DR23.02 Flick Power Study

Overview

SCE's Emerging Technologies Program (ETP) and Emerging Markets and Technology (EM&T) Program jointly initiated a field pilot study to demonstrate and assess the effectiveness of customer behavioral change from a novel communicating light switch technology that displays visual signals to residential consumers about the price of electricity.

While SCE customers have recently been transitioned to Time-Of-Use (TOU) rates, there is a gap in understanding the timing of prices during the day. With the field deployment of a smart light switch and color changing display representing time-based prices, this project seeks to understand the impacts of the device on price-responsive consumer behavior, such as load shifting and curtailment.

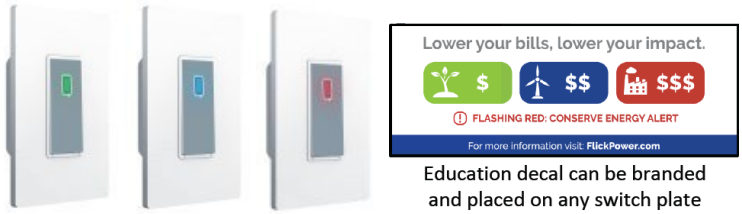
This evaluation will address key research questions relating to TOU response across customer groups and the incremental impact of customer load shifting beyond what behavior change customers normally provide on a time-variant pricing program or rate. Study surveys will provide insight into inherent levels of customer interest regarding their energy consumption and characterization of motivating factors to energy use. Ensuring that several types of units are all proportionally represented in treatment and control, the experimental design allocates for a similar number of top floor, bottom floor, one-bedroom, and two-bedroom units to be included in both treatment and control groups.

Resident Energy Survey provided to 550 Individual Apartments

The project case study is locally sited in a student housing apartment community of Irvine, California. 216 residential units had the signaling device installed, at random, to serve as the test group, with the remaining 344 units in the community serving as a comparative control group.

The Flick Power light switch devices are pre-installed by an electrician. The customers' TOU rates are programmed into the switch and its indicator displays

colored light signals to show the price of electricity during certain hours of the day: green (lowest price), orange (moderate), and red (most expensive). The research test hypothesis is whether the device facilitates consumers to think more about energy use, whether they better understand when the peak hours are, and whether they take more actions to reduce and shift their electricity consumption.



First Generation Flick Signaling Device and Accompanying Legend

To capture the incremental effects of the device on a customer's response to the TOU rate, it is optimal to have pre-treatment data from the prior year (same customer and same premise) to allow for a difference-in-differences calculation. Therefore, an initial survey was delivered to 550 housing units to establish the usage and characterize existing user attitudes of the Vista del Campo Norte community members.

Pre- and post-survey instruments are self-administered, and web based. Door hanger flyers prompt participants to take the survey via QR code on their smartphone, tablet, or PC. The Pre-Pilot questionnaire assessed attitudes and behaviors such as the following:

- Level of interest in lowering their energy bill
- Self-assessment about how much they think about electricity usage
- Awareness of being transitioned to TOU rate
- Knowledge of current rate
- Understanding of how TOU works
- Understanding of peak hours
- Actions taken to shift/reduce

To address the research question whether customers *with* the device demonstrate any conservation or ongoing energy efficiency from lower average usage versus customers *without* a device, treatment and control groups are invited to a similar post-survey to measure effects on their awareness and behavior.

This study scope of work includes the following technical tasks:

1. Data collection, cleaning, and validation
   a. Ensure proper and complete data was received.
   b. Validate treatment assignment.
      i. Validate that pre-treatment load data is similar between treatment and

control group (for TOU) and validate that the load is similar between the treatment and control group on non-event days (for ELRP)

c. Develop analysis dataset combining treatment assignment data, load data, and event data for ELRP and synthetic event days.

2. Load Analysis
   a. TOU: Conduct difference-in-differences calculation via regression model (if pre-treatment data is available) or straight differences via regression model (when not available). Regression models are used to obtain standard errors to determine if the impacts are statistically different from zero.

3. Reporting/Deliverables

   Develop an emerging technologies report with specified contents including description of pilot, summary statistics for pilot population, brief high-level methodology, and findings.

The project is jointly funded with ETP under the EM&T Market Assessments and Technology Assessment investment categories, as there are elements of both research goals in this study. The Market Assessments category is designed to create a better understanding of the emerging innovation and developments of new consumer markets for DR-enabling technologies and an awareness of consumer trends for smart devices. The Technology Assessments category assesses and reviews the performance of DR-enabling technologies through lab and field tests and demonstrations designed to verify or enable DR technical capabilities.

Collaboration

To implement the research study, SCE executed a service contract with Flick Power as the technology provider and primary partner providing technology, installation, & communication support with the pilot participants, electricians, and building managers. The Flick Power research team is also in collaboration with See Change Institute (SCI) and together have developed the lines of inquiry, study design, and messaging campaign.

SCI supported the design of outreach and evaluation materials for this pilot and the project team engaged APEX Analytics for work on the load impact study design & assessment report. As part of the project team, they facilitate load change measurements and calculate impacts via regression models, with the SCE project management engineer presiding as an active reviewer of the work in progress.

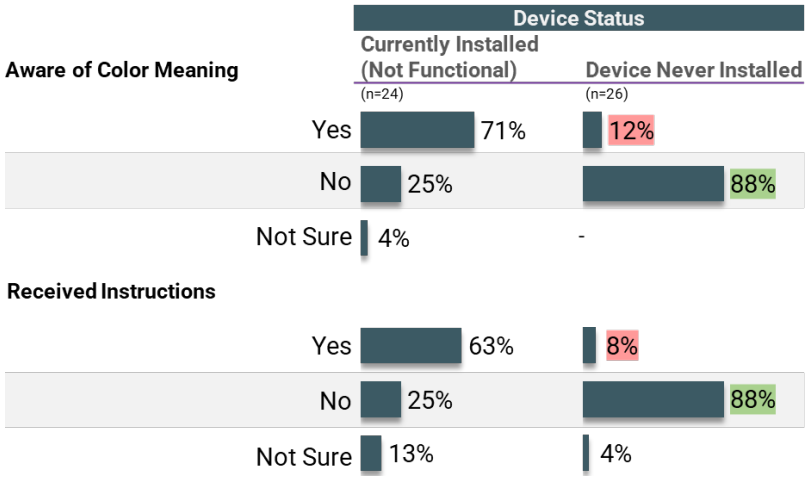
Results/Status

Educational materials were provided via door hangers to test site apartments in October 2023, with 216 devices installed. These apartments received survey

invitations in December 2023, anticipating a 15% response rate from control apartments and 20% from test apartments, to yield sample sizes of 50 for control and 43 for the test.

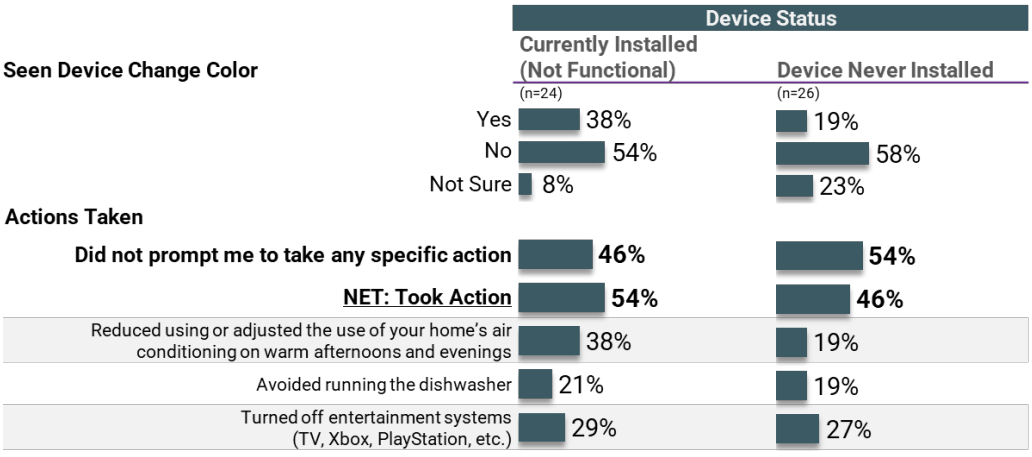
Survey Results

Data collection was conducted ongoingly during Q4 of 2023. Preliminary findings across the sites reflect the following metrics:



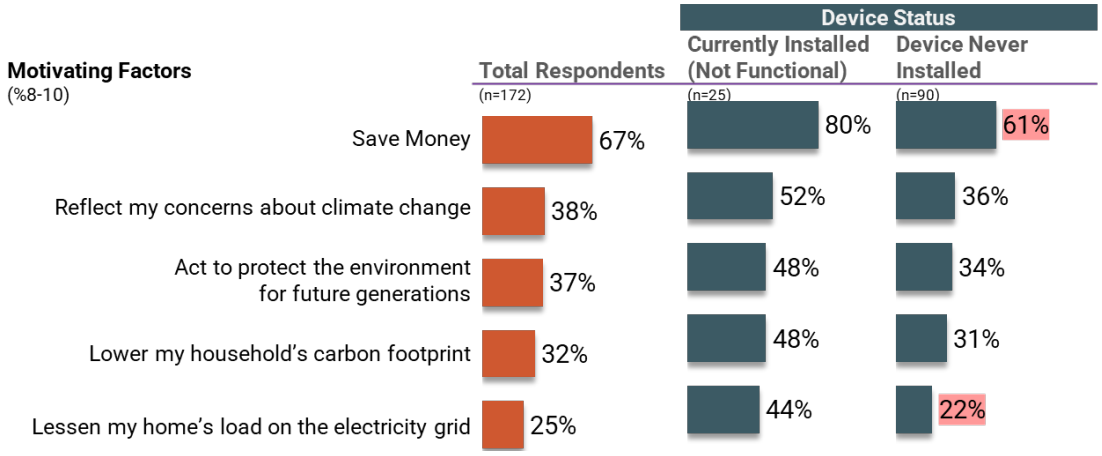
Resident Energy Survey self-reported results

Most students that were aware of the device were also aware of the distinct color meanings (71%). This was highly correlated with those who reported that they received instructions.



Resident Energy Survey self-reported results

While those reporting awareness of the color change was moderate (38%), of those that saw the colors change on the device, over half (54%) took action to reduce/shift their energy usage.



Resident Energy Survey self-reported results

Resident surveys and attitudinal characterization are complete. Based on the surveyed:

1. Most students (67%) are more concerned about saving money as a motivator for energy savings than other non-financial incentives
2. This awareness was highest when the device was installed (reflecting a treatment effect from the intervention)
3. Concern about the grid was the lowest motivating factor

Hardware Performance

The device feedback report produced several lessons learned. Twenty-five devices were unable to access the internet due to an Internet Service Provider (ISP) change. The hardwired light switch devices had to be reset remotely by the vendor, which potentially caused connection disruptions. This lesson learned prompts devising improvements to operational capability in a second-generation device as a closed loop system where Flick Power manages all communications with devices, gateways, and its servers.

Furthermore, during the period when devices could not access the internet, the devices simply flashed white. Treatment group feedback also expressed interest to "know if the device is functioning properly or not." The research team is addressing this need and incorporating an indicator for the next generation device to proactively communicate when it is not functioning.

The project's research work is providing implementation guidance for deployment of such signaling devices in multi-family and affordable housing. The research team continues to explore the applicability for increasing TOU awareness in these communities.

Next Steps

Informed by data gathered during the first phase of the pilot deployment, resident feedback, and input from property managers, the project team has developed an enhanced visual notification feature to display messaging to reinforce color signaling and drive more persistent savings compared to the first-generation light switch, which only utilizes color. The team has also proposed implementing a LoRaWAN protocol based networked system that will enable mass market and multi-family communications across multiple units without the need for a wi-fi interconnection at each residential unit. This will facilitate continuous monitoring and updates to the device and avoid internet outages.

To assess this new technology within an expanded multi-resident facility, the Flick team is developing a proposed scope of work to deploy during the next phase of the study for Q1 2024.