ET Summit 2021

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Residential Behavior Change from a Time of Use Display

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COMPANY OVERVIEW

- Res-Intel is a CA Energy Commission-funded AI software company that has performed building energy benchmarking on most of California's Multifamily Residential (MFR) complexes.
- Owned and operated by social-equity focused data-scientists. Based in Portland, OR.

Our unique analytics and data sets include:

Communities for Conservation MFR Pilot (2015-2017)

SoCalGas
A Sempra Energy utility®

SoCal Gas and SoCal Edison competition with 2,220 MFRs/90,000 meters

SoCal Edison MFR Characterization (2017-2018)

SOUTHERN CALIFORNIA EDISON®
An EDISON INTERNATIONAL® Company

Inventory and Benchmarking of SCE's entire MF portfolio

SDG&E MFR Characterization & MFHOPPs Evaluation (2019-2021)

SDGE connected
A Sempra Energy utility™

1. Inventory and Benchmarking of SDG&E's entire MF portfolio
2. MFHOPPs Impact Evaluation

PG&E MFR Characterization (2020-2021)

PG&E

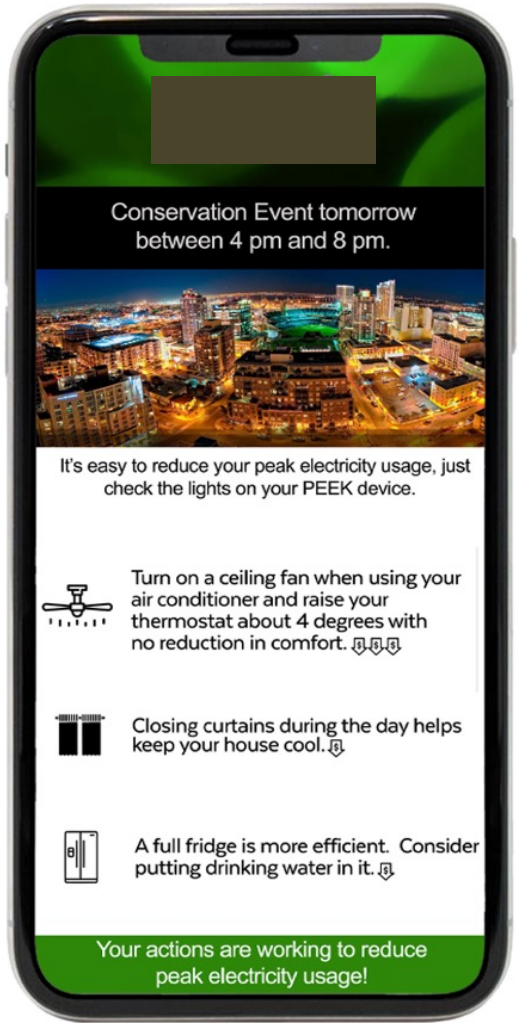
Inventory and Benchmarking of PG&E's entire MF portfolio

THE IHD DEVICE AND SMARTPHONE APP

- **Purpose of this project:** to evaluate the demand response and energy efficiency effects of a Time-of-Use (TOU) Energy Display in-home-device (IHD)
  - Device capital cost $19.77 each, $.69 month O&M and messaging costs

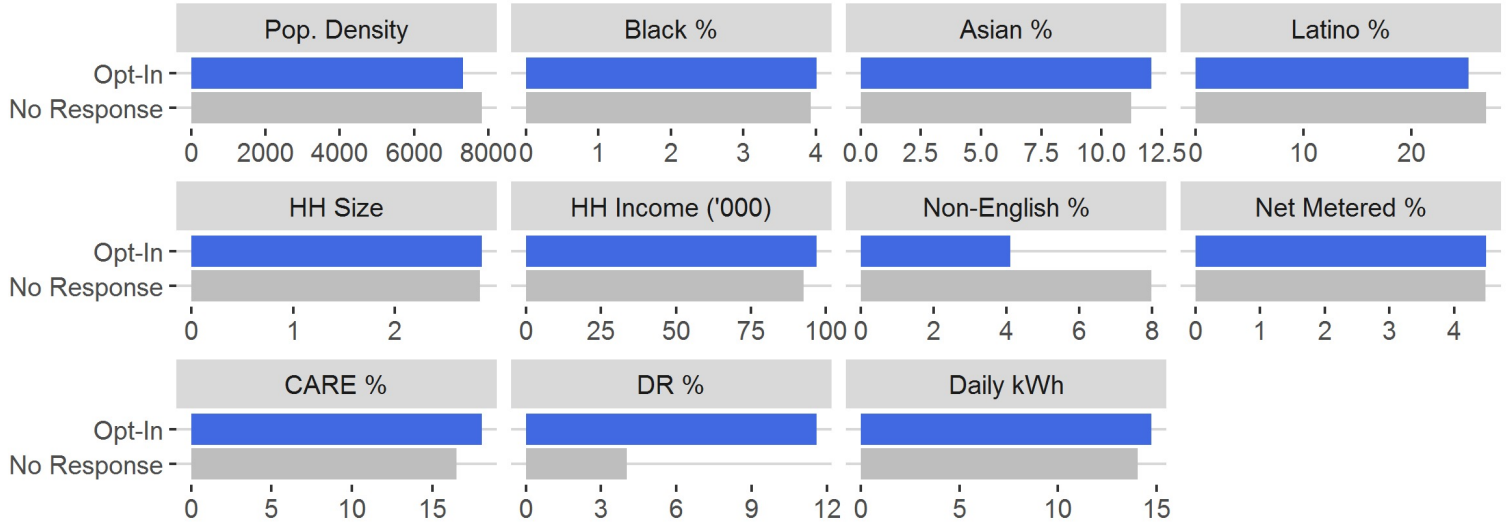
- Stoplight logic to represent current TOU rate

- Messaging encouraged peak-hour energy reductions during designated DR days.
- Customers were encouraged to reduce energy for the purpose of lowering environmental and economic costs.
- Messages also included recommended energy saving activities and messaging about **peer effects and loss aversion**



STUDY DESIGN

- Randomized Encouragement Design with control and treatment groups
  - Solicitation began on July 26, 2019 from a pool of SDG&E's TOU customers
  - Eligible customers received a "Call to Action" flyer by email and postal direct mail.
    - 1,000 customers opted into the study
- Customers who opted in were similar to those who did not. However:
  1. Opt-in participants **were 50% less likely to declare a non-English preferred language**.
  2. Opt-in participants were **nearly 4x more likely to have signed up for SDG&E's existing DR** program.
- Mailing of 500 IHD devices began in October 2019.
  - 239 participants activated the device (*Treated*)

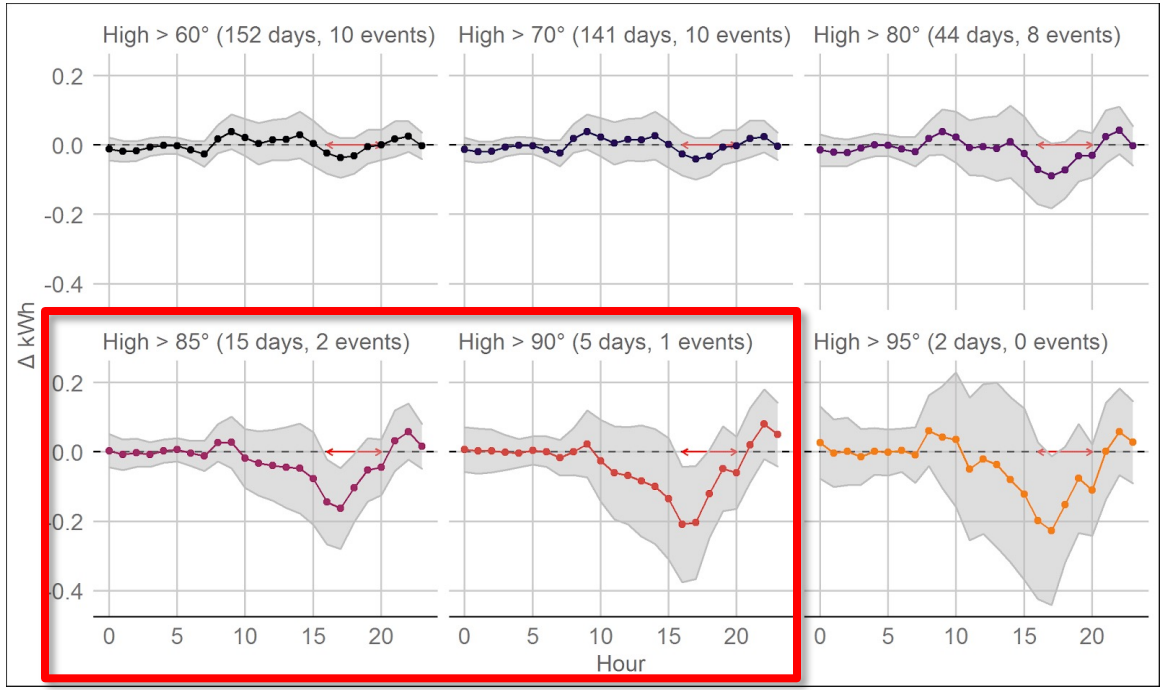


EVALUATION METHODOLOGY

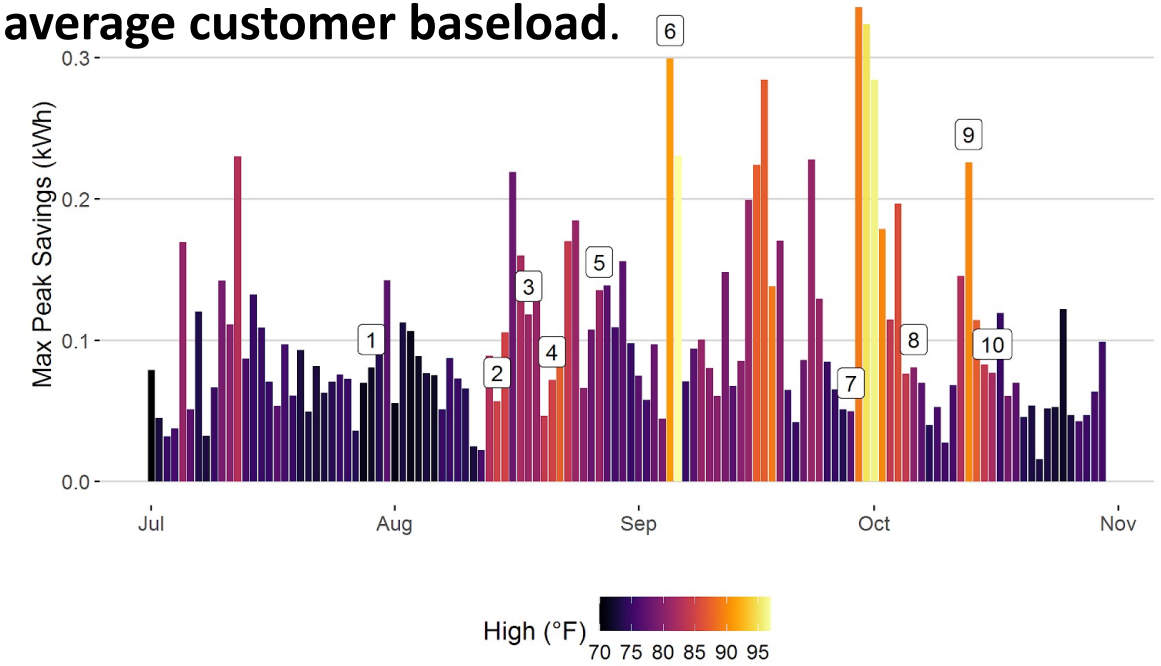
- The IHD device was evaluated along two dimensions:
    1. Effectiveness of device in reducing consumption during 10 DR messaging days.
    2. Effectiveness of device in managing peak-hour (4-9pm) consumption when peak TOU rates increase.
- Changes in customer energy usage are evaluated using 2+ years of hourly advanced metering infrastructure (AMI) data for each of the 1,000 participating customers.
- Statistical modeling of customer energy usage involves two stages:
    1. Construct individual baseline models for each participating customer.
        - Gradient boost machines (GBM) for customer baseline modeling.
    2. Input prediction residuals (λ_i) from these models into a fixed effects regression

RESULTS

- Statistically significant reductions in hourly kWh occur where the shaded grey confidence intervals drop below zero (the dashed line).
- Significant reductions occurred on the hottest days (>85 degrees) in the early peak hours between 4pm and 6pm.

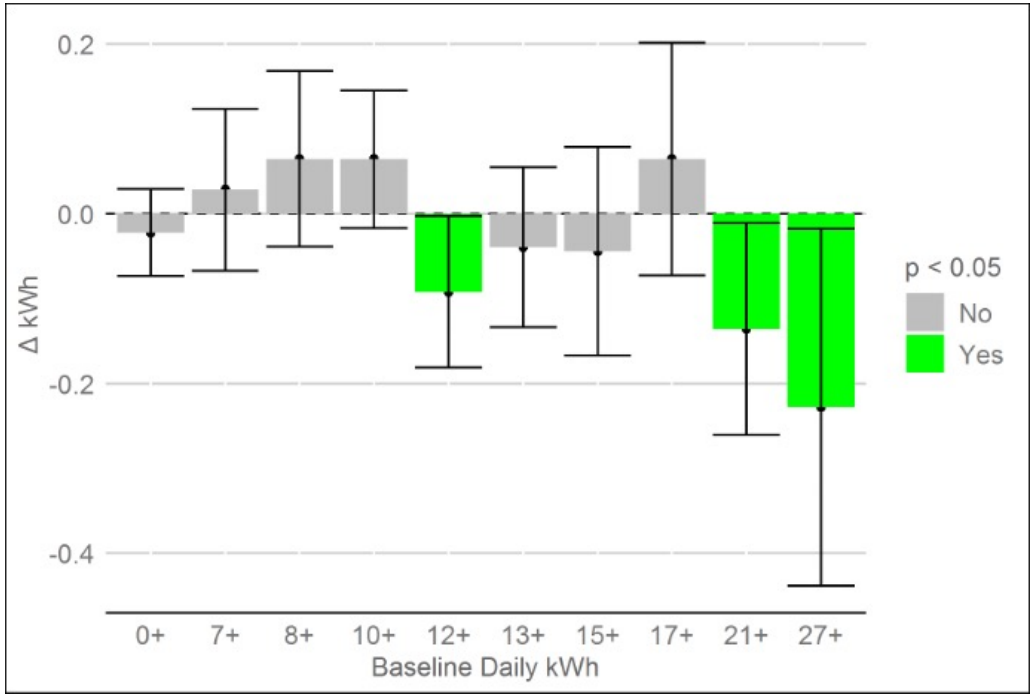


- **Designated event days:** There is consistent evidence that the IHD device and messaging **did not** cause any significant energy-use reductions.
- **Peak period reductions:** were **~3%** and statistically significant in 1 of 3 models.
- **Seasonal reductions**: activation of the device is associated with a reduction in peak-hour electricity-use on hot summer days, **equal to about 8% of the average customer baseload**.

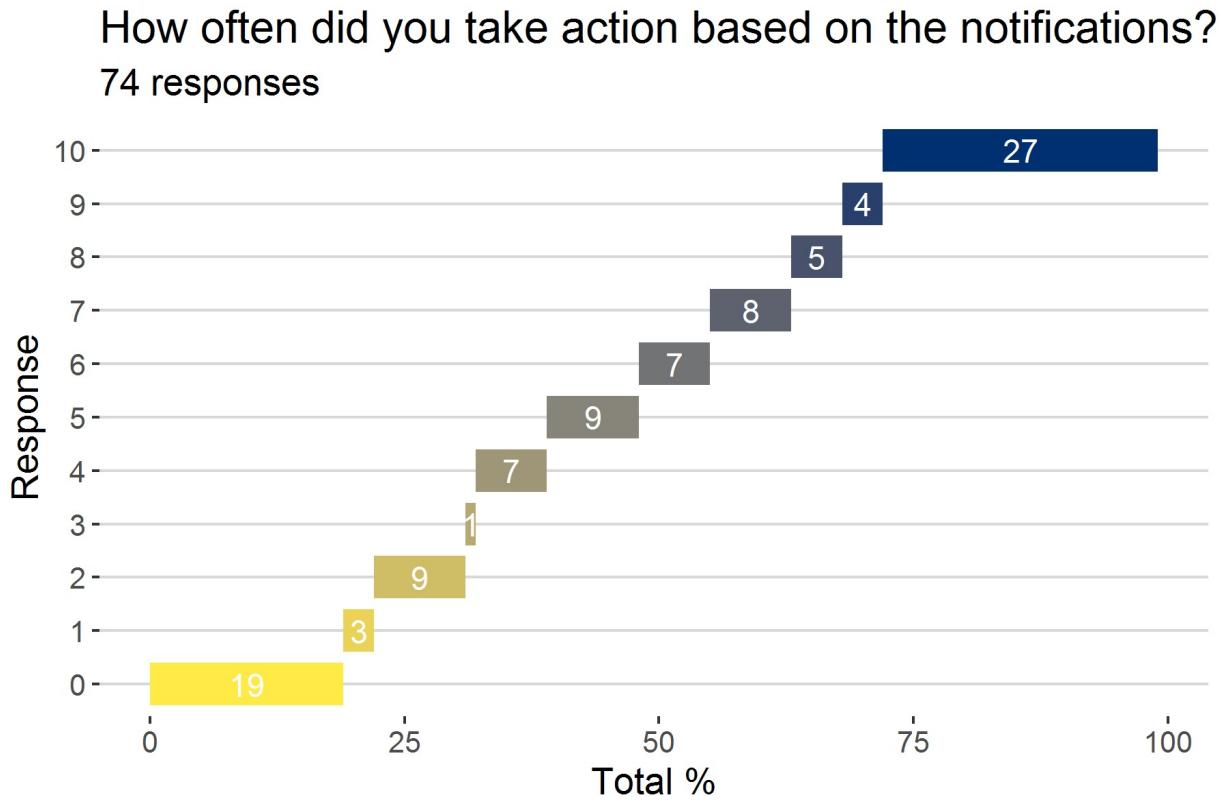


RESULTS (2)

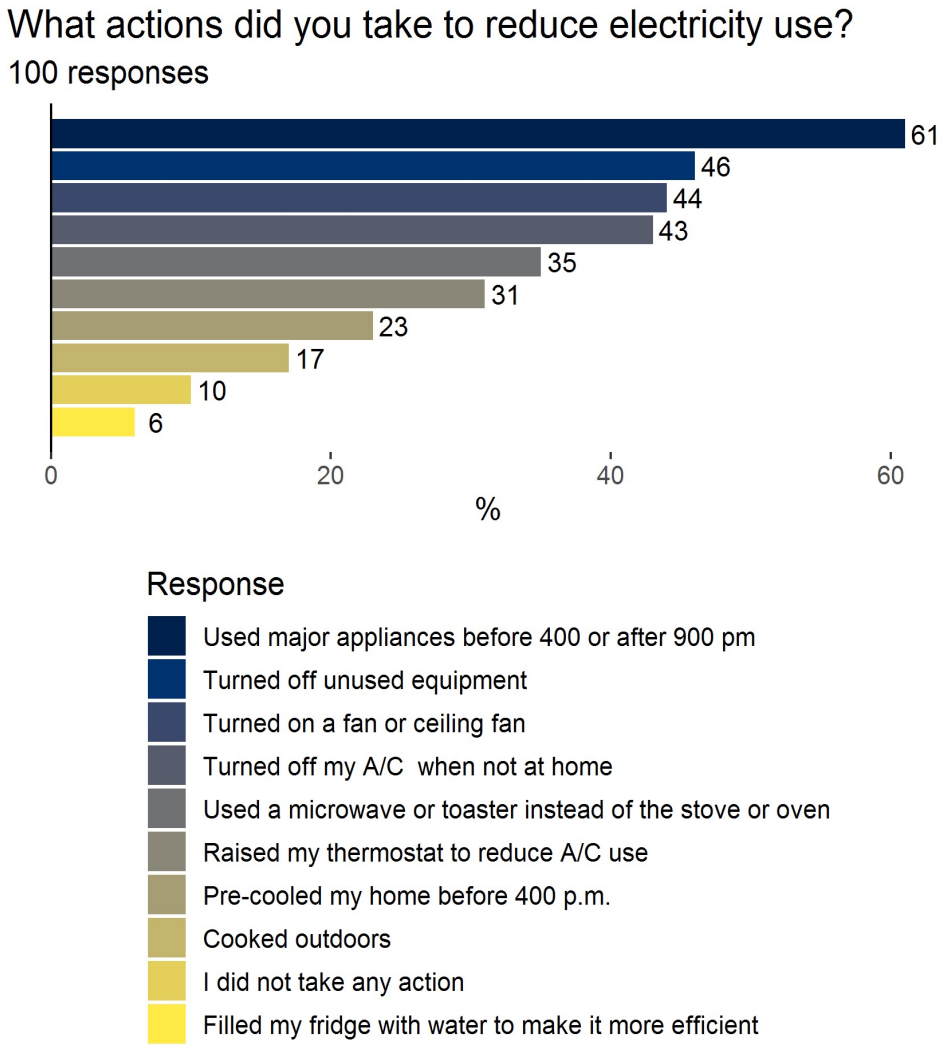
- Savings from the device were driven primarily by those customers who had high baseloads, exceeding a daily average of 12 kWh.
- This finding conforms to the intuition that these customers have a higher margin of adjustment.



- The IHD Device Customer Survey was sent to 1,000 SDG&E customers over a 10-day time frame in January 2021
  - Average response rate of 37%



PARTICIPANT BEHAVIOR



COST EFFECTIVENESS

- The total resource cost (TRC) and cost benefits ratio (CBR) of the energy savings and demand reduction using:
  - The 2016 Demand Response (DR) Cost Effectiveness Calculator
  - The Energy Efficiency (EE) Cost-Effectiveness Tool
- Results
  - DR cost benefit ratio: ~6.4
  - EE cost benefit ratio: .22

CONCLUSIONS

1. The IHD and smartphone application promote seasonal reductions of peak-hour energy usage on the order of 3 to 8 percent of typical use.
   - Reductions are concentrated on the **hottest days of the summer** (exceeding 85 degrees Fahrenheit).
2. Event-day messaging from the IHD Mobile App and device **did not** display statistically significant reductions in energy usage **on event days**.
   - Lack of results are likely due to **small sample size and small effect size**
3. Opportunities for IHD to mitigate impacts of opt-out and dynamic TOU rates for low-to-medium-income households
   - LMI customers tend to be **renters, live in older, less insulated homes**, and have landlords with little incentive to invest in EE upgrades
   - Since utility bills are the primary channel through which utilities disseminate information (through bill inserts, etc.), engaging customers in a meaningful way can be difficult.
     - Most customers spend an **average of 8 minutes per year** interacting with their utility bills (Tweed, 2016).
   - TOU rate implementation needs to be combined with **education, access to energy efficiency measures, and targeted communication** to avoid a costly shift for already energy-burdened households.

This project was funded by the California Emerging Technologies Program.

For more information, contact Jeff Barnes at jbarnes@sdge.com or Hal Nelson at Hal.Nelson@Res-Intel.com

The project report can be found at TBD

Thank you for your attention!

Please email me with questions.

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