PG&E Residential Smart Thermostat Trial

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Pacific Gas & Electric

Honeywell
Opower
Freeman Sullivan & Co.

Trial Goals

o **Key objectives:**

- Validate energy savings potential from reducing HVAC consumption through a smart thermostat controllable via a web/smart phone application and normative messaging

- Study residential consumer preferences and attitudes towards enabling technologies, behavior changes, and level of engagement with the thermostat solution

o **Secondary objective:**

- Calculate a baseline of efficiency savings as a basis for projecting savings for a broader program rollout

Methodology

- o Randomized control trial with 1,388 households

  - 695 in control

  - 693 in treatment (505 thermostats installed)

- o Face-to-face recruiting with onsite qualification and random assignment (recruit and deny)

- o Two phases of direct installations between July 2012 and February 2013

  - Phase 1: East Bay; iphone only

  - Phase 2: Central Valley, iphone and Android

- o Official measurement period began mid-February 2013
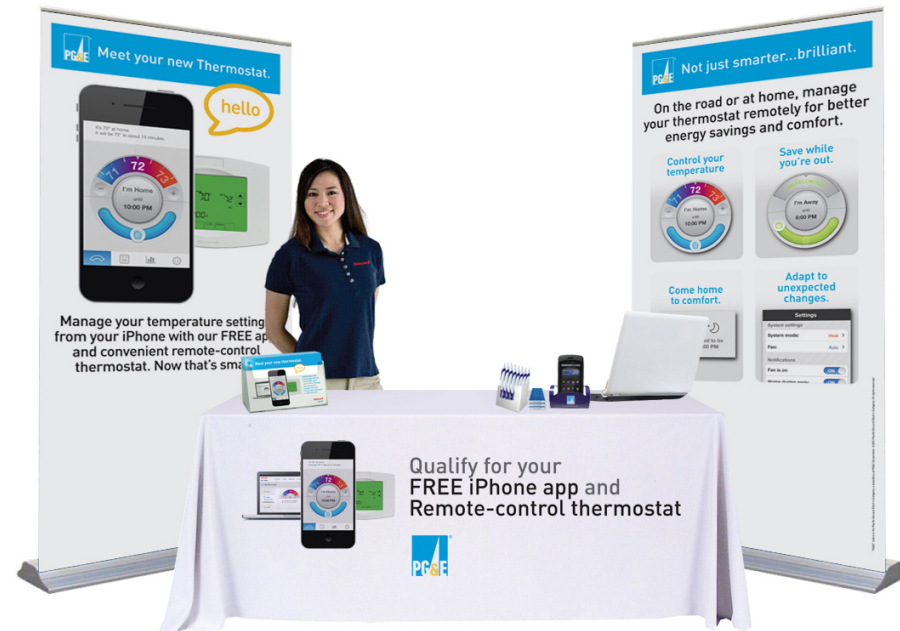
Trial Eligibility

o Trial requirements:

- 1+ iPhone or Android devices in use in the household

- Dual-fuel PG&E customer

- Single family homeowner or condo dweller

- Central heating and air conditioning with single thermostat

- Broadband connection

- No back-up heat or auxiliary/heat pump

- No plans to move in the next 12 months

- Not be participating in PG&E's SmartAC program
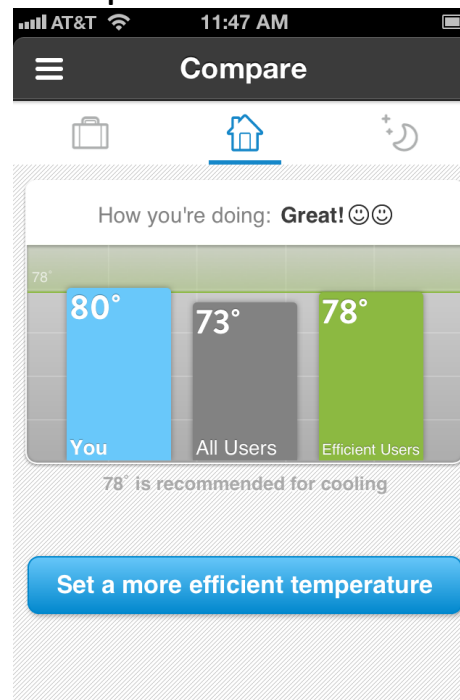
Usability and Interventions

o Honeywell Thermostat

o Opower

- Web portal

- Smart phone-based remote control

- Push messaging capabilities
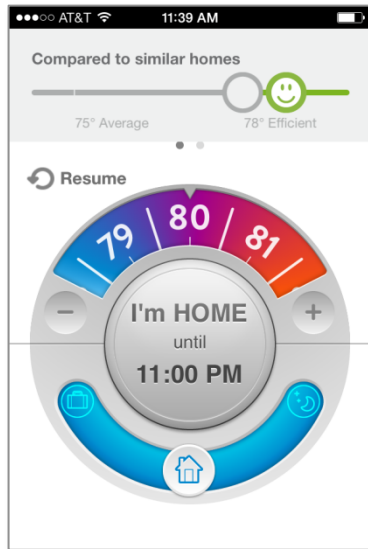

Habits and scheduling
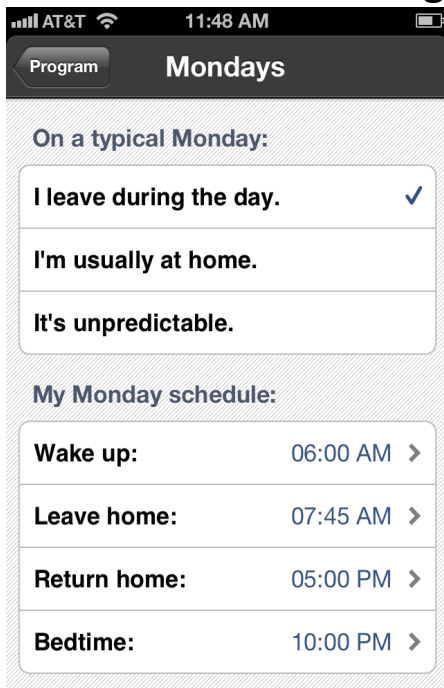
Comparative feedback

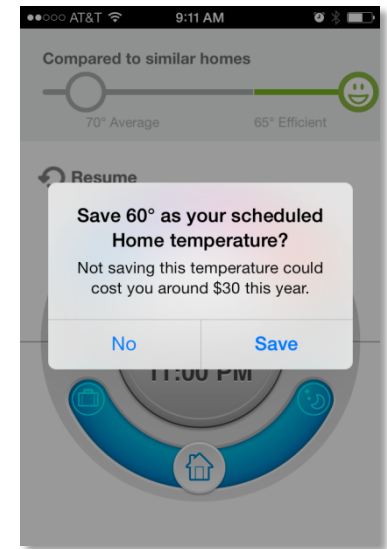# Engagement Drives User Behavior

Normative comparisons

Real-time comparisons with similar homes

Loss aversion
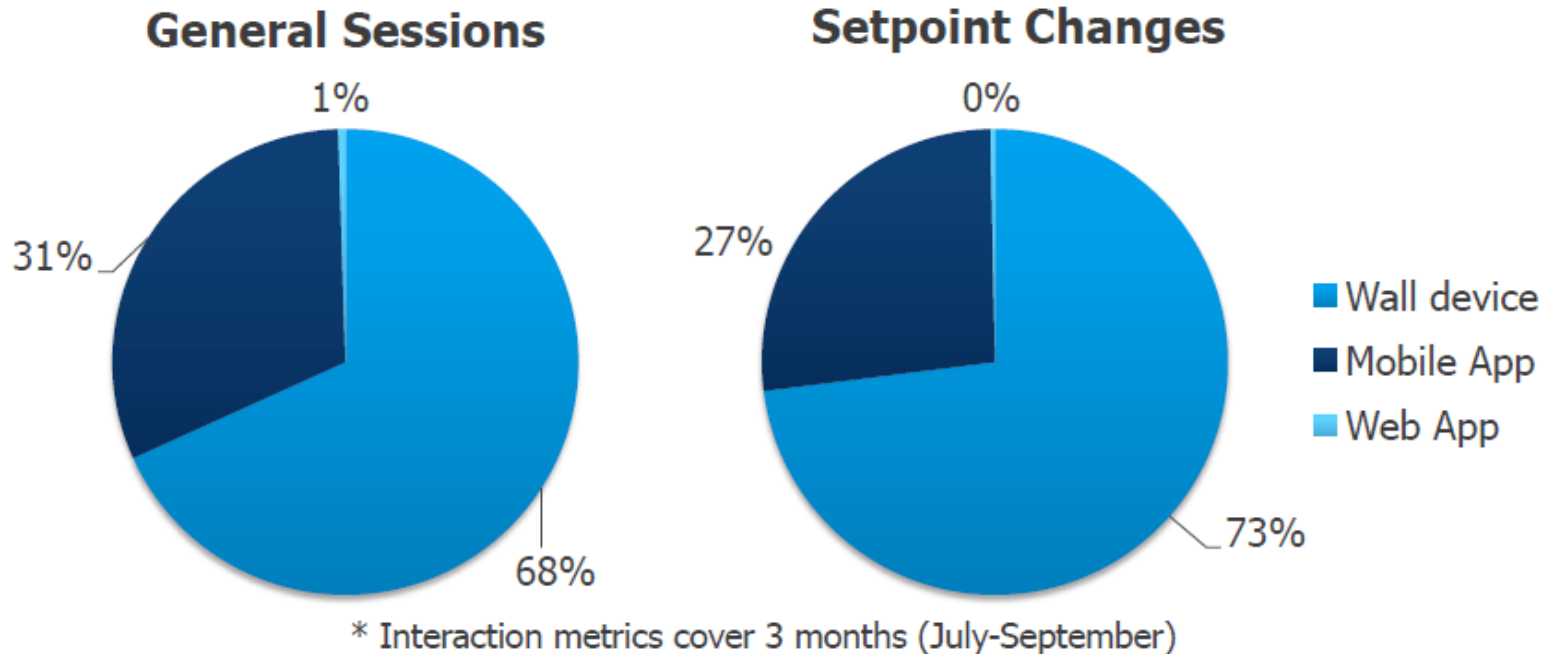

Calculate inefficient losses rather than efficient gains

Setpoint coaching

Notifications that encourage efficiency

Engagement is High

o **1 in 4** engage **daily** with the system

General Sessions

1%

31%

68%

Setpoint Changes

0%

27%

73%

- Wall device
- Mobile App
- Web App

* Interaction metrics cover 3 months (July-September)

o <u>**Setpoint feedback/coaching works**</u>

- <u>**Cooling:**</u> **70%** start with EPA-recommended setpoints; **45%** adopt more efficient setpoints

- <u>**Heating:**</u> **89%** start with EPA recommended setpoints; **67%** adopt more efficient setpoints

Preliminary Findings

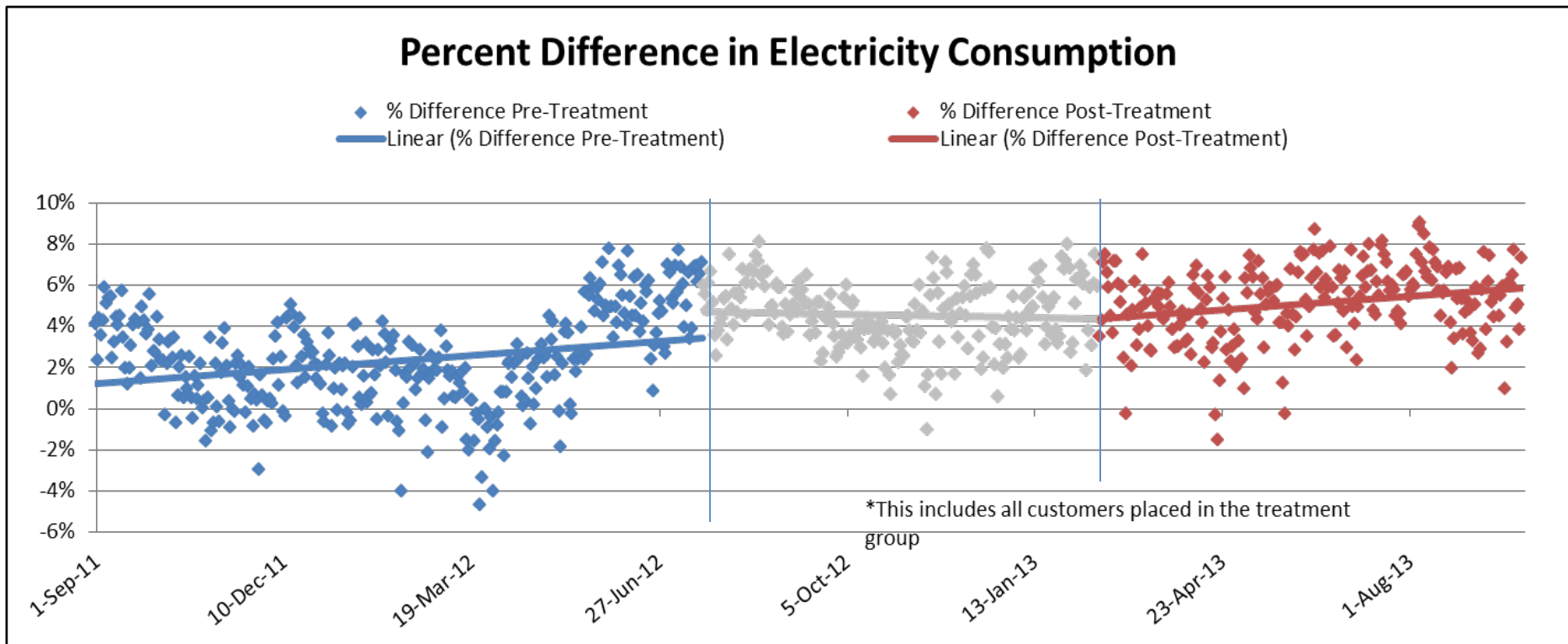o   **OPOWER**   figures for February – August 2013 percentage savings

	Percentage Savings*
Electric	2.4%
Gas	3.4%

* Represents savings divided by ratio of households with a thermostat installed

- The Electric figure is statistically significant; Gas figure is not, due to high variability of gas usage

Analysis is Ongoing

o Length and variability in the installation period (grey points) requires a more nuanced regression model

Percent Difference in Electricity Consumption

*This includes all customers placed in the treatment group
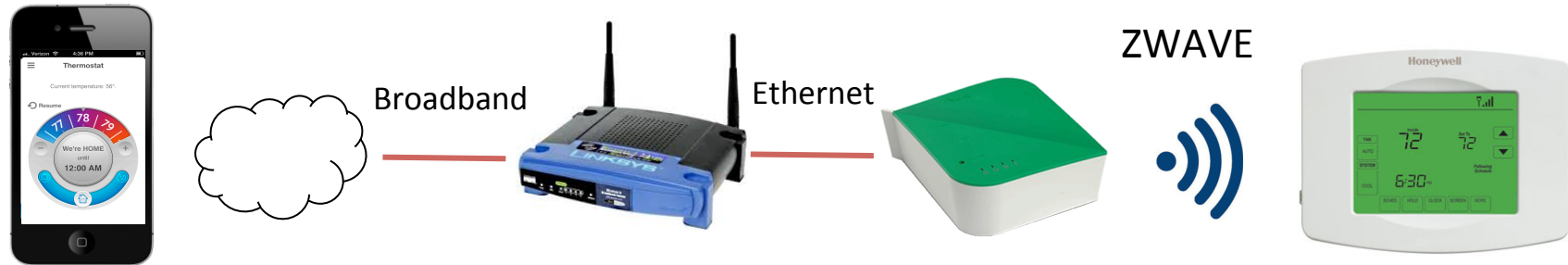
Lessons Learned (1)

o **Recruitment**

- Recruitment under guise of survey, or recruit and delay, could provide a better customer experience

o **Hardware**

- Installation and communication problems:
    - Thermostats could not be installed at ≈30% of treatment households (due to technical HVAC/home issues or trial opt-out)
    - Additional fallout from initial Z-Wave Gateway Connection (wi-fi substitution completed in August-September)

Wi-Fi Upgrade

Old Z-Wave Architecture

Broadband Ethernet ZWAVE

New WiFi Architecture

Broadband WiFi

- Zwave solution presented radio range and data corruption issues. Led to customer frustration
- WiFi architecture is simpler and more robust. Range issues much less likely

Lessons Learned (2)

- **Generalizability.** Specificity of pilot design makes it challenging to claim that findings are generalizable to vendor-agnostic downstream rebate self-install program

- **Isolating feedback/comparison effects.** Inclusion of a smart thermostat-only treatment group would have more explicitly shown the effects of the feedback/comparison information provided through the smart phone app and web portal

- **Statistical Power.** Detecting effects with modest sample sizes, and a long installation period, is challenging

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