# LEAP 2022 LOAD IMPACT EVALUATION

Demand Response Providers' 2023 Final Report Workshop

Hosted by the California Public Utilities Commission

May 10, 2023

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# AGENDA

» Introduction

» Leap portfolio

» Events

» Ex Post

  • Methods

  • Results

» Ex Ante

  • Methods

  • Results

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# 2022 LEAP PORTFOLIO

Based on Customer and Event Data

» Multiple load types

» High frequency of events

» Geographic diversity

| Sector | Load Type | Enrollment Count | | | Unique Event IDs | Unique SubLAPs |
|---|---|---|---|---|---|---|
| | | PG&E | SCE | SDG&E | | |
| Commercial | Cold Storage | | | | 10 | 3 |
| | Electric Vehicle | 17 | | | 13 | 6 |
| | HVAC | 547 | 1,151 | 224 | 172 | 21 |
| | Large Battery Storage | 13 | | 14 | 166 | 8 |
| | Manufacturing / Process | | | | 25 | 2 |
| | Pumping | 142 | 394 | | 52 | 14 |
| | Small Battery Storage | | 12 | | 161 | 5 |
| **Total Commercial** | | **736** | **1,571** | **252** | **599** | **59** |
| Residential | Electric Vehicle | 2,103 | 2,420 | 715 | 417 | 21 |
| | HVAC | 14,395 | 817 | 641 | 178 | 21 |
| | Other | | | | 10 | 2 |
| | Storage | 230 | 464 | 47 | 294 | 21 |
| **Total Residential** | | **16,732** | **3,701** | **1,403** | **899** | **65** |
| **Grand Total** | | **17,468** | **5,272** | **1,655** | **1,498** | **124** |

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# METERS BY EVENT
## Average and percentiles by load type

» For residential load type, use of panel data models make low-participation events more difficult to model.

| Sector | Load Type | # Events | Average # Meters | 10% | 25% | 50% | 75% | 90% | Max |
|---|---|---|---|---|---|---|---|---|---|
| Residential | EV - Resi | 2,318 | 214 | 19 | 57 | 148 | 319 | 492 | 838 |
| | HVAC- Resi | 976 | 415 | 11 | 44 | 185 | 397 | 890 | 3,445 |
| | Resi Storage | 1,099 | 27 | | | | 22 | 122 | 192 |
| Commercial | Battery Storage | | | | | | | | |
| | Cold Storage | 36 | | | | | | | |
| | EV - C/I | 126 | | | | | | | |
| | HVAC - C/I | 1,009 | 37 | | | | 16 | 42 | 83 |
| | Large Battery Storage | 317 | | | | | | | |
| | Manufacturing / Process | 53 | | | | | | | |
| | Pumping | 276 | 25 | | | | 10 | 19 | 62 |
| | Small Battery Storage | 267 | | | | | | | |

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# DATA SOURCES
## Both Non-Residential and Residential Load Types

» Ex post impacts relied on the following data sources:

- Customer/meter information: Load type, location, etc.

- Meter data: hourly net kWh readings.

- Event data: Event ID, event type, start and end time by meter.

- Weather data: Hourly temperature readings, mapped to meters by nearest coordinates.

» Ex ante impacts relied on the above sources, plus:

- Ex ante weather scenarios, provided the utilities and CAISO.

- Low and high enrollment forecasts by load type.

# EVENTS BY LOAD TYPE AND MONTH

» Based on unique "event IDs"

» Predictably, more events during summer.

» Residential EV most evenly distributed over the year.

# EX POST IMPACTS

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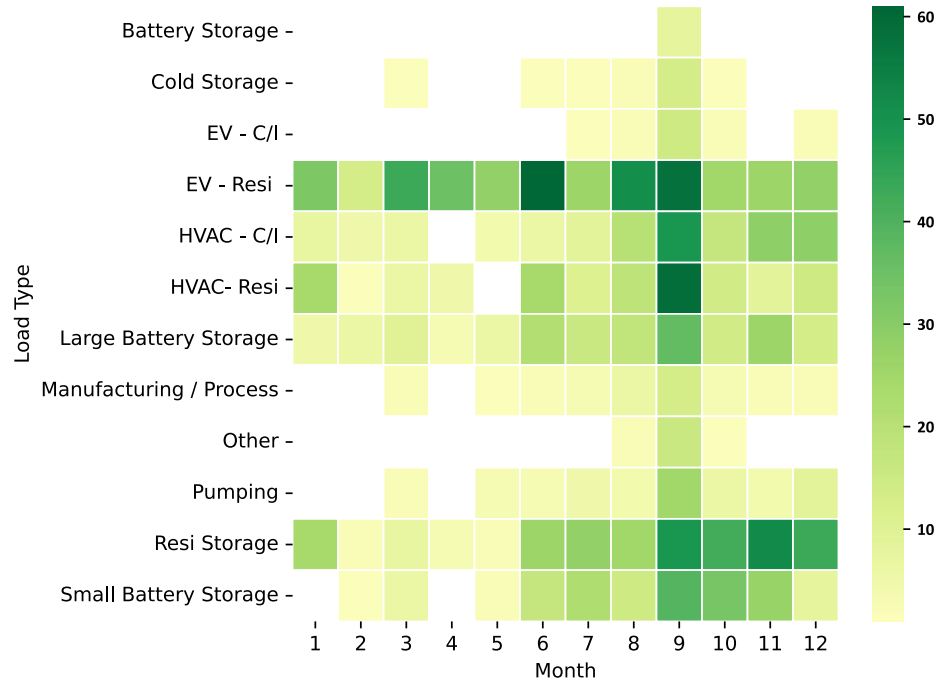
# RESIDENTIAL APPROACH

» Panel data models estimated for each SubLAP and event month.

» Model selection based on a proxy event day to select best model based on out-of-sample performance.

» Estimate impacts by SubLAP for each month separately.

- Impacts estimated separately for each event ID, with overlapping event IDs combined at the meter level:
    - '2022-11-081921' – individual Leap event
    - '2022-10-061617' '2022-10-061920' – Test and market event.
    - '2022-09-071820' 'ELRP2022-09-071621' – Overlapping ELRP and Leap event.

» Participation is not uniform, so in some cases those meters not participating in an event can act as control for those meters that are.

# NON-RESIDENTIAL APPROACH

» Individual regression models for each meter, with some aggregation where appropriate.

» Analysis to assess weather sensitivity of meters to determine a model family, done seasonally.

» Model selection based on a proxy event day to select best model based on out-of-sample performance.

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# EX POST IMPACTS
## Per Capita kW by Load Type and Month

| Month | Non-Residential | | | | | | | Residential | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | Cold Storage | EV | HVAC | Large Battery Storage | Manufact./ Process | Pumping | Small Battery Storage | HVAC | EV | Battery Storage |
| Jan. | -- | -- | 0.8 | 631.7 | -- | -- | -- | 0.11 | -- | -- |
| Feb. | -- | -- | 0.4 | 744.4 | -- | -- | 11.2 | -- | -- | -- |
| Mar. | -- | -- | 6.2 | 150.6 | 81.7 | 69.7 | 53.7 | 0.03 | 0.12 | -- |
| April | -- | -- | 5.3 | 94.9 | -- | -- | -- | 0.08 | -- | -- |
| May | -- | -- | 1.6 | 215.7 | 18.8 | 33.4 | 7.3 | -- | 0.02 | -- |
| June | 131.5 | -- | 6.1 | 52.5 | 76.8 | 35.8 | 40 | 0.17 | -- | 0.11 |
| July | 18.6 | 0.3 | 1.8 | 342.2 | 8.2 | 46.9 | 19.6 | 0.18 | 0.03 | 0.09 |
| Aug. | 23.8 | 5.2 | 2.2 | 475.1 | 34.7 | 41.1 | 57.8 | 0.27 | -- | -- |
| Sept. | 0.4 | 34.4 | 0.8 | 227.9 | 6.8 | 3.7 | 79 | 0.25 | 0.03 | -- |
| Oct. | 17.9 | -- | 0.8 | 869.4 | 2.1 | 16.4 | 130.5 | 0.13 | 0.13 | 0.25 |
| Nov. | -- | -- | 0.7 | 227.9 | 1.2 | 394.4 | 145.6 | 0.01 | -- | -- |
| Dec. | -- | -- | 0.8 | 77.2 | 0.7 | 5.6 | 23.9 | 0.03 | -- | -- |

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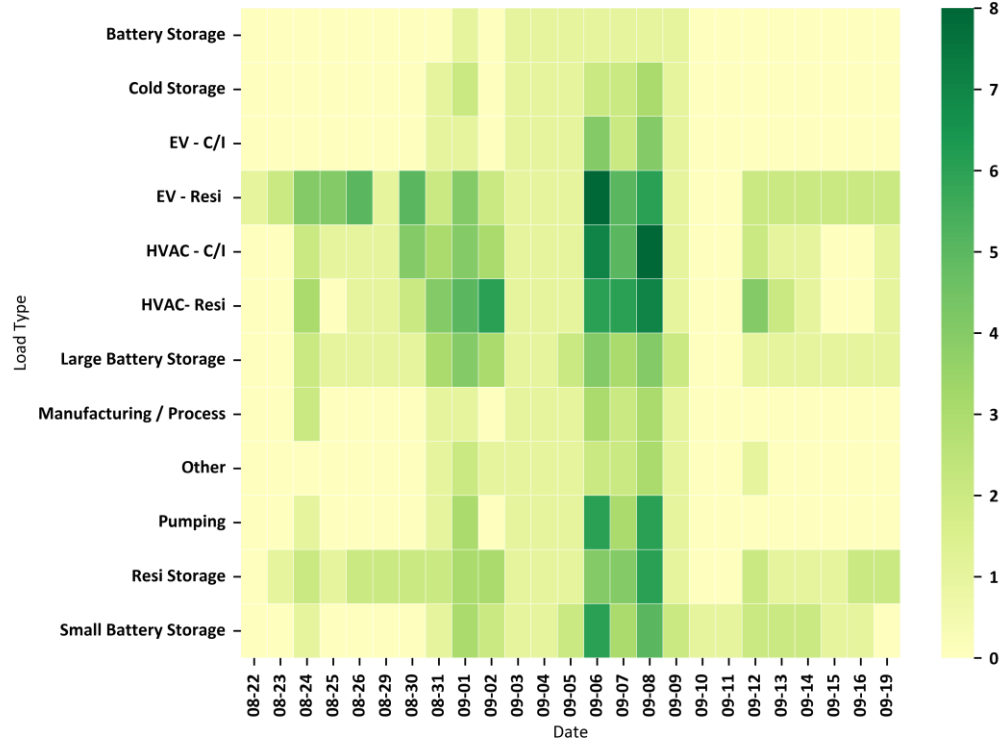# EX POST IMPACTS
## By Month and Load Type

» Full ex post MW resource potential based on all meters enrolled
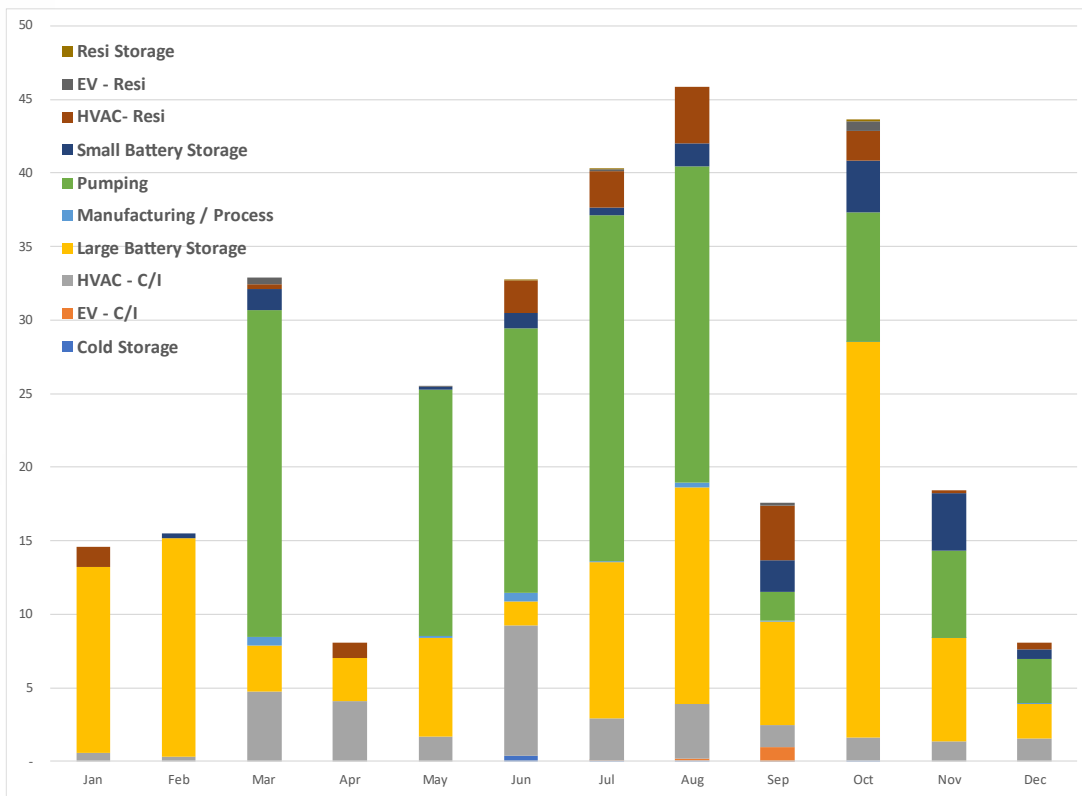
# SEPTEMBER HEAT WAVE EVENTS

## Unique Events by Date and Load Type

» Late August through mid-September had many events.

» Up to nine consecutive days in some cases.

» In some cases, possibly led to event fatigue.

# EX ANTE IMPACTS

# APPROACH

» Models informed by ex post, but modified as follows:

- Events interacted with a weather term

- Specification employs and "hour-of-event" approach.

- Unmodeled RA hours use derated impacts from modeled hours.

» Model impact parameters applied to weather scenarios to reflect impacts under different conditions.

» Per-capita impacts multiplied by low and high enrollment scenarios.

| Date | Hour Ending | Event | EH1 | EH2 | EH3 |
|------|-------------|-------|-----|-----|-----|
| 9-Aug | 16 | N | 0 | 0 | 0 |
| | 17 | N | 0 | 0 | 0 |
| | 18 | Y | 1 | 0 | 0 |
| | 19 | Y | 0 | 1 | 0 |
| | 20 | Y | 0 | 0 | 1 |
| | 21 | N | 0 | 0 | 0 |
| ... | ... | ... | ... | ... | ... |
| 10-Aug | 16 | N | 0 | 0 | 0 |
| | 17 | Y | 1 | 0 | 0 |
| | 18 | Y | 0 | 1 | 0 |
| | 19 | N | 0 | 0 | 0 |
| | 20 | N | 0 | 0 | 0 |
| | 21 | N | 0 | 0 | 0 |

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# EX ANTE IMPACTS BY LOAD TYPE

## August Aggregate Impacts

| Sector and Load Type | Low Case | | | High Case | | |
|---|---|---|---|---|---|---|
| | Forecast Participant Count | CAISO 1-in-2 (MW) | Utility 1-in-2 (MW) | Forecast Participant Count | CAISO 1-in-2 (MW) | Utility 1-in-2 (MW) |
| **Commercial** | | | | | | |
| Cold Storage | 1 | 0.02 | 0.02 | 2 | 0.04 | 0.04 |
| HVAC – Non Residential | 4,127 | 25.24 | 28.16 | 4,953 | 30.29 | 33.79 |
| Large Battery Storage | 92 | 9.45 | 9.96 | 111 | 11.40 | 12.01 |
| Manufacturing/ Process | 8 | 0.25 | 0.25 | 10 | 0.31 | 0.31 |
| Other | 64 | 0.20 | 0.17 | 77 | 0.24 | 0.21 |
| Pumping | 789 | 35.15 | 35.88 | 947 | 42.19 | 43.06 |
| Small Battery Storage | 25 | 0.68 | 0.71 | 30 | 0.82 | 0.86 |
| **Residential** | | | | | | |
| Res HVAC | 26,919 | 13.96 | 14.21 | 32,303 | 16.75 | 17.06 |
| **Total** | | | | | | |
| **Total** | **32,025** | **84.95** | **89.36** | **38,433** | **102.04** | **107.33** |

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# EX ANTE BY MONTH AND SECTOR

» Low enrollment forecast.

» Utility 1-in-2 weather.
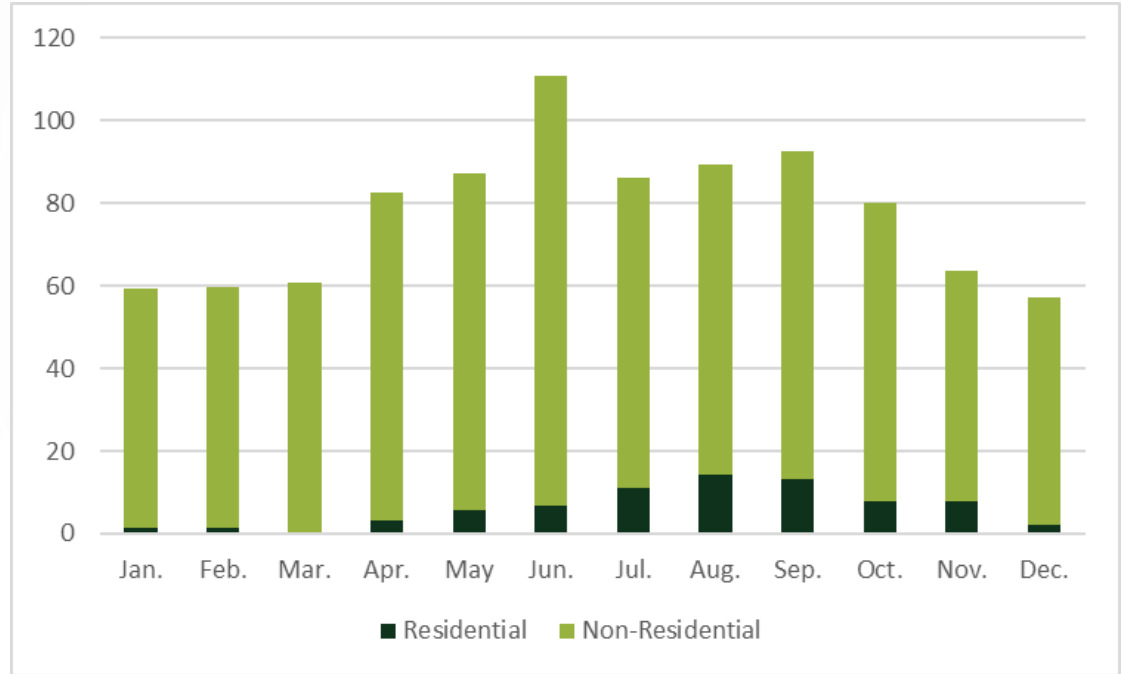
# QUALIFYING CAPACITY VALUES

» August 1-in-2 weather year

» Utility weather scenario

» Low and high growth scenarios in 2024

| IOU Service Territory | Low Growth Forecast Scenario | | High Growth Forecast Scenario | |
|---|---|---|---|---|
| | Number of Customers | MW | Number of Customers | MW |
| PG&E | 18,372 | 14.51 | 22,048 | 17.45 |
| SCE | 10,501 | 61.89 | 12,602 | 74.30 |
| SDG&E | 3,152 | 12.95 | 3,783 | 15.59 |
| **Total** | **32,025** | **89.36** | **38,433** | **107.33** |

# IMPACT RECONCILIATION
## 2021 Ex Ante to 2022 Ex Post

» Per-capita impacts, FY 2022 ex ante for August utility 1-2 with FY 2023 ex post results

| Load Type | FY 2022 Ex Ante | FY 2023 Ex Post |
|---|---|---|
| Cold Storage | 168 | 23.80 |
| Non-Res HVAC | 7.0 | 2.2 |
| Large Battery Storage | 1,322 | 475 |
| Pumping | 83 | 41.1 |
| Small Battery Storage | 13 | 57.8 |
| Res HVAC | 0.60 | 0.27 |

# IMPACT RECONCILIATION
## Caveats

» For non-residential load types, the ex post impacts are highly sensitive to customer makeup.

» For the residential HVAC, impacts highly sensitive to geography, so weighting of ex ante results versus actual meters dispatched influences results.

» Methods a small factor – reasonable baselines should yield similar results.

» Change in evaluator prevents granular investigation into specific causes.

# CONCLUSION AND RECOMMENDATIONS

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» Full extent of ex post impacts incomplete.

- Some events could not be estimated due to insufficient data or load volatility.

- Appropriate extrapolation for volatile customers/load types merits investigation.

» Some resources would benefit from having net load, particularly residential EV and battery storage:

- Very high presence of net energy metering customers.

- Presence of zero load makes it hard to model.

» Ex ante methods could better portray how resources perform – importance of start time, length of events, and other factors are all obscured by current methods.

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