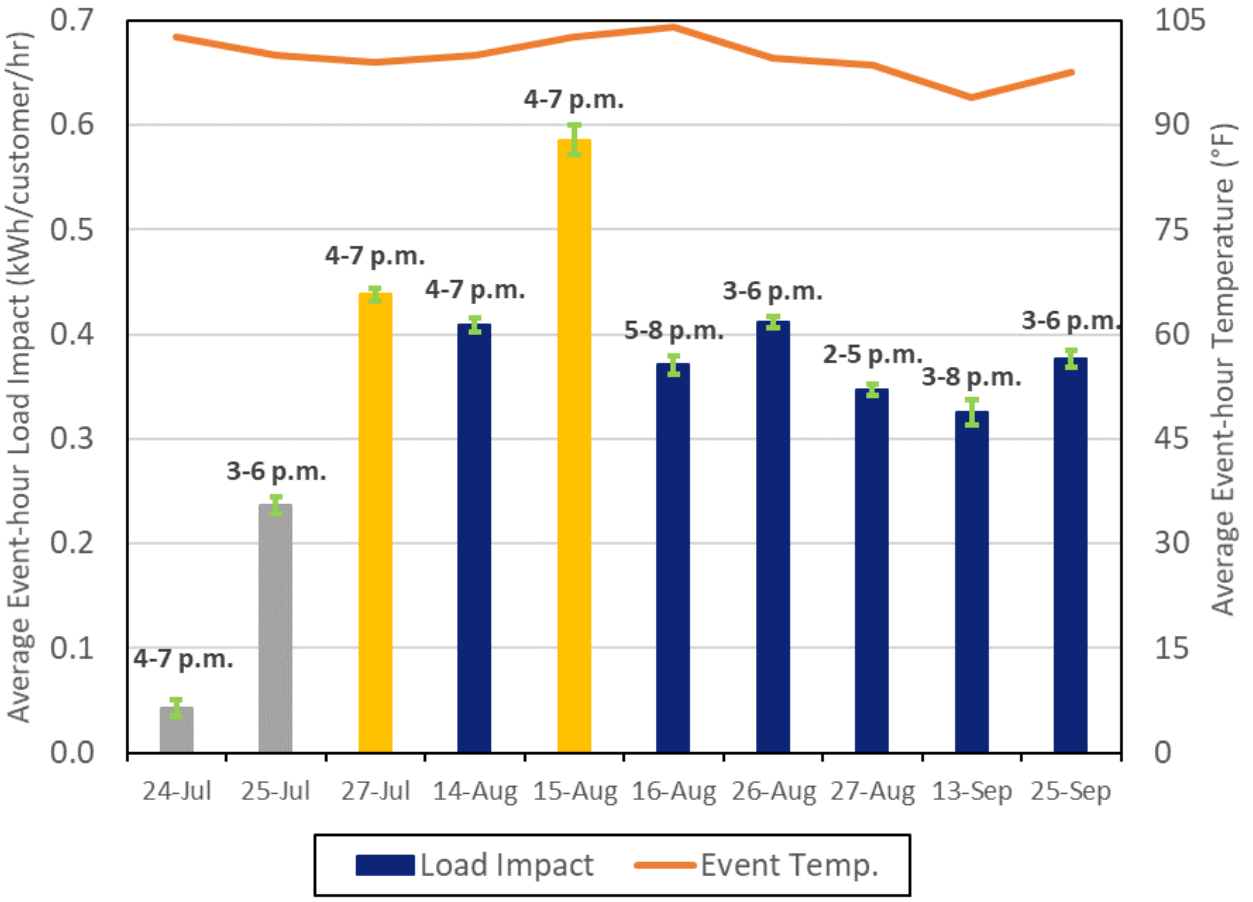
- Simpler than the sub-LAP method because the withheld serial group serves as a randomly determined control group
- All groups were called for one of the two serial events (7/27), so we needed to conduct matching for that event
- The 8/15 serial event (with serial group 2 withheld) is the basis for our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

# 3. *Ex-post* Load Impacts: *Events*

| Date | Hours | Reason | SmartRate Event? | Sub-LAPs/Serial Groups Dispatched | # Customers Dispatched |
|---|---|---|---|---|---|
| 24-Jul | 4 to 7 p.m. | Market Award | Yes | PGF1, PGKN, PGZP | 21,809 |
| 25-Jul | 3 to 6 p.m. | Market Award | No | PGF1, PGKN, PGZP | 25,313 |
| 27-Jul | 4 to 7 p.m. | System-wide test | No | All | 100,857 |
| 14-Aug | 4 to 7 p.m. | Market Award | Yes | PGEB, PGNB, PGP2, PGSB, PGSI | 46,192 |
| 15-Aug | 4 to 7 p.m. | System-wide test | No | Except Serial Group 2 | 87,476 |
| 16-Aug | 5 to 8 p.m. | Market Award | Yes | PGF1, PGKN, PGZP | 21,660 |
| 26-Aug | 3 to 6 p.m. | Market Award | Yes | PGF1, PGKN, PGNC, PGNP, PGSI, PGST, PGZP | 53,727 |
| 27-Aug | 3 to 5 p.m. (PGNC only)<br>2 to 5 p.m. | Market Award | Yes | PGF1, PGKN, PGNC, PGNP, PGSI, PGST, PGZP | 53,662 |
| 13-Sep | 3 to 6 p.m. (PGNB only)<br>5 to 8 p.m. | Market Award | Yes | PGNB, PGP2, PGSB | 13,108 |
| 25-Sep | 3 to 6 p.m. | Market Award | No | PGEB, PGP2, PGSB | 31,997 |

# 3. *Ex-post* Load Impacts
## Summary of All Events

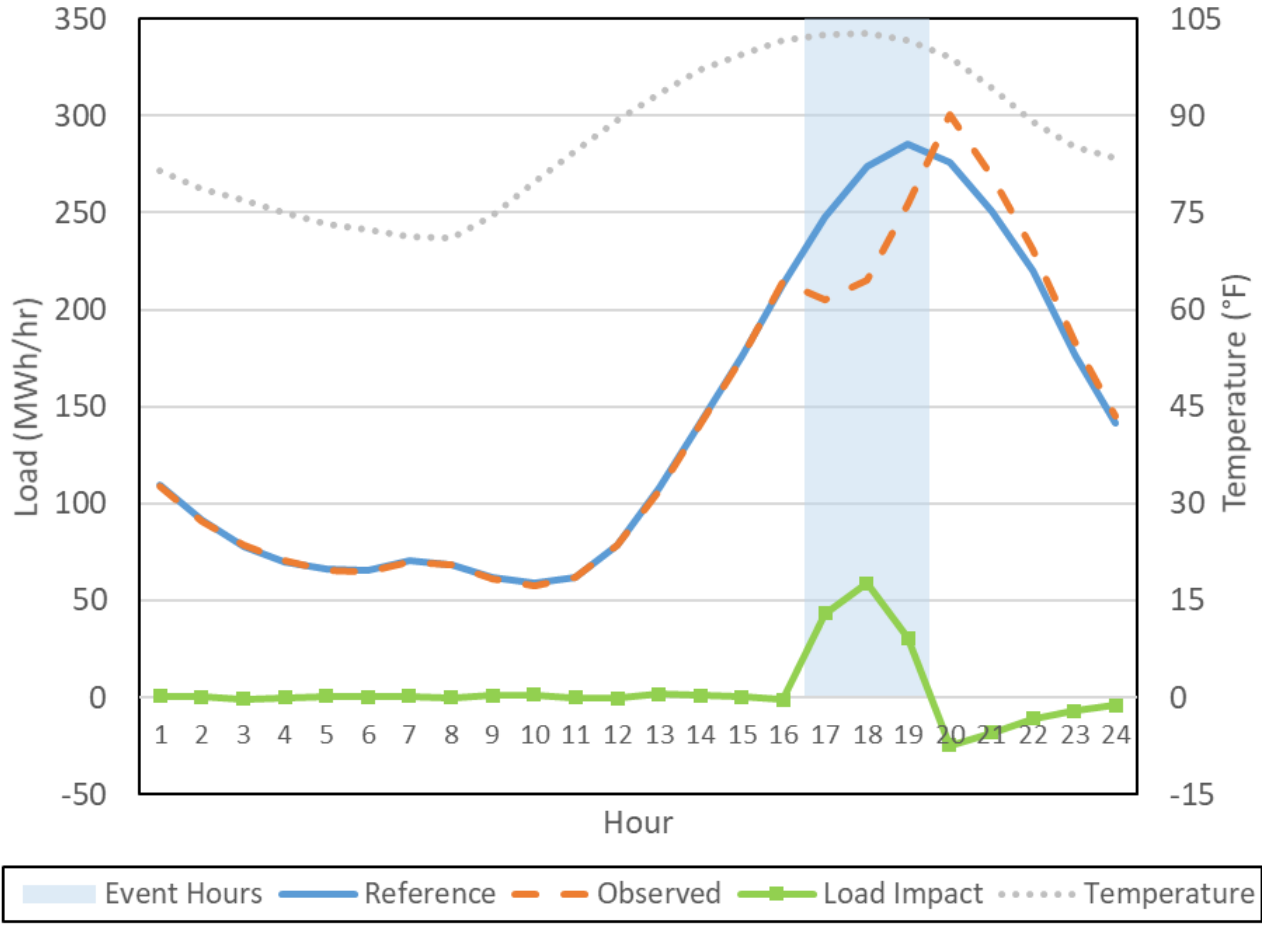
**Average Event-Hour Load Impacts by Event**




- 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

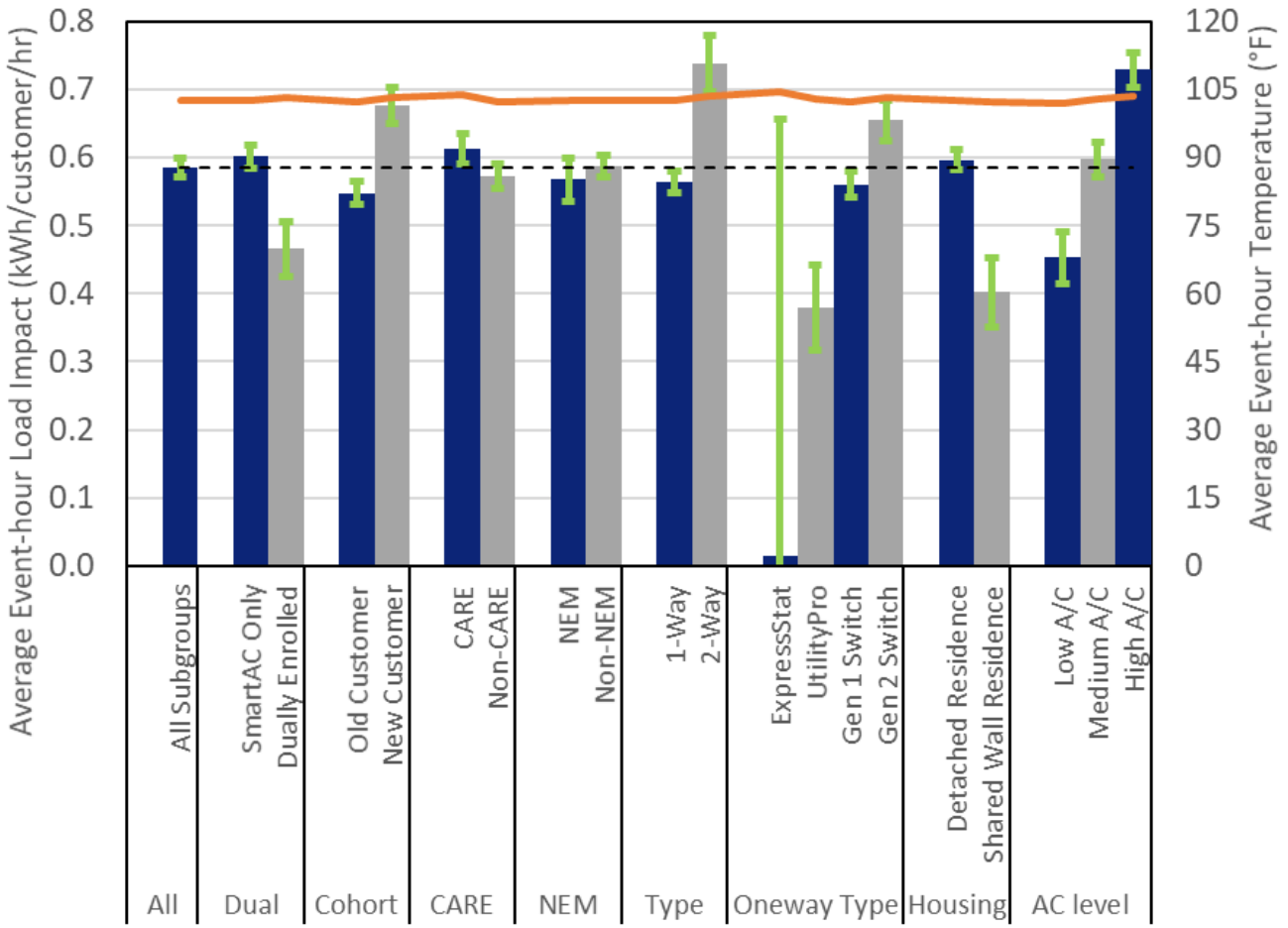
**Hourly Load Impacts on August 15, 2019**




- 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

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




- 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

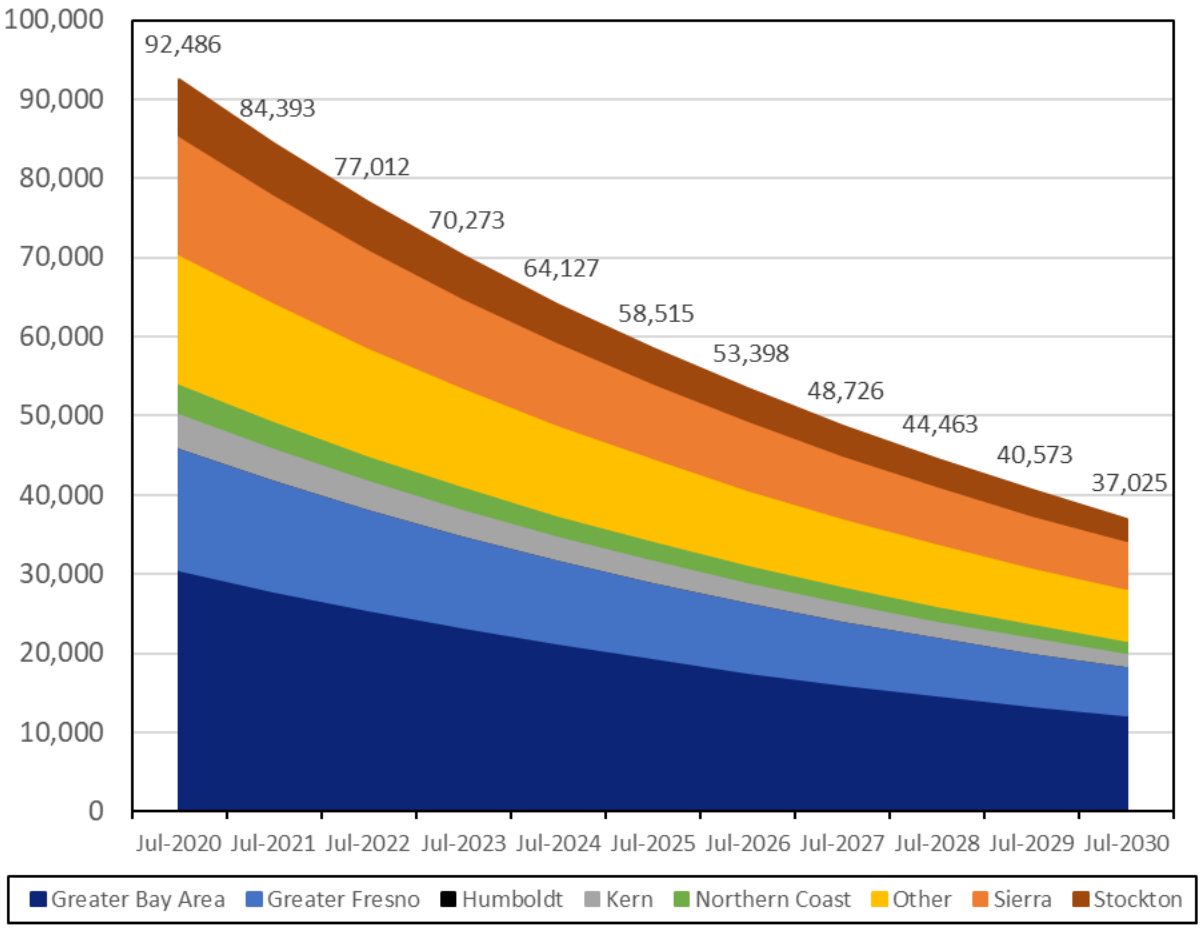
# 4. *Ex-ante* Methodology

- *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)

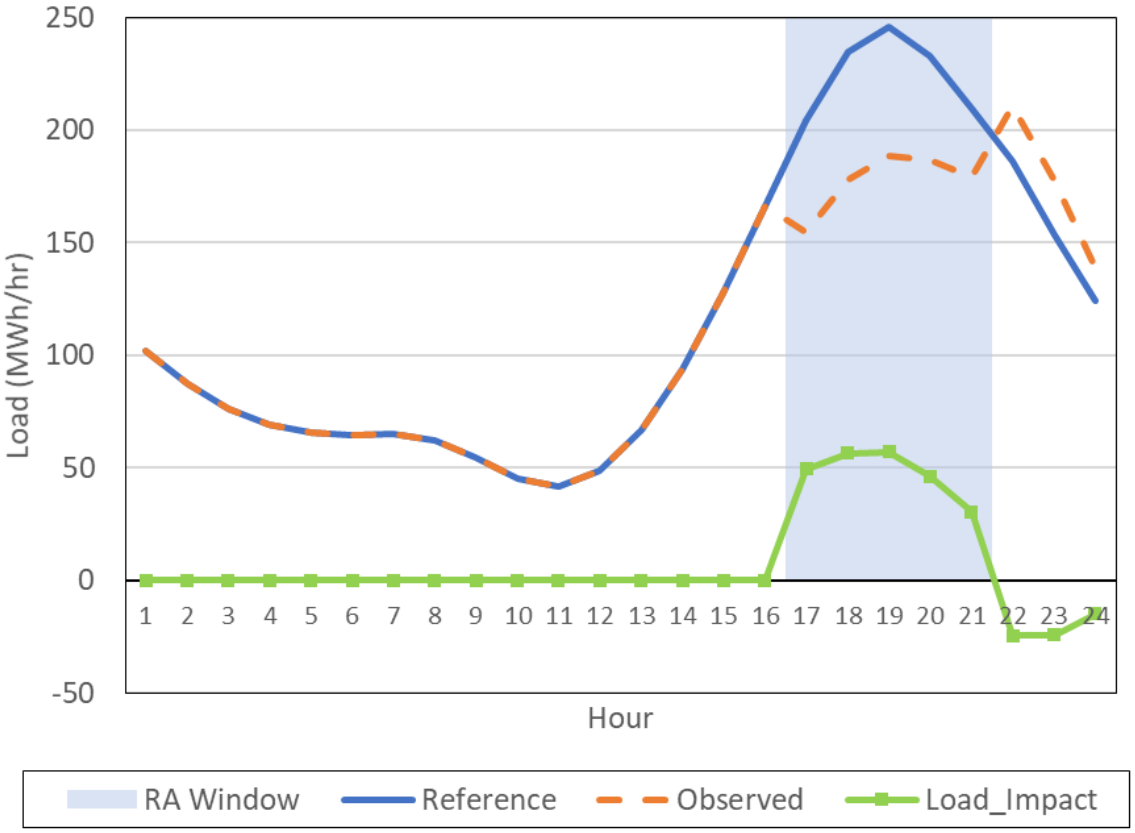
# 5. Enrollment Forecast




- Declining ~9% / year
- PG&E intends to minimize marketing efforts to back-fill attrition

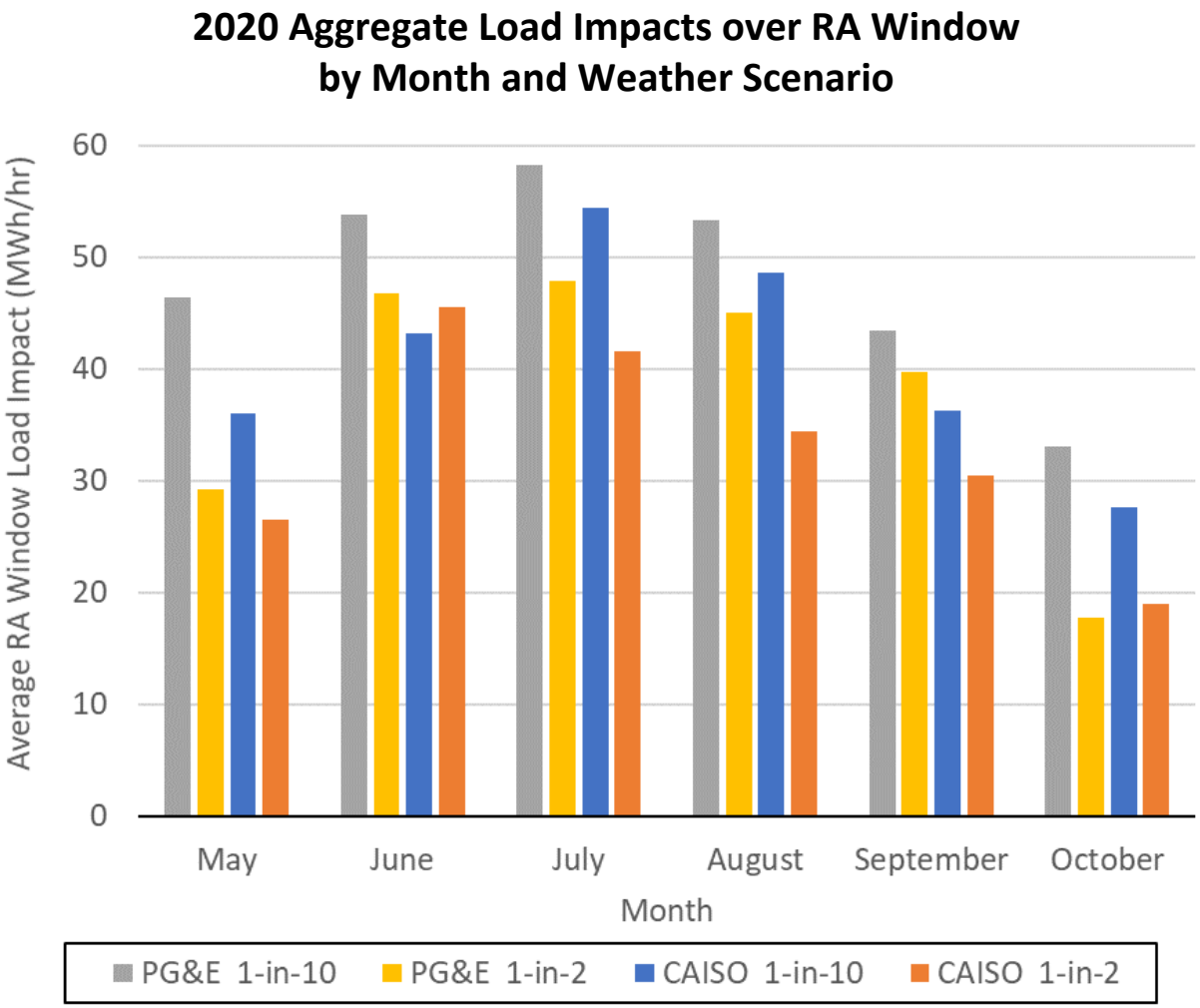
# 6. *Ex-ante* Load Impacts

**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




- 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?

- Contact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