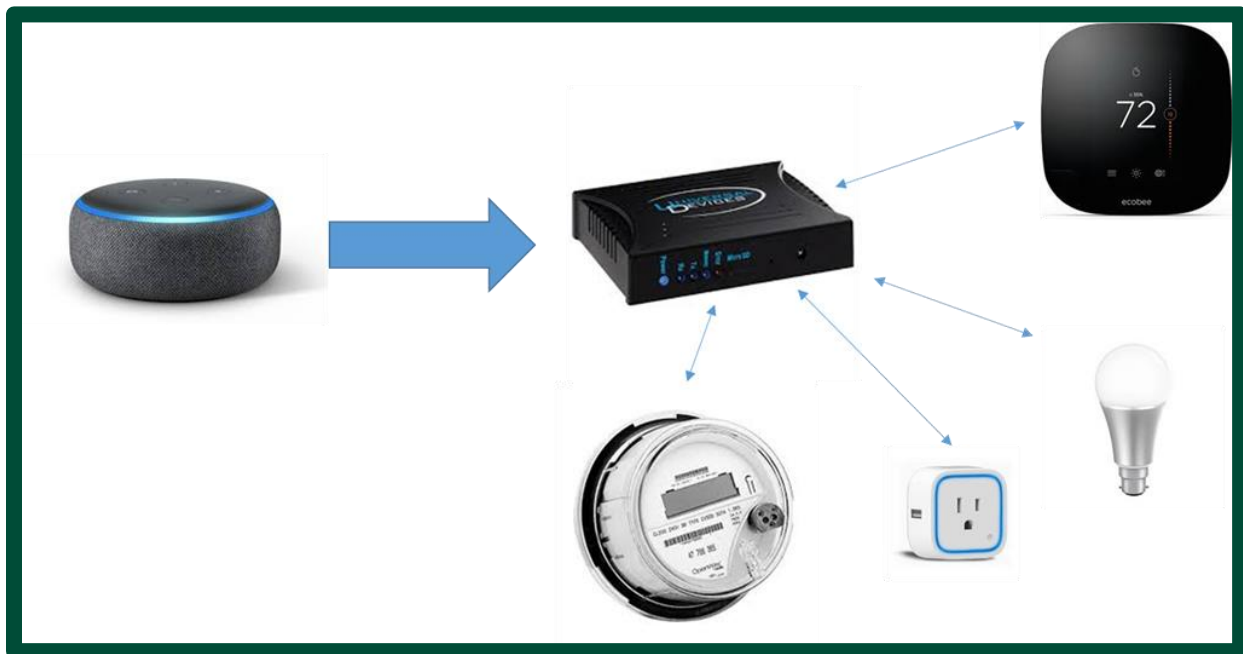


# Smart Speaker Demonstration Project Final Report

DR19.03 / ET19SCE1020



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*July 2022*

### **Acknowledgements**

Southern California Edison's (SCE) Emerging Products & Technologies (EP&T) group is responsible for this project. It was developed as part of SCE's Emerging Technologies Program under internal project numbers DR19.03 / ET19SCE1020. Navniel Pillay conducted this technology evaluation, with overall guidance and management from Sean Gouw and Randy Robinson Jr. For more information on this project, contact navniel.n.pillay@sce.com.

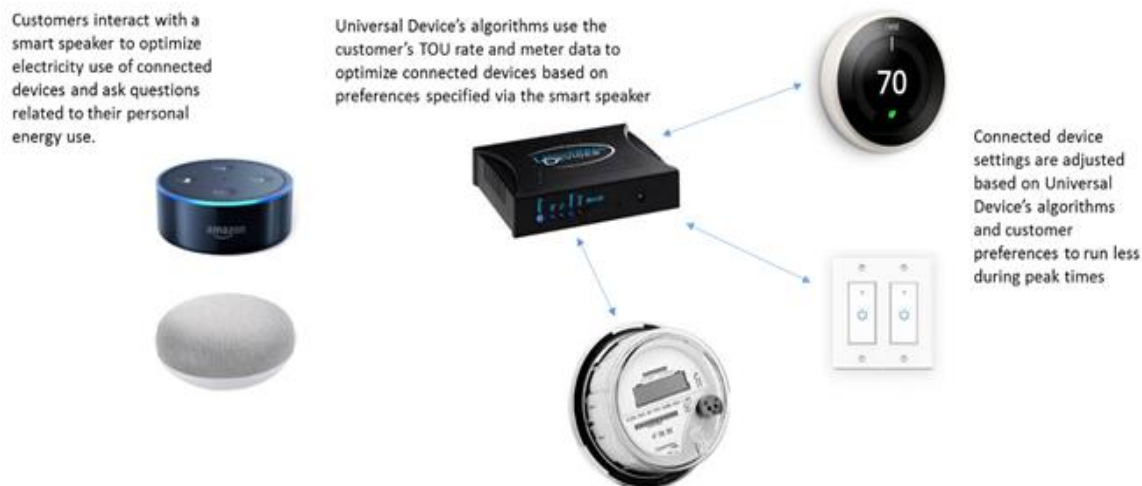
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## EXECUTIVE SUMMARY

The primary goal of SCE's Smart Speaker Demonstration Project was to test customers' ability to optimize connected energy loads in their homes using an Amazon Smart Speaker (voice commands) as the interface. Participants were given an Amazon Echo Dot, smart switches, smart lights, an Ecobee thermostat, and Universal Devices, Inc. (UDI) ISY gateway that unites smart technologies installed and commissioned in the home. These devices are connected to the smart speaker and SCE smart meter through the gateway.

The demonstration project also sought to determine the most desired voice interactions ("how much is my bill," "what rate am I on," etc.) that helped customers better understand and manage their energy usage. SCE contracted with an Measurement and Verification (M&V) Consultant to evaluate the project's efficacy. The M&V Consultant's assessment helped quantify (meter-based, home-by-home) any energy usage impacts. This assessment helps inform the Demand Response (DR) and or Energy Efficiency (EE) potential of home smart speaker devices. SCE also worked with its Customer Experience team to develop a qualitative understanding of the overall customer experience, and to identify desired voice interactions to improve how customers manage their energy usage.

Customers asked energy-related questions and set device optimization preferences using their smart speakers. Universal Devices, Inc.'s (Automation and Energy Management Firm) algorithms used the customers' Time-of-Use (TOU) rates, energy use, and preferences to optimize connected devices, which had their settings adjusted to run less during peak times. An Alexa skill named "Energy Expert" initiated interactions and commands between customers and their Echo Dots. This figure shows the devices connected in participating customer homes:



UDI's ISY 994i ZW pro was the load controller at the center of the smart speaker home automation setup used in this demonstration project. All ISY models were OpenADR 2.0a/2.0b Certified Virtual End Nodes (VENs). In California, the latest revision of Title 24 mandated the installation of a Certified OpenADR device in every new and retrofit venue starting in 2020.

### Project Findings

SCE originally sought to enroll 200 customers in the Smart Speaker Demonstration Project (vetted/selected from responses to initial email outreach to ~20,000 customers). Ultimately, SCE slowed enrollments due to COVID, and enrolled 105 customers (74 was the final active tally). 31 customers were inactive due to eligibility, connectivity, and customer opt-out issues.

An initial customer survey was conducted. 64% of the project's participants responded to our initial customer survey. Overall, survey results indicated participants had a positive experience. Participants said the Alexa Smart speaker was easy to use, accurate, and convenient. They also stated they intended to continue using the smart speakers after the conclusion of the project. Some participants highlighted Alexa's lack of energy-related commands. However, this was an expected outcome, as there was a gap of seven months between when customers had equipment installed and when SCE and the Automation and Energy Management Firm (UDI) launched the Alexa "Energy Expert" skill.

Nexant's M&V load impact and process evaluation, to help understand customer behavior related to DR and EE potential, was scheduled for two phases. Phase 1 included a preliminary post-summer analysis for the period of June 2020. The Phase 2 analysis could not be completed due to complications with SCE's new data system rollout, and COVID-19 in 2021, which would have included a full post 12-month analysis from summer 2020 through summer 2021. Notably, results from the M&V evaluation for the peak time summer average weekday timeframe showed reductions on Rates 4 and 5. Rate 4 show load reductions of 0.03 kW, or 1.7%; however, the results were not statistically significant at the 90% confidence level. Rate 5 showed an impact of 0.22 kW, or 10.6%, and was statistically significant. During the summer average weekend mid-peak period, participants on Rate 4 showed statistically-significant load reductions of 0.23 kW, or 9.6%.

These are key findings and recommendations pertaining to load impacts from the Smart Speaker Demonstration Project:

- The evaluation was limited by low counts of active participants. Additional recruitment of participants and promotion of skills and features would result in a more robust evaluation.
- Load impacts were evident for certain subsets of treatment customers and time periods, but the mechanism(s) leading to the effects could not be definitively attributed without a larger participant population.
- A large portion of the initial set of participants was inactive by the time of the evaluation.
- Skill log and device level data was sparsely populated. More stringent Quality Control (QC) of data the collection would have allowed for a more comprehensive analysis and a more refined attribution of observed effects.
- The specific devices with the most use included smart appliances, refrigerators, thermostats, and interior lighting. Additional education and focus on these end uses could provide the most value to future iterations of this program.

These are key process evaluation findings and recommendations stemming from discussions with program and implementation staff:

- Existing frameworks of the optimization algorithm and initial Alexa skills benefitted the project rollout, but additional skills were developed later, increasing the time between installation and treatment. Since these were developed and tested, any future iterations of the program would benefit from the foundation.
- The project design required a third party to install the equipment during the COVID-19 pandemic, resulting in low participation. The implementer cited customer reluctance to allow people into their homes.

- Installers could have benefitted from further training and support due to the complexity of connecting multiple devices with the meters and gateways. The implementer received frequent requests for additional support from the installers, particularly when the SCE program manager was not present on site to oversee the installation.
- The program implementer reported home equipment (for example, thermostats) was occasionally installed incorrectly and did not communicate with SCE's smart meter. Additional validation that equipment was accurately installed and communicating with other equipment may have been beneficial. Also, presetting home equipment to the largest extent possible and considering a cloud-based approach instead of hardwires could have also been effective.
- Customer outreach seemed to be beneficial in improving engagement with the devices, particularly after the launch of the additional smart speaker skill capabilities. Providing regular outreach and education on program updates would have likely increased program impacts.
- Given the typical customer profile for the demonstration project was "engaged with home automation topics and technologies", they could have potentially been instructed on equipment installation as well, though perhaps with a smaller subset of the components involved in this project.

A detailed load impact, as well as process evaluation findings from the Smart Speaker Demonstration project, can be found in Nexant's report in the Appendix section.

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# INTRODUCTION/BACKGROUND

Smart speaker technology has grown in popularity over the past several years. According to research by Statista.com, 35% of U.S. households were equipped with at least one smart speaker in 2019. Statista.com anticipates 75% of homes will be equipped with at least one smart speaker by 2025. Ownership rates for smart speaker and smart devices are nearly equivalent among people 25, 35, 45, or 55 years old. 48% of first adopters use the device more often now than they did in the first month of ownership. 61% of new smart speaker owners encouraged their friends to buy a device.

In the latter part of 2019, SCE launched this project to explore the customer value proposition associated with smart speakers, and to understand whether smart speakers can be used in conjunction with other connected devices (smart thermostats, smart plugs, etc.) to help customers better manage their energy usage. Other potential use cases include, but are not limited to:

- Helping to improve the customer experience around transactions and interactions related to:
  - Billing (why is my bill high, how can I lower my bill, how does my bill compare to last year's bill).
  - Energy management and usage (SCE's most popular intent thus far).
  - Outage information and alerts.
- Intelligently recommending utility programs using Alexa insights.
- Helping customers develop a better understanding of time-variant rates and increasing adherence to those rates through proactive notifications and customer education.
- Helping customers optimize the energy usage of technology end uses in their homes by using Alexa and the gateway.

The primary goal of the project was to test customers' ability to optimize connected energy loads in their homes using an Amazon smart speaker (voice commands) as the interface. Participants were given Amazon Echo Dots, smart switches, smart lights, Ecobee thermostats, and ISY gateways to unite smart technologies installed and commissioned in the home. The devices were connected to the smart speakers and SCE smart meters through the gateways. The project was to help inform the DR and or EE potential of home smart speaker devices.

The project also sought to determine the most desired voice interactions ("how much is my bill," "what rate am I on," etc.) to help customers better understand and manage their energy usage. SCE contracted with Nexant to evaluate the project's efficacy. Nexant's assessment will help to quantify (meter-based, home-by-home) any energy usage impacts. SCE worked with its Customer Experience team to develop a qualitative understanding of the overall customer experience and identify desired voice interactions to improve how customers manage their energy usage.

The project leveraged the California Energy Commission's (CEC) investment in the Retail Automated Transactive Energy System (RATES) pilot, which optimized connected devices based on real-time prices received from the California Independent System Operator (CAISO) and enabled customers to interact with smart speakers to gain insights to energy use. Modifications were made to the RATES system to provide the requirements of this implementation (optimizing connected devices based on SCE residential TOU rates instead of real-time prices). The results could inform the design of future technology-enabled customer programs to help customers reduce energy use and costs.

SCE originally sought to enroll 200 customers in the project (vetted/selected from responses to an initial email outreach to ~20,000 customers). Ultimately, SCE slowed enrollments due to COVID, and enrolled 105 customers (74 was the final active tally). 31 customers were inactive due to eligibility, connectivity, and customer opt-out issues. Equipment and installation services were provided to customers at no cost. The EE contractor installed a combination of a home automation gateway, smart thermostat, smart plugs, and smart light bulbs. Customers could interface with their smart speakers using the Alexa skill "Energy Expert" SCE and UDI developed for this project, to understand energy usage, set energy-savings preferences, and optimize home equipment for maximum savings and comfort.

## ASSESSMENT OBJECTIVES


The primary objectives of the project were to:

- Better understand how connected smart thermostats and other smart household end-uses could optimize their energy usage via smart speaker voice commands subject to SCE's TOU rates and customer comfort and savings preferences.
- Evaluate how voice interactions related to energy — usage, estimated bill, best times to use appliances — could be improved to identify optimal voice command skills and smart speaker interactions.
- Develop optimization algorithms and voice interaction vocabulary specific to the new TOU rates and DR programs.

The secondary objectives of the project were to:


- Better understand how customers could effectively interact with and use the smart speaker and other connected technologies based on their home energy management preferences.
- Determine how customer satisfaction was impacted by the customers' experience with smart speakers and connected technologies for managing energy, and whether the interactions persisted or were just novelty.
- Estimate the change in customer energy use attributed to the enabling technology of a smart energy management hub with smart speaker and associated Alexa skills as an "integrated energy management package".

**Smart Home automation provides multiple benefits to California utilities and its customers.**




**Supports dynamic rate management**

Provides a channel for educating and engaging customers in TOU and automating their household devices to maximize load shifting and energy saving benefits.



**Improves customer experience**

Empowers customers to easily manage their home's energy use, participate in peak demand events and prepare for reliability events when needed.



**Supports California's clean energy & safety goals**

Connects customers with product-based rebates, EE, DR and income qualified programs, and other informative services designed to help CA meet clean energy goals.

## DEMONSTRATION PROJECT APPROACH

SCE engaged in the following activities to develop and launch the project:

1. Marketing and Enrollment – SCE enrolled customers in the project. A list of potential customers who had not opted out of email marketing was identified based on the following criteria:
  - a. Residential TOU customers (rates were TOU-D-4 and TOU-D-5, including the California Alternate Rates for Energy [CARE] and Family Electric Rate Assistance [FERA] versions).
  - b. Single-family or tract residence.
  - c. Itron smart meter installed.
  - d. Not enrolled in a DR program.
  - e. Not a Medical Baseline customer.
  - f. Not a Community Choice Aggregation (CCA) customer.

A recruitment email with a link to the customer agreement was sent beginning in September 2019. The customer agreement contained additional screening questions, such as whether the customer had central air conditioning (required for participation), solar panels and pools (excluded from participation), or an electric vehicle (could participate, but will impact measured electricity loads).

Information for customers participating in the project was entered in the ISY portal and provided to the installation vendor in November 2019.

2. Equipment Installation and Commissioning – installer training was held in October 2019. Installations began in late November 2019, with enrolled customers having equipment installed and networked, including provisioning the gateways to their SCE smart meters. This connection was essential to understand individual device usage and overall home usage.
3. Optimization Algorithm and Alexa Skill Development

- a. UDI developed algorithm uses customer TOU rates, energy use, and preferences to respond to customer queries, send proactive energy notifications, and optimize installed equipment to perform according to established preferences.
  - b. SCE and UDI developed an Alexa "Energy Expert" skill to help customers better manage and understand their energy usage.
4. Alexa Skill Launch – SCE emailed customers an educational piece guiding them on how to interface with the Alexa "Energy Expert" skill, which will be updated and fine-tuned to ensure relevance and engagement.
  5. SCE and UDI developed data reporting retrievable in the ISY portal. Reports are to be leveraged by Nexant for M&V.
  6. SCE-Implemented Initial Customer Surveys.

Three vendors were leveraged to design, implement, and assess the prototype smart speaker solution: the Automation and Energy Management Firm, the EE Installation Contractor, and the M&V Consultant. Their roles are summarized below:

#### **Automation and Energy Management Firm (UDI)**

1. End-to-end development and testing of installed systems.
  - a. Modify Retail Automated Transactive Energy System (RATES) optimization algorithms and voice interactions to use SCE residential TOU rates.
  - b. Additional voice interactions as identified by SCE and customer feedback.
  - c. Data reporting as determined by SCE and the M&V Consultant.
  - d. TOU processing of a flat file provided by SCE to access residential TOU prices and time periods.
2. Commissioning and Installer Training
  - a. Link to TOU rates, customer account, and portal.
  - b. Ship provisioned ISY devices to SCE or a designated installation vendor.
  - c. Provide training to installers for provisioning ISY devices.
3. Project management and customer support (developed Alexa skill customer guide, resolved customer connectivity issues, etc.)
4. Hosting, data warehouse, and system administration support.

#### **EE Contractor**

Responsible for the purchase (except gateways), installation, and commissioning of equipment used in the project.

#### **M&V Consultant (Nexant)**

Responsible for M&V, with activities and methodology described in the following M&V section.

## 1.1 MEASUREMENT AND VERIFICATION

The following is an excerpt from a Nexant proposal, outlining the technical M&V approach to be leveraged for this project:

### 2.1 Load Impact Estimation

The primary challenge in estimating load impacts for opt-in programs such as the Smart Speaker Integration Project is estimating how much electricity participants would have consumed in the absence of the treatment. The estimated usage in the absence of the treatment is referred to as the reference load. To estimate load impacts, Nexant will compare participant load to a matched control group during each TOU period (e.g. peak, off peak) and for the average day. The control pool will be the group of eligible customers who do not receive recruitment materials. These customers are appropriate candidates for selection into the control group in the load impact analysis because they are also enrolled on a TOU rate and have an email address in SCE's database. Nexant will match participants with nonparticipant customers—the control group—based on similar usage during the pretreatment period. The impact estimates will be based on the difference in loads for the participant and control group customers during the post-treatment period minus any difference in load between the two groups during the pretreatment period—this approach is referred to as a Difference-in-Differences (DiD) analysis.

The matched control group method used for this analysis is superior to a within-subjects analysis because it eliminates the problem of model misspecification. Any reference load model based on loads observed during the pretreatment period requires the modeler to make assumptions about the relationships between load, time, and temperature. If this assumed function does not reflect the true relationships between load, time, and temperature, the model can produce incorrect results. In contrast, the matched control group deals with this problem by assuming that the customers who behave similarly to participants during the pretreatment period would also behave similarly during the post-treatment period. This eliminates the need to specify load as a function of weather.

#### 2.1.1 Control Group Selection

Nexant will select the control group by using a propensity score match to find nonparticipant customers who have similar load shapes to project participants during the pretreatment period. In this procedure, Nexant will use a probit model to identify control customers who were similar to treatment customers in terms of observable characteristics such as hourly use and average daily use. The probit model will estimate a score for each customer with the assumption that observable variables affect a customer's decision to participate in the project. A probit model is a regression model designed to estimate probabilities—in this case, the probability that a customer would participate. The propensity score can be thought of as a summary variable that includes all relevant observable information about whether a customer would enroll in the feature. Nexant will match each customer in the participant population with the customer in the nonparticipant population that has the closest propensity score. We will use the group of eligible customers who did not receive recruitment materials as the matching pool for the participants.

If we are not able to achieve a suitable matched control group due to the small population size, we may elect to explore using a synthetic controls approach for the control group. The approach combines several non-participants' consumption data to create a "synthetic control" customer for each treatment customer.

#### 2.1.2 Estimating Ex Post Load Impacts

The load impacts will be estimated using a DiD analysis. This method estimates impacts by subtracting participants' loads from control customers' loads in each hour or rate period

after the treatments are in place and subtracts from this value the difference in loads between treatment and control customers for the same time period in the pretreatment period. Subtracting any difference between treatment and control customers prior to the treatment going into effect adjusts for any preexisting differences between the two groups that might occur due to random chance.

The DiD calculation can be done arithmetically using simple averages or can be done using regression analysis. Customer fixed effects regression analysis allows each customer's mean usage to be modeled separately, which reduces the standard error of the impact estimates without changing their magnitude. Additionally, standard regression software allows for the calculation of standard errors, confidence intervals, and significance tests for load impact estimates that correctly account for the correlation in customer loads over time.

Implementing a DiD through simple arithmetic would yield the same point estimate but it would not generate confidence intervals. A typical regression specification for estimating impacts is shown below:

$$kW_{i,t} = \alpha_i + \delta treat_i + \gamma post_t + \beta(treatpost)_{i,t} + \nu_i + \varepsilon_{i,t}$$

In the above equation, the variable  $kW_{i,t}$  equals electricity usage during the time period of interest, which might be each hour of the day, peak or off-peak rate periods, daily usage, or some other period. The index  $i$  refers to customers and the index  $t$  refers to the time period of interest. The estimating database would contain electricity usage data during both the pretreatment and post-treatment periods for both treatment and control group customers. The variable  $treat$  is equal to 1 for treatment customers and 0 for control customers, while the variable  $post$  is equal to 1 for days after customers enroll in the project and a value of 0 for days prior to enrollment. The  $treat\ post$  term is the interaction of  $treat$  and  $post$  and its coefficient  $\beta$  is a DiD estimator of the treatment effect that makes use of the pretreatment data. The primary parameter of interest is  $\beta$ , which provides the estimated demand impact of the technology during the relevant period. The parameter  $\alpha_i$  is equal to mean usage for each customer for the relevant time period (e.g., hourly, peak period, etc.). The  $\nu_i$  term is the customer fixed effects variable that controls for unobserved factors that are time-invariant and unique to each customer.

Importantly, the estimated load impacts from the above analysis methodology is for the average customer in the participant groups, not for individual customers. It is not possible to estimate load impacts for individual customers with any reasonable degree of accuracy or internal validity because it's impossible to control for other potential exogenous factors that might cause usage to change between pre- and post-treatment periods.

Nexant will analyze available device-level data from the gateway, smart plugs, and thermostats in addition to estimating load impacts. While the device-level data will not be used explicitly in the load impact analysis, it will be used to identify any usage patterns or trends that arise throughout the project. For example, Nexant will examine how often customers use the speaker, how they interact with device controls, and override behaviors. The full M&V load impact analysis can be found in the appendix section of this report.



# RESULTS & DISCUSSION

## 1.2 COMPLETED TASKS

### Task A: Solution Development

- Developed an Artificial Intelligence (AI) interface to allow customers to ask about energy usage information and prices, and configure automation routines based on prices and preferences.
- The project team created a new category in Amazon’s development environment for customers to receive proactive notifications related to energy usage. The “Energy Expert” skill could be invoked by saying “Alexa, open Energy Expert”.
- Established a bench test lab with Ecobee, WiFi light bulbs, Philips Hue, and a couple of Z-Wave devices in which the system was tested. The bench test lab was established in UDI’s office and was not owned by SCE.
- Developed and tested the following in the lab:
  - Savings/comfort settings.
  - Opt out.
  - Alexa notifications.
  - SMS text notifications.
- Created email instructions to show participants how to connect to, initiate, and use the Alexa “Energy Expert” skill via desktop computer or mobile device.
- Created supporting documentation (website, recordings) for the “Energy Expert” skill (see Appendix).

### Task B: Implementation/Installation

- Shipped and commissioned ISY devices and other equipment to be installed in customer’s homes.
- The EE Contractor installed and commissioned products at 105 customer sites.
- UDI’s team reached out to every participant with installation issues and attempted to remediate them with all the participants who responded. UDI reached out multiple times, via email and phone.
- Completed an initial customer participant survey.
- Sent customer email instructions on how to use the Alexa “Energy Expert” skill post launch.

### Task C: M&V

- Completed an M&V post-load impact analysis for summer 2020, as well as reporting with Nexant. Project development continued into 2021, including updating smart speaker capabilities to leverage Green Button data. However, customer service platform updates to SCE’s data systems imposed significant delays that prevented update rollout and subsequent customer reengagement. Therefore, the evaluation focused on the summer of 2020.

### Task D: Data Collection

- UDI collected and warehoused data from end point to end point (customers smart meters and other connected equipment).

- UDI's data reports were generated and housed in a SharePoint folder. Reports contained 15-minute energy usage data for connected equipment and customer meters. Reports also catalogued "Energy Expert" interactions.

### Task E: Customer Survey

64% of the project's participants responded to our initial customer survey. Overall, survey results indicate participants had positive experiences, saying the Alexa smart speaker was easy to use, accurate, and convenient. Participants also indicated they intended to continue using the smart speaker after the conclusion of the project. However, there was room for improvement. Some participants highlighted Alexa's lack of energy-related commands, but this was expected, as there was a gap between when equipment was installed and stabilized and when SCE released the "Energy Expert" skill.

Key insights include:

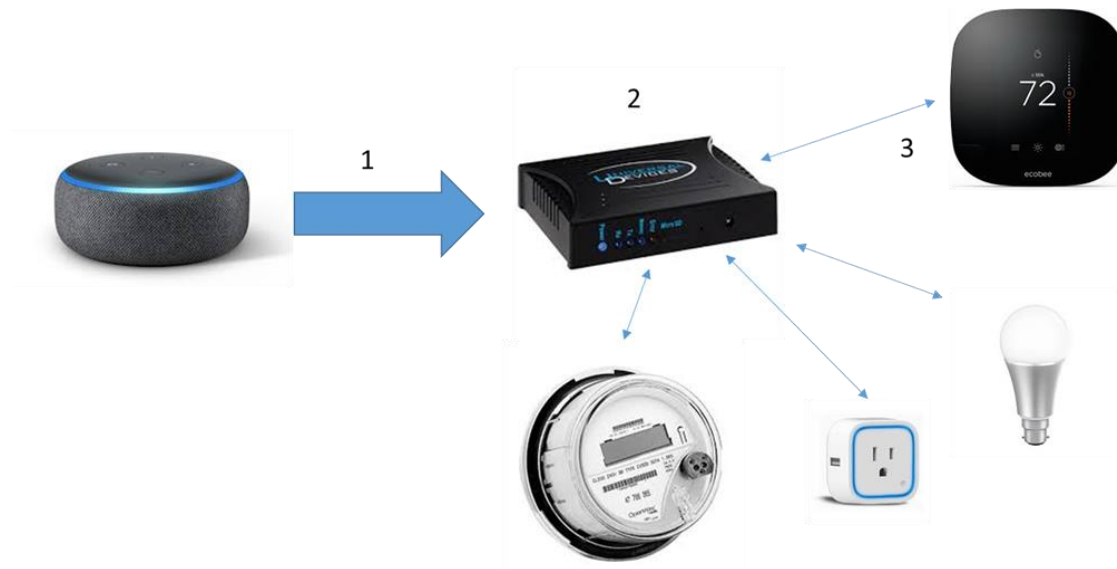
- *Overall experience* with the smart speaker was satisfying at 69%, but there was significant room for improvement.
- In general, *familiarity* with the speaker was low – only about a quarter of respondents (23%) were *very- or extremely familiar* with the device before they participated in the project.
- Only about a half (51%) *owned a smart speaker before* participating in the project.
- The most common general use of the device was to *listen to streaming music* (83%).
- Overall, the energy-related aspects of the speaker were rated highly – *ease of use* (mean: 3.9) and *accuracy of commands completion* (mean: 3.8).
- The most satisfying features of the device (based on 5-pt. agree/disagree scale) were:
  - Provides convenience (4.3).
  - Makes home more comfortable (4.0).
  - Helps save time (4.0).
- The speaker was considered less efficient when it came to *helping participants better manage their usage* (3.6) and *helping them save money on their bill* (3.5).
- The most common energy-related use of the device was for *lights* (84%) and *thermostats* (72%). Particularly, the speaker was used mostly to *turn lights on or off* and *set thermostat levels* (71% and 61% respondents used these features often or always).
- 41% of participants reported their usage decreased because of using the speaker.
- Nearly 40% contacted SCE via *live rep* or *sce.com*. The most common reasons for contacting SCE were to *get more information about the smart speaker study* (40%) and/or *bill* (40%).
- The vast majority (89%) did not have any issues with the device.
- Most participants (80%) were likely (very- or extremely) to continue using the speaker after the project.

### Task F: Customer Education and Engagement

- Emailed customers an Alexa "how to" guide explaining how to setup and interact with Alexa.
- Sent weekly emails to customers, to give them examples of how to use the Alexa "Energy Expert" skill.



### 1.2.1 TASK A: SOLUTION DEVELOPMENT



**FIGURE 1. PROTOTYPE SOLUTION – ALEXA SMART SKILL & HOME AUTOMATION PLATFORM**

The ISY 994i ZW Pro was the load controller at the center of the smart speaker home automation setup used in this project. All ISY models were OpenADR 2.0a/2.0b certified VENS. In California, the latest revision of Title 24 mandated the installation of a Certified OpenADR device in every new and retrofit venue starting in 2020.

The ISY device was not cloud based. All of the logic, programs, and communication with local devices ran on the ISY itself – even if the ISY network cable was unplugged, everything would continue to run. The ISY had multiple communication protocols built in, including Z-Wave, WiFi, and others, as shown in the table below:

**TABLE 1. ISY COMMUNICATION PROTOCOLS**

	ISY994i	ISY994i ZW+	ISY994i ZW+/IR PRO	Notes
<b>Z-Wave+</b>	✘	✔	✔	
<b>INSTEON</b>	✔	✔	✔	<b>Requires 2413s PLM</b>
<b>X10</b>	✔	✔	✔	<b>Requires 2413s PLM</b>
<b>IR</b>	✘	✘	✔	IR Input Sensor – Phillips RC5
<b>Batch Mode</b>	✘	✘	✔	Let ISY program your devices offline
<b>Max Nodes</b>	254	254	1023	Devices, buttons, scenes, folders
<b>Max Programs</b>	300	300	1024	Triggers, schedules, programs

Other equipment used in the project:

- Light Bulbs – Etekcitiy – Wifi
- Smart Switch (Smart Plug) – Aeotec – Z-Wave
- Smart Bulbs Dimmable Lights – Nutone - Z Wave
- Smart Speaker – Echo Dot – Wifi Enabled
- Smart Thermostat – Ecobee Lite – WiFi Enabled

## SMART SPEAKER SKILL

UDI and SCE worked together to develop and launch the Alexa "Energy Expert" skill. 38 project participants downloaded the skill as of 7/1/2020. The skill was designed to respond to the following customer intents:

- "Alexa, open Energy Expert."
- "What devices are being optimized" (what devices are being controlled as part of the project to optimize savings consistent with preferences established by the customer).
- "Start optimizing my [end use device]."
- "Stop optimizing my [end use device]."
- "What is my savings level."

Customers could optimize their devices by setting their savings levels to low, medium, high, or none:

- "Set my savings level to [low, medium or high]."
- "What is the best time to [charge my car]."
- "Enable text notifications."
- "Enable alexa notifications."
- "What is my electricity usage for [the last 20 days]."
- "How much energy has my [thermostat] used."
- "Which devices were used [yesterday]."

An audio file was developed to capture example interactions with the developed skill. Transcript of the audio recording:

User: Alexa, open Energy Expert.  
Alexa: Welcome back to the Energy Expert. What can I do for you?  
User: What devices are being optimized?  
Alexa: You currently have two devices being optimized: Laundry light and dining light. Anything else?  
User: Start optimizing my thermostat.  
Alexa: Do you want to start optimizing your thermostat?  
User: Yes.  
Alexa: Your thermostat will now be optimized. Anything else?  
User: Stop optimizing my laundry light.  
Alexa: Do you want to stop optimizing your laundry light permanently?  
User: Yes.  
Alexa: Your laundry light will no longer be optimized. Anything else?  
User: What is my savings level?  
Alexa: Your savings level is currently set to high. Anything else?  
User: Set my savings level to medium.  
Alexa: Your savings level was successfully set to medium. Anything else?  
User: What is the best time to charge my car?  
Alexa: The best time is now and it will use approximately 12.0 kWh's for a cost of \$2.76, but if you wait to 5 p.m. it will cost \$5.76. Anything else?  
User: Are text notifications enabled?  
Alexa: Text notifications are disabled. Anything else?  
User: Enable Alexa notifications.  
Alexa: Your Alexa notification setting was successfully enabled. Anything else?  
User: What is my electricity usage for the last 20 days?  
Alexa: Your total electricity use for the last 20 days is approximately 315.1 kWh's or \$83.37. Do you want it for some other timeframe?  
User: No.

Alexa: Would you like your electricity usage for a specific device?

User: No.

Alexa: Okay. Anything else?

User: When were my devices used in the last 36 hours?

Alexa: Your laundry light was used for 25 minutes during low-cost times and 5 minutes during high-cost times. Your front light was used for 5 minutes during low-cost times and not used during high-cost times. Your closet light was used for 1 hour and 30 minutes during low-cost times and not used during high-cost times. Your thermostat was used for 1 hour and 40 minutes during low-cost times and 2 hours and 25 minutes during high-cost times. Your fridge was used for 21 hours and 10 minutes during low-cost times and 2 hours and 35 minutes during high-cost times, and your coffee maker was used for 5 hours and 45 minutes during low-cost times and not used during high-cost times. Your devices dining light, microwave, and washer were not used. Anything else?

User: No, thank you.

Alexa: -Sound tone-

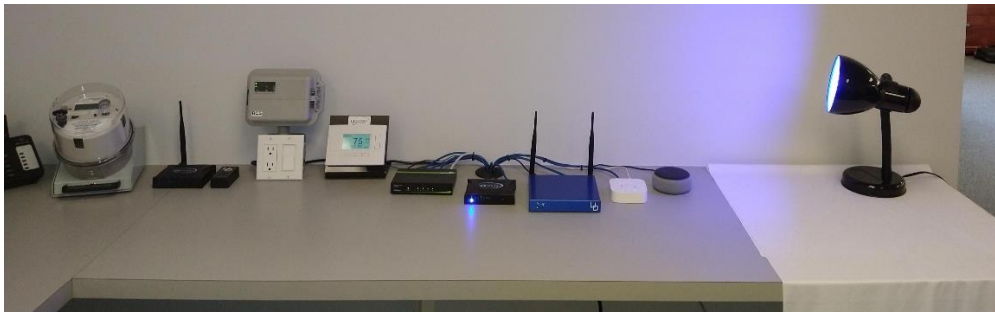


FIGURE 2. INTEGRATION TEST AREA – ISY, HUE, ALEXA SMART SPEAKER, TEST SMART METER, Z-WAVE DEVICES



FIGURE 3. INTEGRATION TEST AREA – VESYNCH LIGHT BULB, ECOBEE SMART T-STAT

## 1.2.2 TASK B: IMPLEMENTATION/INSTALLATION

Product installation counts by equipment category, and date:

Equipment	1/28/2020	2/10/2020	3/5/2020	3/26/2020	Total
Smart Switches	47	205	55	15	<b>322</b>
Smart Bulbs	48	173	44	8	<b>273</b>
Smart Speakers - Amazon Echo Dot	12	45	11	3	<b>71</b>
Smart Thermostats - Ecobee 3 Lite	13	44	10	2	<b>69</b>
Thermostat Remote Sensors - Ecobee	13	1	1	55	<b>70</b>
ISY Gateway Provisioning	13	46	12	3	<b>74</b>
<b>Total</b>	<b>146</b>	<b>514</b>	<b>133</b>	<b>86</b>	<b>879</b>

Customer site-level product installation:

Customer Number	Installation Date	City	Zip	Climate Zone	Smart Switch	Smart Bulbs	Smart Speaker Amazon Echo Dot	Smart Thermostat Ecobee 3 Lite	Thermostat Remote Sensor (Ecobee)	UDI Gateway Provisioning
<b>Total</b>					<b>402</b>	<b>357</b>	<b>92</b>	<b>90</b>	<b>73</b>	<b>97</b>
1	01/28/2020	ADELANTO	92301	14	4	4	1	2	2	1
2	01/20/2020	LAGUNA HILLS	92653	8	5	4	1	1	1	1
3	02/22/2022	LA PALMA	90623	8	5	4	1	2	2	1
4	01/09/2020	PLACENTIA	92870	8	5	4	1	1	1	1
5	01/03/2020	COVINA	91724	9	5	4	1	1	1	1
6	01/17/2020	CORONA	92881	10	5	4	1	0	0	1
7	01/06/2020	LAKE FOREST	92630	8	5	4	1	1	1	1
8	01/16/2020	RANCHO SANTA MARGARITA	92688	8	4	4	1	1	1	1
9	12/10/2019	RIVERSIDE	92509	10	4	4	1	1	1	1
10	01/08/2020	CERRITOS	90703	8	0	4	1	1	1	1
11	01/10/2020	LONG BEACH	90807	8	5	4	1	1	1	1
12	12/13/2019	IRVINE	92602	8	4	4	1	1	1	1
13	01/16/2020	RANCHO SANTA MARGARITA	92688	8	4	4	1	1	1	1
14	01/14/2020	WESTMINSTER	92683	6	4	0	0	1	1	1
15	12/11/2019	FOOTHILL RANCH	92610	8	4	4	1	1	1	1

Customer Number	Installation Date	City	Zip	Climate Zone	Smart Switch	Smart Bulbs	Smart Speaker Amazon Echo Dot	Smart Thermostat Ecobee 3 Lite	Thermostat Remote Sensor (Ecobee)	UDI Gateway Provisioning
16	02/14/2020	VALENCIA	91354	9	5	4	1	1	1	1
17	02/06/2020	GOLETA	93117	6	5	4	1	1	1	1
18	01/10/2020	LAKEWOOD	90712	8	4	4	1	1	1	1
19	02/04/2020	BELLFLOWER	90706	8	5	4	1	1	1	1
20	01/22/2020	VICTORVILLE	92394	14	5	4	1	0	1	1
21	01/08/2020	YUCAIPA	92399	10	4	1	1	0	0	1
22	01/31/2020	SANTA CLARITA	91321	9	5	4	1	1	1	1
23	01/23/2020	MONTEBELLO	90640	9	5	0	1	1	1	1
24	02/10/2020	MONTEBELLO	90640	9	5	4	1	1	1	1
25	01/28/2020	VICTORVILLE	92392	14	4	4	1	1	1	1
26	01/10/2020	CYPRESS	90630	8	5	4	1	1	1	1
27	01/17/2020	GARDEN GROVE	92843	8	4	4	1	1	1	1
28	12/06/2019	SANTA ANA	92705	8	4	4	1	2	2	1
29	01/24/2020	PLACENTIA	92870	8	5	4	1	1	1	1
30	12/12/2019	IRVINE	92602	8	4	4	1	1	1	1
31	01/02/2020	IRVINE	92614	8	4	4	1	1	1	1
32	01/17/2020	ORANGE	92865	8	5	4	1	1	1	1
33	01/09/2020	LONG BEACH	90814	6	5	4	1	1	1	1
34	02/03/2020	GARDENA	90247	8	5	4	1	1	1	1
35	02/10/2020	CYPRESS	90630	8	4	4	1	1	1	1
36	02/26/2020	RANCHO SANTA MARGARITA	92688	8	5	0	1	1	1	1
37	01/06/2020	LAGUNA BEACH	92651	6	5	4	1	0	0	1
38	11/21/2019	CHINO HILLS	91709	10	4	4	1	1	1	1
39	01/15/2020	PERRIS	92570	10	4	4	1	2	2	1
40	02/14/2020	HUNTINGTON BEACH	92646	6	4	4	0	0	0	1
41	02/14/2020	LONG BEACH	90808	8	4	4	1	1	1	1
42	02/20/2020	CERRITOS	90703	8	4	4	1	1	1	1
43	12/06/2019	TEMECULA	92592	10	4	4	1	1	1	1
44	12/09/2019	IRIVNE	92606	8	3	4	1	1	1	1
45	01/21/2020	PLACENTIA	92870	8	5	4	1	1	1	1
46	01/07/2020	BREA	92821	8	4	4	1	1	1	1
47	01/21/2020	HUNTINGTON BEACH	92646	6	5	4	1	1	1	1
48	01/27/2020	LOMITA	90717	6	5	4	1	1	1	1
49	01/30/2020	MONROVIA	91016	9	4	4	1	1	1	1
50	01/27/2020	LONG BEACH	90808	8	4	4	1	1	1	1

Customer Number	Installation Date	City	Zip	Climate Zone	Smart Switch	Smart Bulbs	Smart Speaker Amazon Echo Dot	Smart Thermostat Ecobee 3 Lite	Thermostat Remote Sensor (Ecobee)	UDI Gateway Provisioning
51	01/31/2020	SANTA CLARITA	91350	9	4	4	1	1	1	1
52	01/19/2020	ORANGE	92867	8	4	4	1	1	1	1
53	01/24/2020	LONG BEACH	90806	6	5	4	1	1	1	1
54	01/14/2020	MISSION VIEJO	92691	8	4	4	1	1	1	1
55	02/06/2020	MENIFEE	92585	10	1	1	1	1	1	1
56	01/07/2020	SOUTH PASADENA	91030	9	5	4	1	1	1	1
57	01/29/2020	RANCHO PALOS VERDES	90275	6	5	4	1	0	0	1
58	01/13/2020	TUSTIN	92782	8	5		1	1	1	1
59	01/07/2020	SANTA ANA	92706	8	5	4	1	1	1	1
60	01/30/2020	LA MIRADA	90638	9	5	4	1	1	1	1
61	01/03/2020	WEST COVINA	91791	9	5	4	1	1	1	1
62	01/13/2020	GARDEN GROVE	92845	8	5	4	1	1	1	1
63	01/30/2020	LA MIRADA	90638	9	3	4	1	0	0	1
64	02/05/2020	CYPRESS	90630	8	5	4	1	0	0	1
65	12/13/2019	IRVINE	92620	8	4	4	1	0	0	1
66	12/12/2019	TUSTIN	92782	8	4	3	1	1	1	1
67	11/21/2019	FONTANA	92336	10	4	4	1	2	2	1
68	01/20/2020	HUNTINGTON BEACH	92646	6	4	4	1	1	1	1
69	01/22/2020	LONG BEACH	90808	8	5	4	1	1	1	1
70	01/08/2020	YUCAIPA	92399	10	5	4	1	1	1	1
71	02/07/2020	PORT HUENEME	93041	6	4	4	1	1	1	1
72	12/09/2019	IRVINE	92606	8	3	4	0	0	0	1
73	01/07/2020	CERRITOS	90703	8	4	4	1	1	1	1
74	01/28/2020	MONTEREY PARK	91754	9	5	4	1	1	1	1
75	12/23/2019	TUSTIN	92782	8	2	4	1	2	0	1
76	12/24/2019	POMONA	91766	9	4	0	1	1	1	1
77	*	*	*	*	0	0	0	0	0	0
78	12/27/2019	LAKE FOREST	92630	8	4	4	1	0	0	1
80	12/24/2019	CORONA	92881	10	4	0	1	1	0	1
81	12/26/2019	CORONA	92881	10	4	4	1	1	0	1
82	12/20/2019	MORENO VALLEY	92553	10	4	4	1	1	1	1
83	12/26/2019	TUSTIN	92782	8	2	4	1	1	0	1
84	*	*	*	*	0	0	0	0	0	0
85	12/17/2019	ORANGE	92867	8	4	4	1	1	0	1

Customer Number	Installation Date	City	Zip	Climate Zone	Smart Switch	Smart Bulbs	Smart Speaker Amazon Echo Dot	Smart Thermostat Ecobee 3 Lite	Thermostat Remote Sensor (Ecobee)	UDI Gateway Provisioning
86	*	*	*	*	0	0	0	0	0	0
87	12/30/2019	FULLERTON	92833	8	3	4	1	1	0	1
88	*	CERRITOS	90703	8	0	0	0	0	0	0
89	12/26/2019	LA VERNE	91750	9	4	4	1	1	1	1
90	12/17/2019	CERRITOS	90703	8	4	4	1	1	0	1
91	12/26/2019	MONTCLAIR	91763	10	4	4	1	1	0	1
92	12/31/2019	TORRANCE	90503	6	4	4	1	1	0	1
93	12/30/2019	FULLERTON	92883	8	4	4	1	1	0	1
94	12/18/2019	IRVINE	92604	8	3	4	1	1	0	1
95	12/20/2019	IRVINE	92612	8	3	4	1	0	0	1
97	12/27/2019	IRVINE	92620	8	4	4	1	1	0	1
98	12/18/2019	LAKE FOREST	92630	8	4	4	0	1	0	1
99	*	*	*	*	0	0	0	0	0	0
100	12/19/2019	LONG BEACH	90806	6	4	4	1	1	0	1
101	12/23/2019	RANCHO CUCAMONGA	91739	10	0	4	1	0	0	1
102	12/19/2019	TORRANCE	90503	6	4	4	1	1	0	1
103	*	*	*	*	0	0	0	0	0	0
104	12/20/2019	LAKE FOREST	92630	8	3	4	0	1	0	1
105	12/23/2019	MISSION VIEJO	92692	8	4	4	1	1	0	1

“Energy Expert” instructions can be found in the Appendix section.

### 1.2.3 TASK C: M&V

Nexant hosted a web-based Project Initiation (PI) meeting with the SCE team, UDI, SCE, and Nexant project managers jointly developed the agenda. The purpose was to introduce key evaluation team staff to SCE's evaluation staff and program advisors, and for the group to refine the research objectives and methodology and review the data requirements and data collection methods.

After the meeting, Nexant produced a memo summarizing the discussions, highlighting key issues raised, and noting any important decisions made. The memo also included documentation of any changes to the scope of work contained in the proposal, and served as the evaluation plan for the project.

To estimate load impacts, Nexant compared participant load to a matched control group with similar load shape and kWh usage characteristics during the pre-treatment period. The control group customers were an appropriate match to the treatment group, because they met the eligibility criteria in the demonstration program and were therefore likely to be similar to the participants.

Secondly, the impact estimates were based on the difference in loads for the participant and control group customers during the post-treatment period minus any difference in load between the two groups during the pre-treatment period (DiD analysis). A discussion of the impact methodology used to estimate participant energy savings is detailed below.

The primary challenge in estimating load impacts for opt-in programs such as this is estimating how much electricity participants would have consumed without the treatment, referred to as the reference load. To estimate load impacts, participant loads were compared to a matched control group, which was developed using a nearest-neighbor matching technique to find control customers with usage patterns and other characteristics most similar to treatment customers, who were matched within Rate 4 or Rate 5 TOU rates.

A control group was developed for each rate during each season and day type (summer/winter, average weekday/average weekend). The control and treatment groups were matched based on kilowatts (kW) for all hours during June 2020. This allowed the matches to account for changes in usage behavior patterns under the COVID-19 pandemic and prior to the Alexa skill launch.

Customers were removed if they differed by more than 0.25 kW in terms of maximum kW during Summer 2019, which represented the pre-treatment timeframe (summer 2019 maximum kW variable proxies for weather-usage sensitivity at peak temperatures). The matched control group method used for this analysis was superior to a within-subjects analysis, because it eliminated the problem of model misspecification. Any reference load model based on loads observed during the pretreatment period required the modeler to make assumptions about the relationships between load, time, and temperature. If this assumed function did not reflect the true relationships between load, time, and temperature, the model could produce incorrect results. In contrast, the matched control group dealt with this problem by assuming customers who behaved similarly to participants during the pretreatment period would also behave similarly during the post-treatment period. This eliminated the need to specify load as a function of weather.



## 1.3 CHALLENGES

- It was difficult to contact customers to help them with commissioning Ecobee thermostats that were not commissioned (or were decommissioned).
- More than 15% abandoned participation when confronted with installation challenges, such as being unavailable, COVID, or not being familiar with the technologies.
- There was a significant lag between when equipment was installed and commissioned and when the Alexa skill was launched (up to seven months for some customers). During that time, some customers may have become disengaged or may not have understood how to use their Alexa skills to manage energy usage.
- UDI's test lab was not connected to an SCE meter, so they had to work with SCE employee customers to complete some testing. This impacted the amount of time it took to complete testing, as well as the accuracy of some testing scenarios.
- The amount of data captured was much larger than anticipated, and required adjusting data processing, storage methods, and hardware infrastructure.
- Launching SCE's new customer platform in 2021 slowed down the process of obtaining customer data to accurately depict billing information.

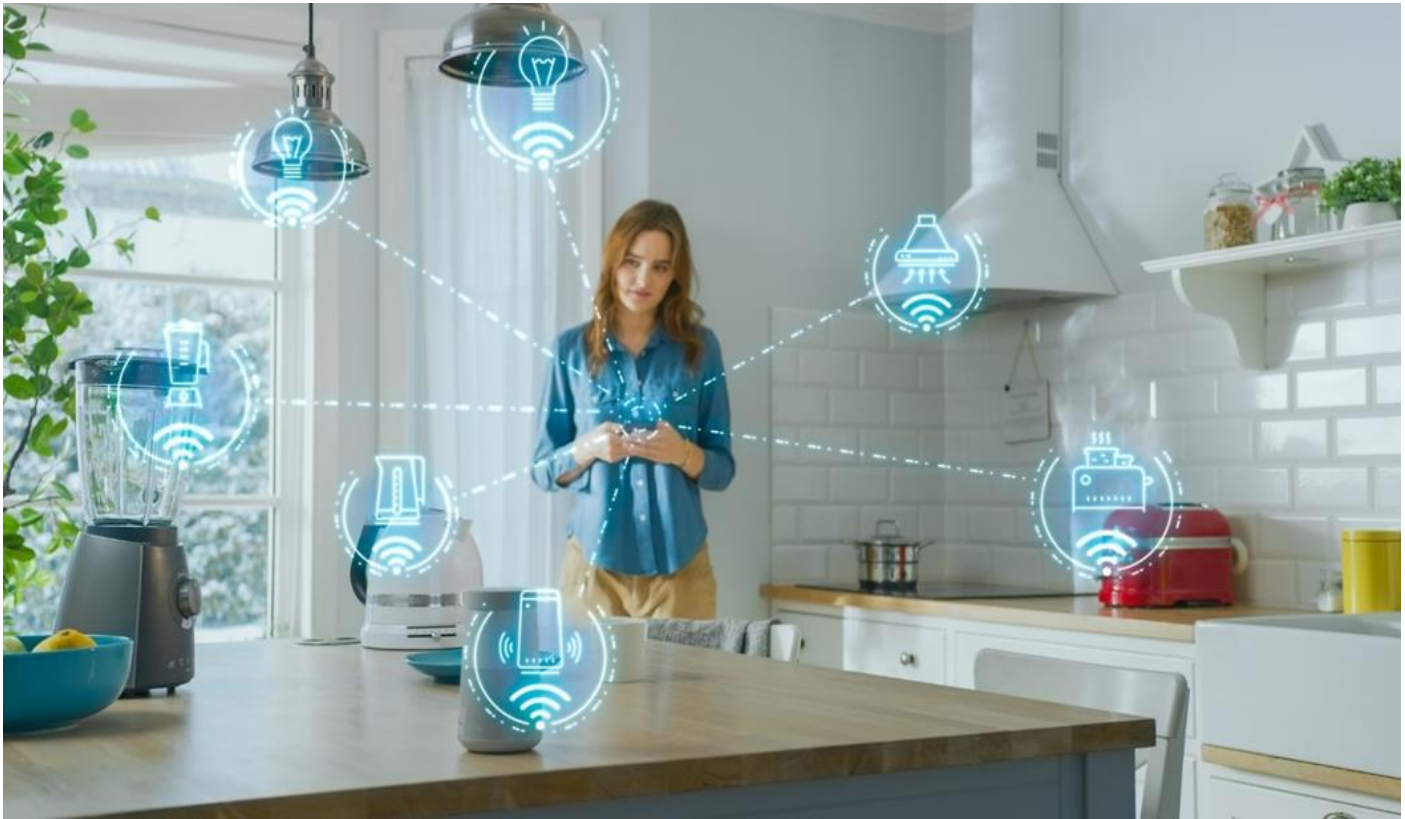
## RECOMMENDATIONS

- Gear toward a customer-driven self-installation model. The simplified self-installation model is the “new normal.”
- Maintain constant communication with customers via surveys, educational outreach, awareness, notifications, and updated changes to help increase customer engagement with the smart speaker devices and other smart devices.
- Have a larger pool of participants to ensure a stronger evaluation outcome.
- Have a set of process and procedures to collect stringent data to allow a more thorough analysis to observe participant engagement and overall load estimations as well as individual smart devices interactions.
- Provide enhanced training for the installers on connecting smart devices to the gateway and meters to ensure all smart devices function correctly and communicate as intended.
- Complete skill development and data gathering prior to reaching out to customers to participate in the project.
- Reevaluate additional recruitment and promotion of skills and features. Include a large pool of participants who own electric vehicles, solar, battery energy storage systems, and swimming pools, to understand overall load impacts and estimations by using the smart speaker technology.

Learnings from this project are being evaluated for a future phased project in which more customers will be marketed to participate and understand how the smart speaker technology and “Energy Expert” smartphone application, in conjunction with Alexa skills, may help with customer energy usage and billing, and potentially receiving outage information, Public Safety Power Shutoff (PSPS) notifications, and energy-related education/awareness.

# APPENDIX A LOAD IMPACTS AND PROCESS EVALUATION BY NEXANT

The Nexant M&V report starts on the next page.



## SCE SMART SPEAKER DEMONSTRATION PROJECT – LOAD IMPACTS AND PROCESS EVALUATION

Submitted to Southern California Edison

May 24, 2022

Prepared by:

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# EXECUTIVE SUMMARY

In early 2020, SCE launched a Smart Speaker Demonstration Project to test customer ability to optimize connected residential energy loads in their homes using an Amazon Alexa Smart Speaker. The project ran from June – September 2020. Each participant was provided an Amazon Echo Dot, smart switches, smart lights, smart plugs, an Ecobee thermostat, and an ISY gateway that unites smart technologies installed in the home. These devices are connected to the smart speaker and SCE smart meter through Universal Devices, Inc.-supplied ISY gateway.

Customers in the study received training on how to ask energy-related questions and set their home energy optimization preferences using the smart speaker. A “smart hub” provided algorithms to use various data points, such as the customer TOU rate, energy use, and preferences, to optimize connected devices. In-home device settings were adjusted to run less during peak times. The project team developed the smart speaker’s interactive capabilities with household occupants and the in-home technologies were provided to assess whether the smart speaker can enable customers to manage their energy use and costs by optimizing all their connected devices.

The objectives of the demonstration project were to better understand how customers can interact with smart speakers and other technologies to better manage their energy costs, determine if the technology experience affected customer satisfaction, and estimate the change in customer energy use attributable to smart technology usage. Additionally, the project sought to identify barriers, challenges, and lessons learned from the in-field assessment that could inform SCE for future program application use cases.

This report documents the load impact and process evaluation findings from the Demonstration Project. The report contains information on the project design, implementation, enrollment information, evaluation methodology, participant load impacts, and in-depth interview findings from the SCE program management and implementation teams.

## 1.4 SUMMARY OF FINDINGS AND RECOMMENDATIONS

### 1.4.1 LOAD IMPACT FINDINGS AND RECOMMENDATIONS

To estimate load impacts, Nexant compared participant load to a matched control group with similar load shape and kWh usage characteristics during a pre-treatment period. Secondly, the impact estimates were based on the difference in loads for the participant and control group customers during the post-treatment period minus any difference in load between the two groups during the pre-treatment period (DiD analysis). For the analysis period of interest of June through September 2020, a population of 63 customers remained as the treatment group.

The ex-post load impacts were analyzed in four scenarios during summer 2020 by the two TOU Rates 4 and 5 as shown in Table 0-1. Overall, participants demonstrated load reductions during the analysis timeframe. However, the analysis cannot definitively attribute these load impacts to specific features of the Demonstration Project without a larger participant population and adjustments to the project's experimental design.

Notably, results for the peak time summer average weekday timeframe show reductions on both Rate 4 and 5. Rate 4 show load reductions of 0.03 kW, or 1.7%, however, the results are not statistically significant at the 90% confidence level. Rate 5 shows an impact of 0.22 kW, or 10.6% and is statistically significant. During the summer average weekend mid-peak period, participants on Rate 4 show statistically significant load reductions of 0.23 kW, or 9.6%.

TABLE 0-1: LOAD IMPACT RESULTS

Summer Average Weekday						
Rate	Period	Treated Customers	Reference Load	Treatment Load	Absolute Impact	Percent Impact
Rate 4	Peak	25	1.91 kW	1.87 kW	0.03 kW	1.7%
Rate 5		38	2.05 kW	1.83 kW	0.22 kW*	10.6%*
Rate 4	Day	25	30.97 kWh	30.71 kWh	0.26 kWh	0.8%
Rate 5		38	30.26 kWh	29.88 kWh	0.38 kWh	1.3%
Summer Average Weekend						
Rate	Period	Treated Customers	Reference Load	Treatment Load	Absolute Impact	Percent Impact
Rate 4	Mid-Peak	25	2.36 kW	2.13 kW	0.23 kW*	9.6%*
Rate 5		38	2.18 kW	2.03 kW	0.16 kW	7.1%
Rate 4	Day	25	35.77 kWh	34.31 kWh	1.45 kWh*	4.1%*
Rate 5		38	33.68 kWh	33.43 kWh	0.24 kWh	0.7%

\* Indicates impact is statistically significant

Key findings and recommendations pertaining to load impacts from the Smart Speaker Demonstration Project include the following:

TABLE 0-2: SUMMARY OF IMPACT EVALUATION FINDINGS AND RECOMMENDATIONS

Finding	Recommendation
The evaluation was limited by low counts of active participants.	Additional recruitment of participants and promotion of skills and features would result in a more robust evaluation.
Load impacts are evident for treatment customers, but the mechanism(s) leading to the effects cannot be definitively attributed.	
A large portion of the initial set of participants were inactive by the time of evaluation.	
Skill log and device level data was sparsely populated.	More stringent QC of data collection will allow for a more comprehensive analysis and more refined attribution of observed effects.
The devices with the most use include smart appliances, refrigerators, thermostats, and interior lighting.	Additional education and focus on these end uses could provide the most value to future iterations of this program.

### 1.4.2 PROCESS EVALUATION FINDINGS AND RECOMMENDATIONS

Following the conclusion of the Smart Speaker Demonstration Project, Nexant conducted a process evaluation consisting of in-depth interviews with SCE and UDI to understand the program development, implementation, and lessons learned. The key process evaluation findings and recommendations are summarized in Table 0-3 below.



TABLE 0-3: SUMMARY OF PROCESS EVALUATION FINDINGS AND RECOMMENDATIONS

Finding	Recommendation
Existing frameworks of the optimization algorithm and initial Alexa skills benefitted the rollout of the project, but additional skills were developed later, increasing the time between installation and treatment.	Since these are now developed and tested, any future iterations of the program will benefit from the foundation.
The implementer received frequent requests for additional support from the installers, particularly when the SCE program manager was not present on-site to oversee the installation.	Installers could have benefitted from further training and support due to the complexity of connecting multiple devices with the meters and gateways.
Home equipment was occasionally installed incorrectly and did not communicate with SCE's smart meter. The program implementer reported problems with incorrectly installed thermostats and connectivity with the SCE smart meter.	Additional validation that the equipment was accurately installed and is communicating with other equipment may be beneficial. Also, presetting home equipment to the largest extent possible and considering a cloud-based approach instead of hardwires could also prove effective.
Customer outreach seemed to be beneficial in improving engagement with the devices, particularly after the launch of the additional smart speaker skill capabilities.	Providing regular outreach and education on program updates would likely increase program impacts.
Because the project design required a third-party to install the equipment during the COVID-19 pandemic, this resulted in low participation. The implementer cited customer reluctance to allow people into their homes.	Participants could potentially be instructed on installation of equipment, though perhaps with a smaller subset of the components involved in this project.
The typical customer profile for the demonstration project is engaged with home automation topics and technologies.	

## INTRODUCTION

The Smart Speaker Demonstration Project engaged residential customers in SCE's service territory from June through September 2020. Participants were provided an Amazon Alexa Smart Speaker, UDI's ISY home automation platform, Ecobee smart thermostat, Wi-Fi enabled light bulbs, and smart plugs. The devices were connected to a SCE smart meter, the internet, and to these smart devices or smart plugs in the home. A third-party contractor installed and networked the devices in customer homes. SCE was able to access the device and usage data.

Price signals were passed to the gateway device, and the gateway device then optimized energy use of smart devices or smart plugs according to customer preferences for maximum savings or maximum comfort. Customers interacted with the gateway device through the smart speaker, which could also provide customers ongoing insights related to energy use. Participants could interact with Alexa to optimize their energy consumption, receive insights related to their energy use, bill comparisons information, and outage alerts. Figure 0-1 below illustrates the general setup of participants' devices and their connectivity with the ISY gateway.

FIGURE 0-1: SMART SPEAKER PROJECT EQUIPMENT AND CONNECTIVITY



Source: Universal Devices

The price signals were based on the residential default TOU pricing rates that SCE began implementing in the spring of 2018. The TOU rollout tested two different TOU rates: Rate 4 and Rate 5. Approximately 400,000 households were assigned to one of the TOU rates (200,000 to each rate). Figure 0-2 and Figure 0-3 summarize the rate periods and prices for Rates 4 and 5. Importantly, the prices shown in the figures and discussed below do not

reflect the baseline credit of 7¢/kWh that applies to each rate.<sup>1</sup> Additional details can be found in Section 0.

**FIGURE 0-2: DEFAULT TOU RATE 4<sup>2</sup>**

Day Type	Season	Hour Ending																							
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Weekday	Summer	Off-Peak (25¢)												Peak (40¢)											
	Winter	Off-Peak (24¢)								Super Off-Peak (22¢)								Mid-Peak (32¢)							
Weekend	Summer	Off-Peak (25¢)												Super Off-Peak (22¢)						Mid-Peak (33¢)					
	Winter	Off-Peak (24¢)								Super Off-Peak (22¢)								Mid-Peak (32¢)							

**FIGURE 0-3: DEFAULT TOU RATE 5**

Day Type	Season	Hour Ending																							
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Weekday	Summer	Off-Peak (25¢)												Peak (50¢)											
	Winter	Off-Peak (25¢)								Super Off-Peak (22¢)								Mid-Peak (38¢)							
Weekend	Summer	Off-Peak (25¢)												Super Off-Peak (22¢)						Mid-Peak (38¢)					
	Winter	Off-Peak (25¢)								Super Off-Peak (22¢)								Mid-Peak (38¢)							

## 1.5 PARTICIPANT SUMMARY

Customers who were enrolled on an SCE TOU rate were targeted to participate in the Smart Speaker Demonstration Project. Specifically, SCE customers who met the following criteria were targeted:

- Residential TOU Customers (rates included were TOU-D-4 and TOU-D-5 including the CARE and FERA versions)
- Single Family or Tract Residence
- Itron smart meter installed
- Not enrolled in a DR program
- Not a Medical Baseline customer
- Not a CCA customer
- Not opted out of email marketing

SCE originally aimed to recruit up to 200 customers for participation in the study. Ultimately, due to the effects of the COVID-19 pandemic, a total of 105 customers were initially enrolled in the project. As shown in Table 0-1, a total of 91 remaining customers were enrolled in the Smart Speaker study at the time of evaluation due to eligibility and connectivity issues. After removing inactive customers and customers who had opted out of their TOU rate, a population of 63 customers remained as the treatment group for the analysis.

<sup>1</sup> The baseline credit was equal to 7.027¢/kWh on January 1, 2020 and rose to 7.576¢/kWh on June 1, 2020.

<sup>2</sup> Winter rates effective Jan 1, 2020. Summer rate effective Jun 1, 2020.

TABLE 0-1: TREATMENT CUSTOMER SUMMARY

Enrolled Customers	Customers with Connected Device Data	Active Customers at Time of Analysis	Active Customers Still on TOU Rate
105	91	69	63

## 1.6 EVALUATION OBJECTIVES

The overarching objectives of the Smart Speaker Demonstration Project were to:

- Better understand how connected smart thermostats and other “smart” household end-uses can optimize their energy usage via “smart speaker” voice commands subject to SCE’s TOU rates and customer comfort and savings preferences.
- Evaluate how voice interactions related to energy — usage, estimated bill, best times to use appliances — can be improved to identify optimal voice command “skills” and “smart speaker” interactions.
- Develop optimization algorithms and voice interaction vocabulary specific for the new SCE TOU rates and DR programs.

The secondary objectives of the Smart Speaker Demonstration Project were to:

- Better understand how customers can effectively interact with and use the smart speaker and other connected technologies in the home, for their preferences for energy management.
- Determine how customer satisfaction is impacted by the customers’ experience with smart speakers and connected technologies for managing energy, and if the interaction persists or is just a novelty.
- Estimate the change in customer energy use that can be attributed to the enabling technology of a smart energy management hub with Smart Speaker and associated Alexa skills as an “integrated energy management package”.

While SCE was responsible for the first two evaluation objectives, Nexant’s focus was on estimating the changes in customer energy use through a load impact estimation analysis consistent with the DR load impact protocols that govern how DR programs and TOU rates are evaluated in California. The methodology and results for this estimation are detailed in Sections 0 and 0 of the report, respectively. Following the conclusion of the project, Nexant also conducted retrospective in-depth interviews with both the program implementer and the SCE project team, focusing on barriers/challenges encountered, what worked/didn’t work in the process, and lessons learned. The findings from these interviews are presented in Section 0 of the report.

# LOAD IMPACT METHODOLOGY

To estimate load impacts, Nexant compared participant load to a matched control group with similar load shape and kWh usage characteristics during the pre-treatment period. The control group customers were an appropriate match to the treatment group because they met the eligibility criteria in the demonstration program and are therefore likely to be similar to the participants.

Secondly, the impact estimates were based on the difference in loads for the participant and control group customers during the post-treatment period minus any difference in load between the two groups during the pre-treatment period (DiD analysis). A discussion of the impact methodology used to estimate participant energy savings is detailed below.

## 1.7 DESIGN OF CONTROL GROUPS

The primary challenge in estimating load impacts for opt-in programs such as the Smart Speaker Demonstration Project is estimating how much electricity participants would have consumed in the absence of the treatment. The estimated usage in the absence of the treatment is referred to as the reference load. To estimate load impacts, participant loads were compared to a matched control group. The matched control group was developed using a Nearest-Neighbor matching technique to find control customers with usage patterns and other characteristics that were most similar to each treatment customer. Treatment customers were matched to control customers within each Rate 4 or Rate 5 TOU rate.

A control group was developed for each rate during each season and day type (summer/winter, average weekday/average weekend). The control and treatment groups were matched based on kW for all hours during June 2020. This allowed for the matches to account for changes in usage behavior patterns under the COVID-19 pandemic and prior to Alexa skill-enabling launch.

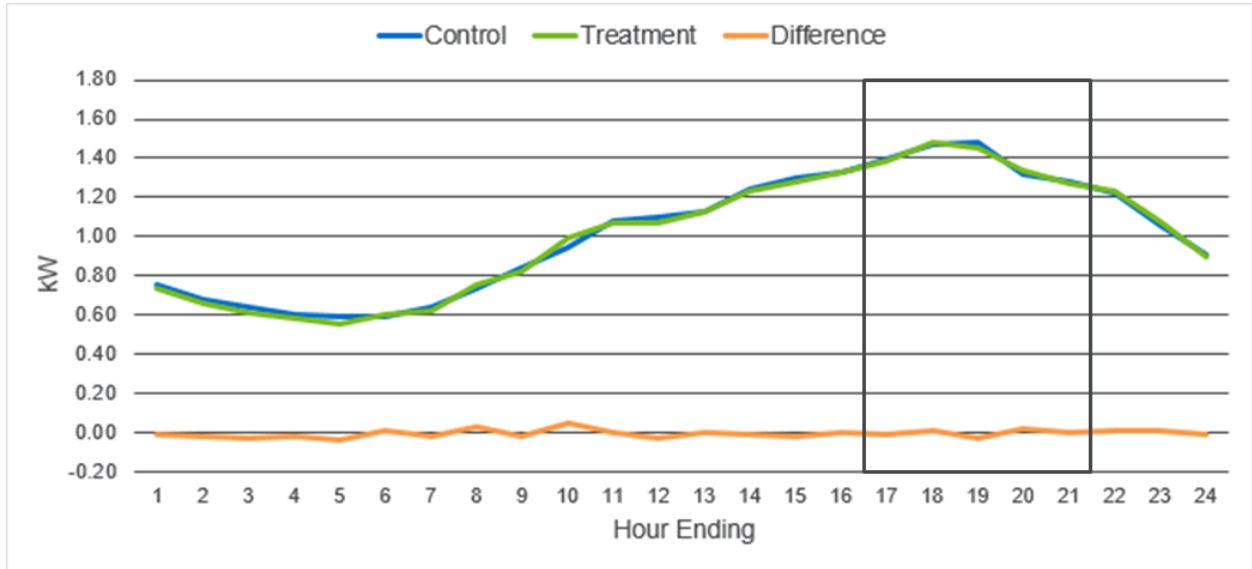
Customers were removed that differed by more than 0.25 kW in terms of maximum kW during Summer 2019, which represented the pre-treatment timeframe. The Summer 2019 maximum kW variable proxies for weather-usage sensitivity at peak temperatures.

The matched control group method used for this analysis is superior to a within-subjects analysis because it eliminates the problem of model misspecification. Any reference load model based on loads observed during the pretreatment period requires the modeler to make assumptions about the relationships between load, time, and temperature. If this assumed function does not reflect the true relationships between load, time, and temperature, the model can produce incorrect results. In contrast, the matched control group deals with this problem by assuming that the customers who behave similarly to participants during the pretreatment period would also behave similarly during the post-treatment period. This eliminates the need to specify load as a function of weather.

### 1.7.1 MATCHED CONTROL GROUP – RATE 4

Twenty-five control customers were matched to the 25 treatment customers on Rate 4. As shown in Figure 0-1 below, overall, the matches look reasonable during the Rate 4 on-peak hours ending 17– 21 (4 PM – 9 PM) during the pre-treatment period. The black rectangle represents the peak hours of Rate 4. The apparent lack of smoothness in the average 24-hour load shape is driven by the low number of customers.

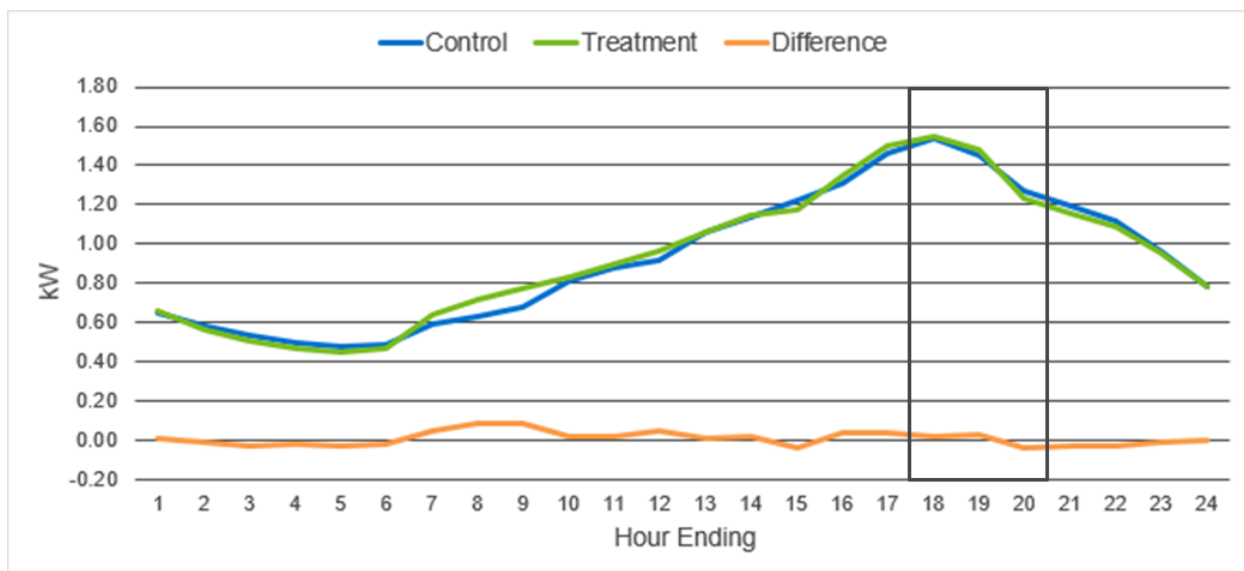
**FIGURE 0-1: MATCHED CONTROL AND TREATMENT GROUPS - RATE 4**



### 1.7.2 MATCHED CONTROL GROUP – RATE 5

As shown in Figure 0-2, 38 control customers were matched to the 38 treatment customers on Rate 5. While some differences are noted during certain hours of the pre-treatment period (7 AM to 9 AM), the matches overall look reasonable during the peak hours of 5 PM to 8 PM.

**FIGURE 0-2: MATCHED CONTROL AND TREATMENT GROUPS - RATE 5**



## 1.8 ESTIMATING EX POST LOAD IMPACTS

The load impacts were estimated using a DiD analysis. This method estimates impacts by subtracting treatment customers' loads from control customers' loads in each hour or time period in the post-treatment timeframe and subtracts from this value the difference in loads between treatment and control customers for the same time period in the pre-treatment period. Subtracting any difference between treatment and control customers prior to the treatment going into effect adjusts for any difference between the two groups that might occur due to random chance, such as weather, policy changes, public health pandemics, etc.

The DiD method attempts to mimic an experimental research design by comparing usage for treatment customers in the pre-treatment and post-treatment period to control customer usage in the same periods. The treatment effect is the incremental impact of the smart speaker for customers on TOU rates. The fixed effects, DiD model equation for estimating impacts is shown below:

$$kW_{i,t} = \alpha_i + \delta \text{treat}_i + \gamma \text{post}_t + \beta(\text{treatpost})_{i,t} + v_i + \varepsilon_{i,t}$$

In the above equation, the variable  $kW_{i,t}$  equals electricity usage during the time period of interest, which might be each hour of the day, peak or off-peak rate periods, daily usage, or some other period. The index  $i$  refers to customers and the index  $t$  refers to the time period of interest. The estimating database would contain electricity usage data during both the pretreatment and post-treatment periods for both treatment and control group customers. The variable  $\text{treat}$  is equal to 1 for treatment customers and 0 for control customers, while the variable  $\text{post}$  is equal to 1 for days after customers enroll in the project and a value of 0 for days prior to enrollment. The  $\text{treatpost}$  term is the interaction of  $\text{treat}$  and  $\text{post}$  and its coefficient  $\beta$  is a DiD estimator of the treatment effect that makes use of the pretreatment data. The primary parameter of interest is  $\beta$ , which provides the estimated demand impact of the technology during the relevant period. The parameter  $\alpha_i$  is equal to mean usage for



each customer for the relevant time period (e.g., hourly, peak period, etc.). The  $v_i$  term is the customer fixed effects variable that controls for unobserved factors that are time-invariant and unique to each customer.

The estimated load impacts from the above analysis methodology are for the average customer in the participant groups, not for individual customers. It is not possible to estimate load impacts for individual customers with any reasonable degree of accuracy or internal validity because it's impossible to control for other potential exogenous factors that might cause usage to change between pre- and post-treatment periods.

# LOAD IMPACT RESULTS

This report section summarizes the load impacts for the Smart Speaker Project from June through September 2020. Load impacts were estimated for the following periods of interest:

- Summer average weekday
  - Peak Load Impacts
  - Daily Load Impacts
- Summer average weekend
  - Mid-Peak load impacts
  - Daily load impacts

The subsequent subsections present results for the average participant in each of these periods. Figure 0-2 and Figure 0-3 in Section 2 summarized the rate periods and prices for Rates 4 and 5. Rate 4 has two rate periods on summer weekdays. The peak period on Rate 4 runs from 4 PM to 9 PM. The peak to off-peak price ratio (ignoring the baseline credit) is 1.6 to 1 in summer, and off-peak prices are in effect on weekends from 9 PM to 4 PM. Rate 5 has two rate periods on summer weekdays, the same structure as Rate 4. Compared with Rate 4, Rate 5 has a much shorter peak period but a slightly higher peak price in summer months (50¢/kWh for Rate 5 versus 40¢/kWh for Rate 4). The peak period runs from 5 PM to 8 PM. The ratio of peak to off-peak prices in the summer is roughly 2 to 1. On weekends, customers pay the off-peak price between 8 PM and 8 AM and the super off-peak price during the same overnight hours as on weekdays, from 8 AM to 5 PM. On summer weekends, the peak period is referred to as the “mid-peak”. For the two rates, the summer season covers the months of June through September.

## 1.9 LOAD IMPACTS SUMMARY: SUMMER AVERAGE WEEKDAY BY RATE

Table 0-1 shows the summary of load impacts for the summer average weekday for both Rates 4 and 5. Results are presented for each rate’s peak period as well as the entire average weekday. Figure 0-1 and Figure 0-2 show the reference load and treatment load over each hour in the summer average weekday’s 24-hour period. Rate 5 customers show larger load reduction impacts than Rate 4 customers. These results are discussed in further detail in the subsections below.

TABLE 0-1: LOAD IMPACT SUMMARY: SUMMER AVERAGE WEEKDAY

Rate	Period	Treated Customers	Reference Load	Treatment Load	Absolute Impact	Percent Impact
Rate 4	Peak	25	1.91 kW	1.87 kW	0.03 kW	1.7%
Rate 5		38	2.05 kW	1.83 kW	0.22 kW*	10.6%*
Rate 4	Day	25	30.97 kWh	30.71 kWh	0.26 kWh	0.8%
Rate 5		38	30.26 kWh	29.88 kWh	0.38 kWh	1.3%

\* Indicates impact is statistically significant

FIGURE 0-1: RATE 4 LOAD IMPACT SUMMARY: SUMMER AVERAGE WEEKDAY

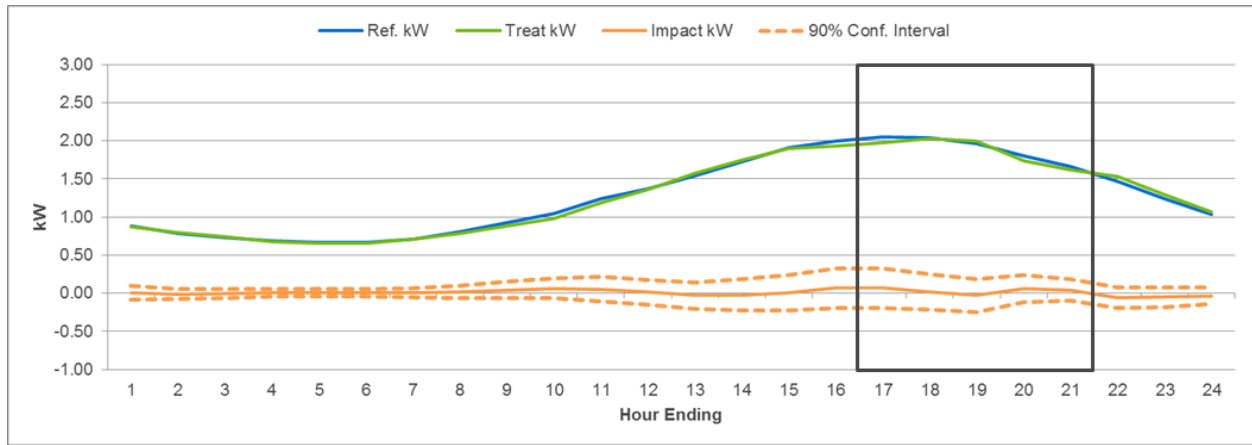


FIGURE 0-2: RATE 5 LOAD IMPACT SUMMARY: SUMMER AVERAGE WEEKDAY

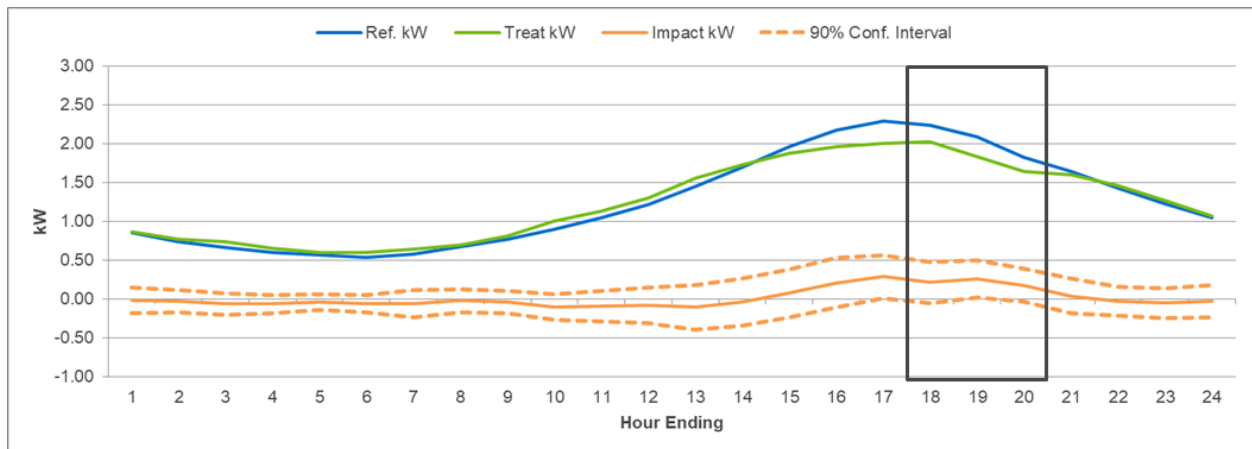
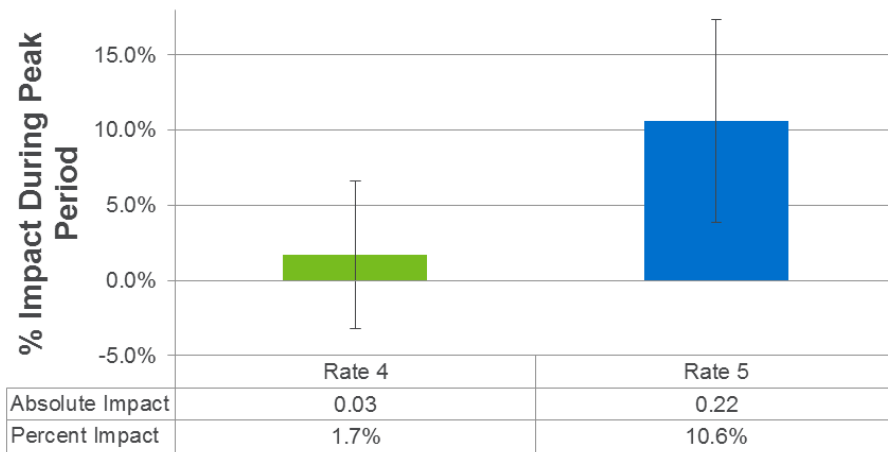


Figure 0-3 shows the peak period load impacts for the summer average weekday. The lines bisecting the top of each bar in the figure show the 90% confidence band for each estimate. If the confidence band includes zero, it means that the estimated load impact is not statistically different from zero at the 90% level of confidence. If the confidence bands for two bars do not overlap, it means that the observed difference in the load impacts is statistically significant. If they do overlap, it does not necessarily mean that the difference is

not statistically significant. In these cases, t-tests were calculated to determine whether the difference is statistically significant.<sup>3</sup>

As presented below, customers on Rate 4 show load reductions of 1.7%, or 0.03 kW, during the peak period on an average weekday. However, the results are not statistically significant. Peak period load reductions for Rate 5 show an impact of 10.6%, or 0.22 kW. Rate 5 impacts are larger in comparison to Rate 4 and are statistically significant. The confidence bands show large variance for both rates, largely due to small sample sizes and wide differences in kW across customers.

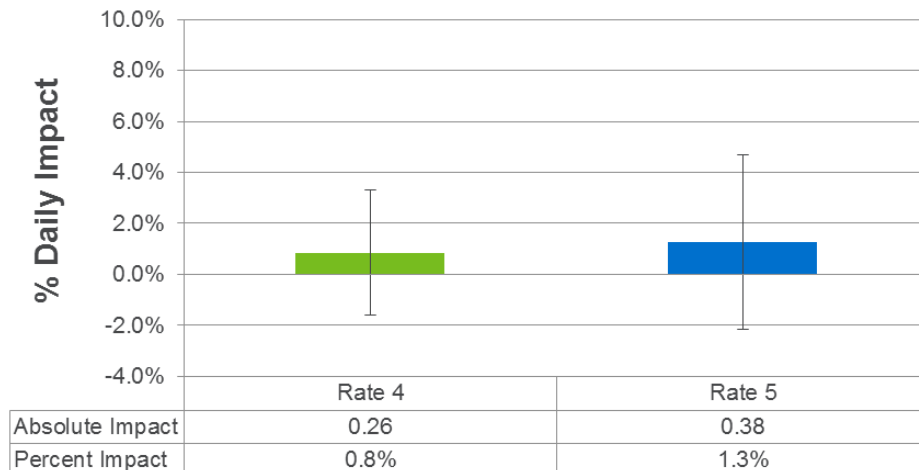
**FIGURE 0-3: PEAK PERIOD LOAD IMPACTS (kW): SUMMER AVERAGE WEEKDAY BY RATE**



The analysis also evaluated the change in daily load for the summer average weekday. Figure 0-4 shows customers on Rate 4 and Rate 5 demonstrate small daily load reductions that range from 0.8% to 1.3%, respectively. However, the results are not statistically significant, with wide confidence bands due to small sample size.

<sup>3</sup> The test was applied at the 90% confidence level which means that a t-value exceeding 1.65 indicates statistical significance.

FIGURE 0-4: DAILY LOAD IMPACT (kWh): SUMMER AVERAGE WEEKDAY BY RATE



## 1.10 LOAD IMPACTS DURING THE SUMMER AVERAGE WEEKEND BY RATE

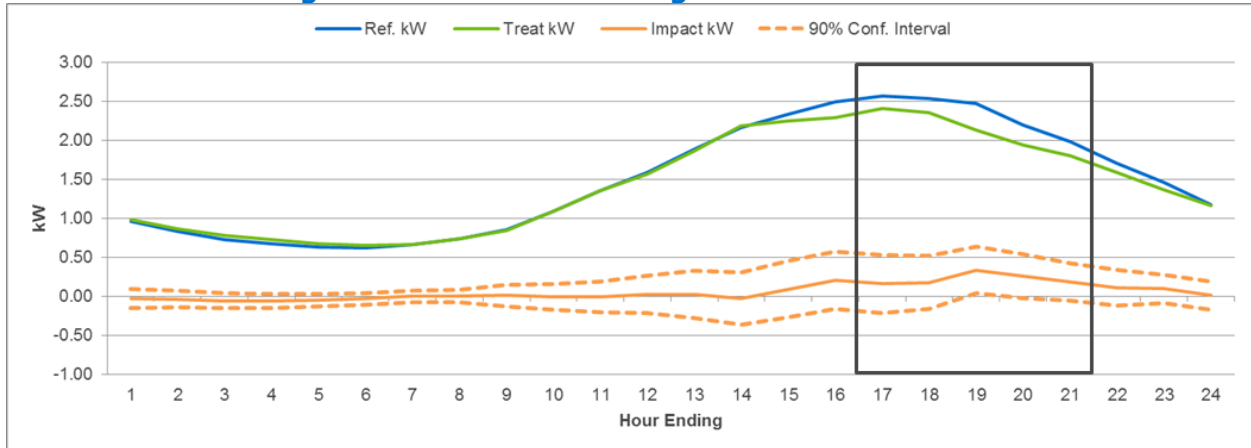
Table 0-2 below provides a summary of load impacts for the summer average weekend for both Rates 4 and 5. Results are presented for each rate's weekend peak period (referred to as the mid-peak for these SCE TOU rates) as well as the entire average weekend day. Figure 0-5 and Figure 0-6 show the reference load and treatment load over each hour in the summer average weekend day's 24-hour period. On the summer weekend days, Rate 4 participants show larger load impacts than Rate 5 participants. These results are discussed in further detail below.

TABLE 0-2: LOAD IMPACT SUMMARY: SUMMER AVERAGE WEEKEND

Rate	Period	Treated Customers	Reference Load	Treatment Load	Absolute Impact	Percent Impact
<b>Rate 4</b>	<b>Mid-Peak</b>	25	2.36 kW	2.13 kW	0.23 kW*	9.6%*
<b>Rate 5</b>		38	2.18 kW	2.03 kW	0.16 kW	7.1%
<b>Rate 4</b>	<b>Day</b>	25	35.77 kWh	34.31 kWh	1.45 kWh*	4.1%*
<b>Rate 5</b>		38	33.68 kWh	33.43 kWh	0.24 kWh	0.7%

\* Indicates impact is statistically significant

**Figure 0-5: Summer Average Weekend – Rate 4**



**Figure 0-6: Summer Average Weekend – Rate 5**

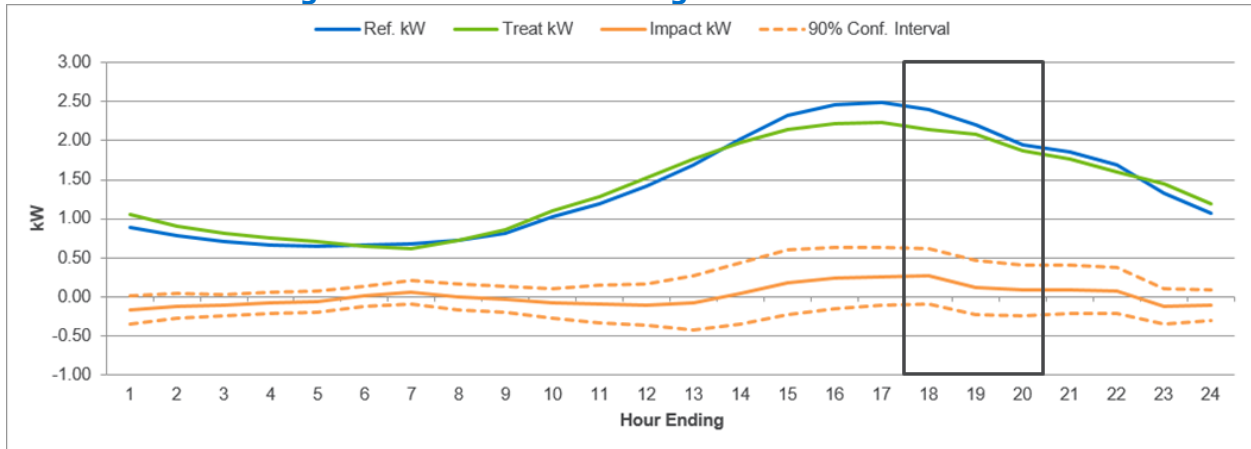
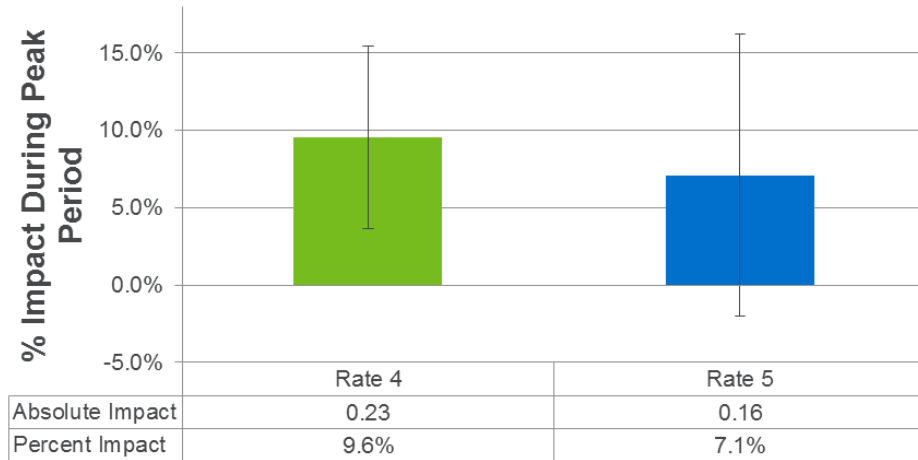


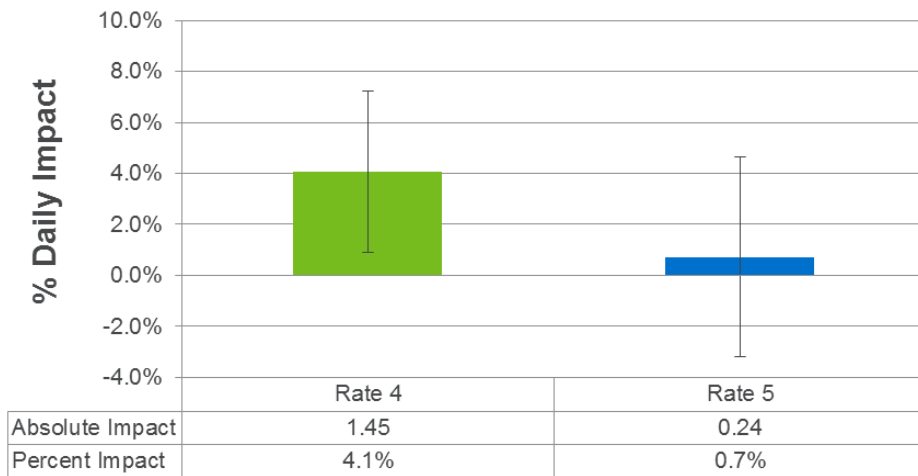
Figure 0-7 provides the weekend mid-peak load impacts on average weekend days for both rates. Rate 4 customers show load reductions of 9.6%, or 0.23 kW, which are statistically significant. Rate 5 customers show load reductions of 7.1%, or 0.16 kW during the mid-peak periods on summer weekend days, but these are not statistically significant. Similarly to the results for the peak period summer average weekday, the small sample sizes for the participant population lead to large confidence bands on the impact estimates.

**FIGURE 0-7: MID-PEAK LOAD IMPACTS (KW): SUMMER AVERAGE WEEKEND BY RATE**



In Figure 0-8 below, customers on Rate 4 show a statistically significant daily load reduction of 4.1% or 1.45 kWh on summer average weekend days. Rate 5 daily load impacts are smaller at 0.7%, or 0.24 kWh, and are not statistically significant.

**FIGURE 0-8: DAILY LOAD IMPACTS (kWh): SUMMER AVERAGE WEEKEND BY RATE**



## DEVICE AND SKILL ANALYSIS

Participant device and smart speaker skill usage data was collected through the UDI's ISY portal to investigate customer behavior over the summer study period to identify any usage patterns or trends that arose throughout the project. An analysis of these usage patterns for participants on Rate 4 and Rate 5 is provided in the following sections.

### 1.11 RATE 4 DEVICE USAGE

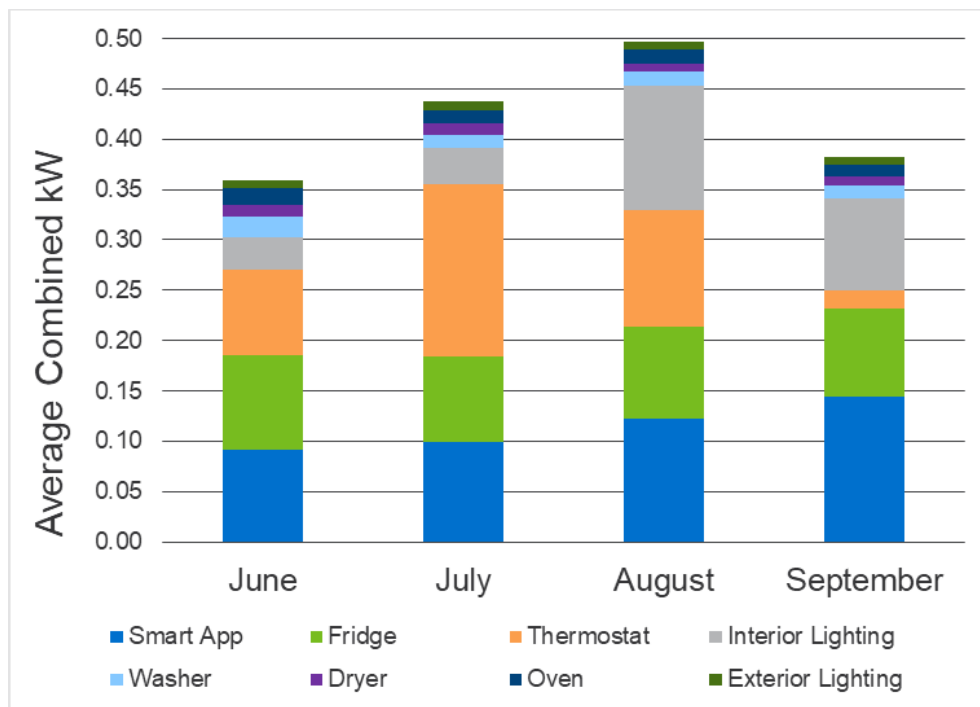
Nexant analyzed the average hourly device usage during peak periods on average weekdays during the summer months. Results are presented on the aggregated device data for each summer month in Table 0-1 and Figure 0-1. Note that not every customer has all device types connected to UDI's gateway. The devices with the most use were smart appliances, refrigerators, thermostats, and interior lighting. These device types comprised approximately 90% of the monthly demand throughout the summer period.

TABLE 0-1: DEVICE USAGE DURING AVERAGE WEEKDAY PEAK PERIOD BY MONTH – RATE 4

Device	Customer Count	kW			
		June	July	August	September
Smart Appliance	20	0.09	0.10	0.12	0.14
Refrigerator	23	0.09	0.09	0.09	0.09
Thermostat	15	0.09	0.17	0.12	0.02
Interior Lighting	16	0.03	0.04	0.12	0.09
Washer	14	0.02	0.01	0.01	0.01
Dryer	19	0.01	0.01	0.01	0.01
Oven	4	0.02	0.01	0.01	0.01
Exterior Lighting	1	0.01	0.01	0.01	0.01
<b>Total</b>		<b>0.36</b>	<b>0.44</b>	<b>0.50</b>	<b>0.38</b>

FIGURE 0-1: DEVICE USAGE DURING AVERAGE WEEKDAY PEAK PERIOD BY MONTH – RATE 4





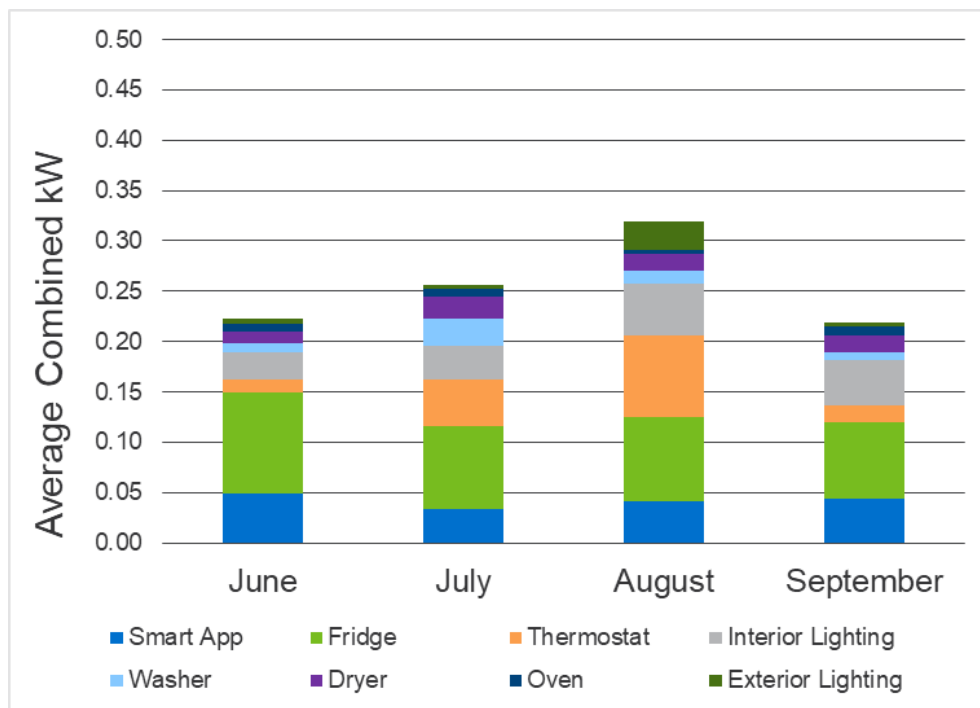
## 1.12 RATE 5 DEVICE USAGE

As shown in Table 0-2 and Figure 0-2, the monthly device usage during the average weekday peak period for Rate 5 is lower compared to Rate 4 on an average basis. However, it should be noted that Rate 5 customers had many more 0 kW reads in the portal’s device data compared to Rate 4 customers. The devices with the most use are smart apps, refrigerators, thermostats, and interior lighting. These device types comprised approximately 80% of the monthly demand throughout the summer period.

**TABLE 0-2: DEVICE USAGE DURING AVERAGE WEEKDAY PEAK PERIOD BY MONTH – RATE 5**

Device	Customer Count	kW			
		June	July	August	September
Smart App	36	0.05	0.03	0.04	0.04
Refrigerator	29	0.10	0.08	0.08	0.08
Thermostat	28	0.01	0.05	0.08	0.02
Interior Lighting	30	0.03	0.03	0.05	0.04
Washer	16	0.01	0.03	0.01	0.01
Dryer	28	0.01	0.02	0.02	0.02
Oven	6	0.01	0.01	0.01	0.01
Exterior Lighting	3	0.01	0.003	0.03	0.003
<b>Total</b>		<b>0.22</b>	<b>0.26</b>	<b>0.32</b>	<b>0.22</b>

**FIGURE 0-2: DEVICE USAGE DURING AVERAGE WEEKDAY PEAK PERIOD BY MONTH – RATE 5**



## 1.13 SKILL LOG SUMMARY

Nexant also analyzed data from the skill log reports that were derived from the ISY portal. Overall, data for summer 2020 was sparse and incomplete for the majority of customers. A total of 177 requests were available for analysis, representing 14 customers. Seventy-nine percent (79%) of device requests were from the four most active users while nine customers interacted with the device less than ten times.

### 1.13.1 SKILL LOG SUMMARY STATISTICS

Intent requests accounted for 72% of all smart device interactions. Intent requests are questions or requests made by customers to the smart speaker. Of these intent requests, the “Get Electricity Cost” accounted for about one-third of all questions. Twenty-eight percent of requests were not able to be collected and appeared as blanks in the data. Table 0-3 details the skill log usage by month and Table 0-4 shows the intent request details by month.

**TABLE 0-3: SKILL LOG SUMMARY STATISTICS**

Use Type	July	August	September	Total
Intent Request	32	72	24	<b>128</b>
Launch Request	12	15	5	<b>32</b>
Link skill Account	1	9	2	<b>12</b>
Enable Skill	1	0	0	<b>1</b>
Change Skill Permission	2	1	1	<b>4</b>
<b>Total</b>	<b>48</b>	<b>97</b>	<b>32</b>	<b>177</b>

TABLE 0-4: DETAILED REQUESTS

Intent	July	August	September	Total	Percent
Get Electricity Cost	9	40	7	56	32%
Other (Blank in Data)	16	25	8	49	28%
Amazon Fallback Intent	2	13	3	18	10%
Device Use Time	8	2	8	18	10%
Lowest Cost Time	0	5	2	7	4%
Amazon Stop Intent	4	3	0	7	4%
Get Notification Settings	5	0	0	5	3%
Amazon Help Intent	0	2	1	3	2%
Amazon Cancel Intent	1	1	1	3	2%
Get Devices	0	1	2	3	2%
Extended Help	0	2	0	2	1%
Disable Notification	2	0	0	2	1%
Get Control Status	0	1	0	1	1%
Get "Good Time For"	0	1	0	1	1%
Health Check	0	1	0	1	1%
Set Comfort Level	1	0	0	1	1%
<b>Total</b>	<b>48</b>	<b>97</b>	<b>32</b>	<b>177</b>	<b>100%</b>

# PROCESS EVALUATION

Following the conclusion of the Smart Speaker Demonstration Project, Nexant conducted a process evaluation to understand the program development, implementation and lessons learned. Findings are derived from interviews with program staff from SCE and implementation staff from UDI to assess the effectiveness of the program's design and delivery.

## 1.14 UTILITY AND IMPLEMENTER INTERVIEWS

Nexant developed interview guides about key topics for program management and implementation staff. Two interviews were conducted, one with SCE program management staff and one with UDI's implementation staff. Topics included:

- Program development and recruitment
- Program implementation
- Program performance
- Barriers and lessons learned

### 1.14.1 PROGRAM DEVELOPMENT AND RECRUITMENT

UDI (the implementer) was selected for the project's solution development. The optimization algorithm was developed prior to the project and only needed to be tailored to incorporate SCE TOU rates. Similarly, the "Energy Expert" smart speaker skill was partially developed for the Retail Automated Transactive Energy System (RATES) project to inform the user about their home energy usage information. The demonstration project was rolled out with these initial features. As the project continued to ramp up, additional enhancements were added to entice greater engagement such as bill comparison information, rate information, and high bill alerts. UDI reported that the development of the smart speaker skill was a smooth process, and that they were able to harness efficiencies from the existing skill framework.

SCE initially targeted 200 single-family residential homes to enroll in the demonstration project. The company targeted existing TOU customers who had a smart meter, A/C units and a Wi-Fi connection. Net metering and EV owners were initially excluded from participating. SCE recruited participants via email invitation, which was chosen due to ease of implementation, low cost, and the desire to target tech-savvy customers. Program recruitment ceased in March 2020 due to the COVID-19 pandemic, resulting in much lower final participation levels than targeted. Therefore, it is difficult to attribute the low population counts to lack of interest or the effects of the pandemic.

### 1.14.2 PROGRAM IMPLEMENTATION

### **Training and Equipment Installation**

A third-party EE contractor installed the equipment in customers' homes prior to the COVID-19 pandemic. The EE contractor was responsible for installing the smart speaker, smart devices and connecting them to the SCE smart meter. All customers received identical equipment, however the equipment quantity differed based on each home's characteristics.

Previously, the EE contractor had experience installing thermostats for SCE. However, they acknowledged the complexity and lack of experience in installing some of the new devices associated with the smart speaker project. UDI was tasked with training third-party installers. The implementer completed several trainings and provided a handout to provide further assistance to installers. UDI reported that the project experienced relatively high levels of incomplete and incorrect equipment installation. They also noted that some participants did not like the setup once installation was completed, and others did not like having installers coming into their homes and changing existing setups.

The Ecobee thermostat and SCE smart meter were cited as the two most challenging devices to integrate during the installation process. Existing thermostats in participant homes often contained different types of equipment, such as different wiring that was not compatible with Ecobee. There were also challenges linking the SCE smart meter to UDI's ISY gateway; occasionally, the smart meter identification numbers didn't sync to UDI's system. The implementer reported that some installers did not complete the install due to this difficulty. Also, sometimes successful initial synchronizations experienced internet connection issues and lapses in communications. These issues were generally easily resolved over the phone. Lastly, the implementer reported difficulties in compiling all the smart devices into the centralized UDI app. Overall, the equipment installation for this project was more cumbersome than what an average customer would be expected to be able to do on their own without a professional installer due to the quantity and complexity of the components.

#### **1.14.3 SMART SPEAKER SKILL**

Following the equipment installation, the UDI monitored a customer's baseline energy usage for a period of time. After the baseline was established, the implementer began informing the participant of the "Energy Expert" smart speaker skill. The skill had previously been developed and refined with the initial program manager. However, the demonstration project experienced staff turnover at SCE, resulting in a new program management and direction. Consequently, the project paused in July 2020 to develop new smart speaker skill capabilities. One challenge encountered during the development of the skill was enhancing it to be more customer-friendly, as some of the intended functionality was not available at the beginning of the rollout. By the time the additional functionality was added, most participants had been enrolled in the project for a number of months and may have lost some interest in the novelty of the equipment. Ideally, the additional capabilities would have been developed and tested prior to the inception of the project. UDI performed outreach and education after the launch of the additional functionality, which may have revitalized customer engagement and driven a stronger response to the project.



# FINDINGS AND RECOMMENDATIONS

The first summer of SCE's Smart Speaker Demonstration Project provided a useful program design template to continue building from. While the impacts of the COVID pandemic stymied program participation, the demonstration project did show promising signs and offers another way to engage SCE customers in a useful dialogue and educate them about their own energy usage.

## 1.15 LOAD IMPACT FINDINGS AND RECOMMENDATIONS

Key findings and recommendations pertaining to load impacts from the Smart Speaker Demonstration Project include the following:

- The evaluation was limited by low counts of active participants. Additional recruitment of participants and promotion of skills and features would result in a more robust evaluation.
- Load impacts are evident for certain subsets of treatment customers and time periods, but the mechanism(s) leading to the effects cannot be definitively attributed without a larger participant population.
- A large portion of the initial set of participants were inactive by the time of evaluation.
- Skill log and device level data was sparsely populated. More stringent QC of data collection will allow for a more comprehensive analysis and more refined attribution of observed effects.
- The specific devices with the most use include smart appliances, refrigerators, thermostats, and interior lighting. Additional education and focus on these end uses could provide the most value to future iterations of this program.

## 1.16 PROCESS EVALUATION FINDINGS AND RECOMMENDATIONS

Key process evaluation findings and recommendations stemming from discussions with program and implementation staff include:

- Existing frameworks of the optimization algorithm and initial Alexa skills benefitted the rollout of the project, but additional skills were developed later, increasing the time between installation and treatment. Since these are now developed and tested, any future iterations of the program will benefit from the foundation.
- Because the project design required a third-party to install the equipment during the COVID-19 pandemic, this resulted in small participation. The implementer cited customer reluctance to allow people into their homes.
- Installers could have benefitted from further training and support due to the complexity of connecting multiple devices with the meters and gateways. The

implementer received frequent requests for additional support from the installers, particularly when the SCE program manager was not present on-site to oversee the installation.

- Home equipment was occasionally installed incorrectly and did not communicate with SCE's smart meter. The program implementer reported problems with incorrectly installed thermostats and connectivity with the SCE smart meter. Additional validation that the equipment was accurately installed and is communicating with other equipment may be beneficial. Also, presetting home equipment to the largest extent possible and considering a cloud-based approach instead of hardwires could also prove effective.
- Customer outreach seemed to be beneficial in improving engagement with the devices, particularly after the launch of the additional smart speaker skill capabilities. Providing regular outreach and education on program updates would likely increase program impacts.
- Given that the typical customer profile for the demonstration project is engaged with home automation topics and technologies, they could potentially be instructed on installation of equipment as well, though perhaps with a smaller subset of the components involved in this project.



# APPENDIX B CUSTOMER ENGAGEMENT

Customer Engagement Email

## Smart Speaker Pilot

Alexa, Open Energy Expert



Welcome to Energy Expert!

**Hi John Doe!**

My name is Jane & I'm the project manager for SCE's Smart Speaker Pilot! I'm sending quick email tip on how to use Alexa to save energy. Have you ever wondered the best time (lowest cost) to use your washing machine, dish washer or other kitchen appliances? Wonder no more. Simply ask Alexa!

1. "Alexa, open Energy Expert"
2. "Alexa, when is the best time to use my washing machine?"

Alexa will suggest the best times to use your kitchen appliances based on your energy rate; helping you to use energy at the lowest prices! This is one of the many ways that Alexa can help you better manage your energy usage!

If you have not yet used Energy Expert, please follow [these very easy instructions](#). And, if you don't feel like it, just contact us and we'd be delighted to make the introductions!

This newsletter is the first in a series to provide you with tips, tricks, and information for using Energy Expert to its fullest potential. So, let's get going ...

Thanks!

The Smart Speaker Pilot Team

Southern California Edison  
Phone: XXX.XXX.XXXX

# APPENDIX C ENERGY EXPERT INSTRUCTIONS

## Energy Expert Instructions



Alexa, open Energy Expert

Welcome to Energy Expert!

### Table of Contents

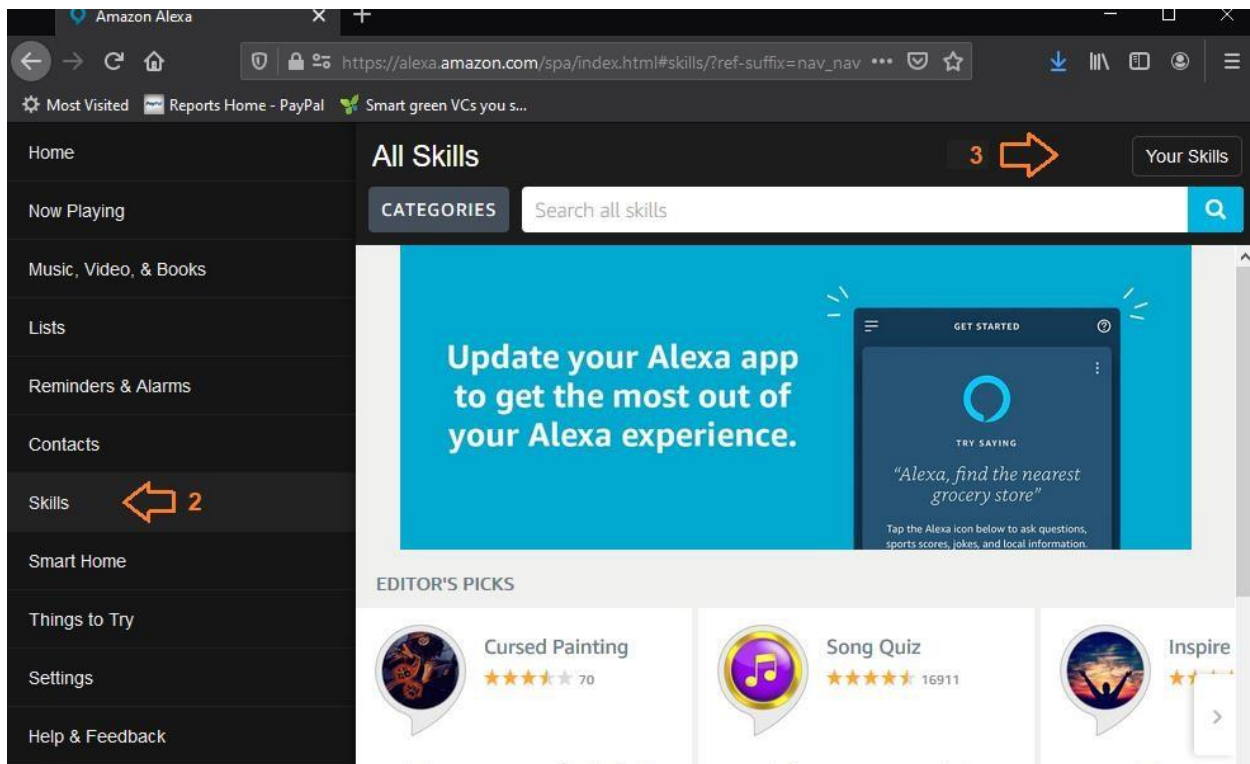
<b>GETTING STARTED</b>	<b>58</b>
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## GETTING STARTED

- Please make sure you have the credentials for your [Alexa account](#)
- Please make sure you have the credentials for your [ISY Portal](#) account
- If at any point in the process you run into any problems, please do not hesitate to [contact us](#)

## GETTING STARTED USING A BROWSER

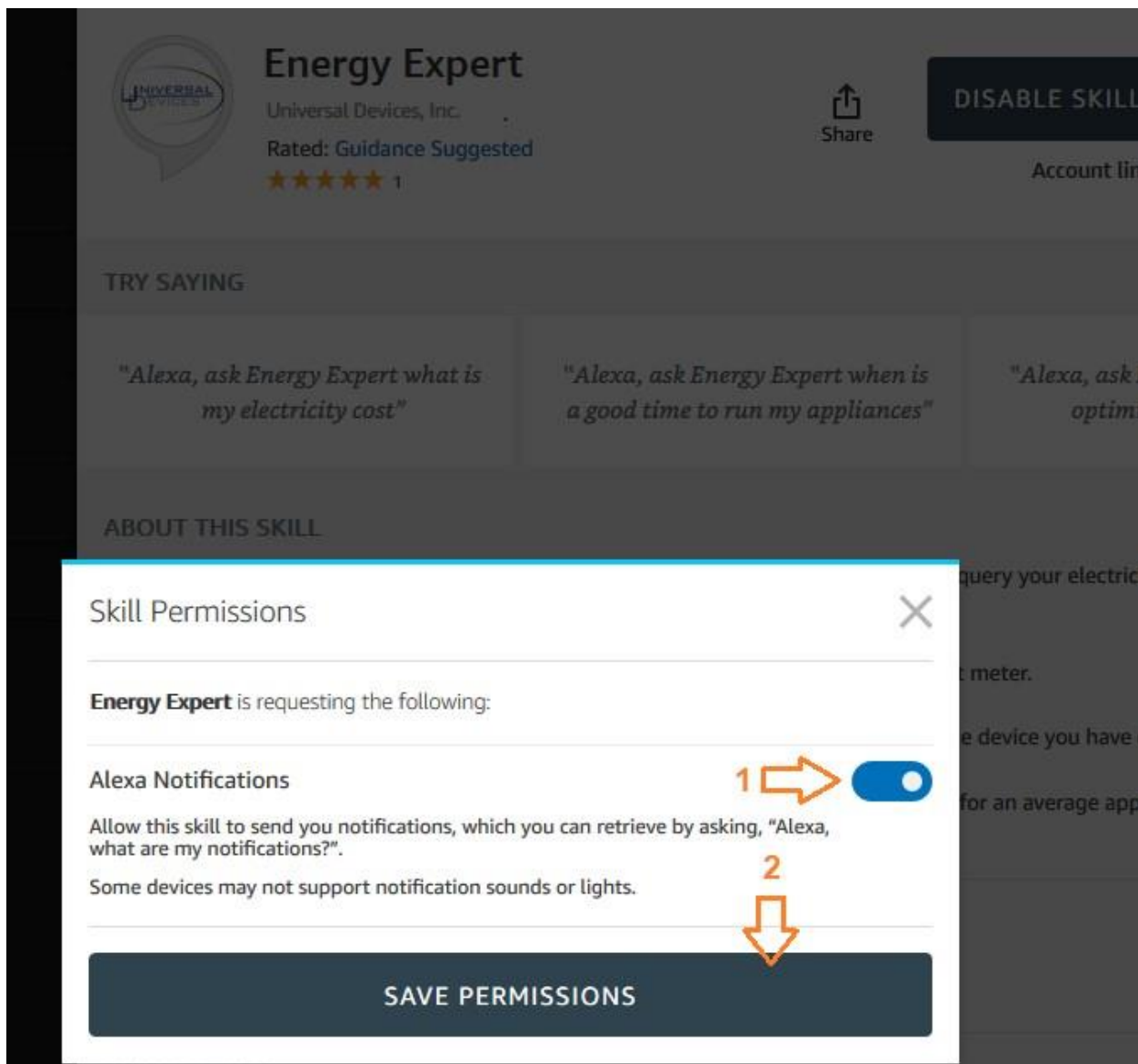
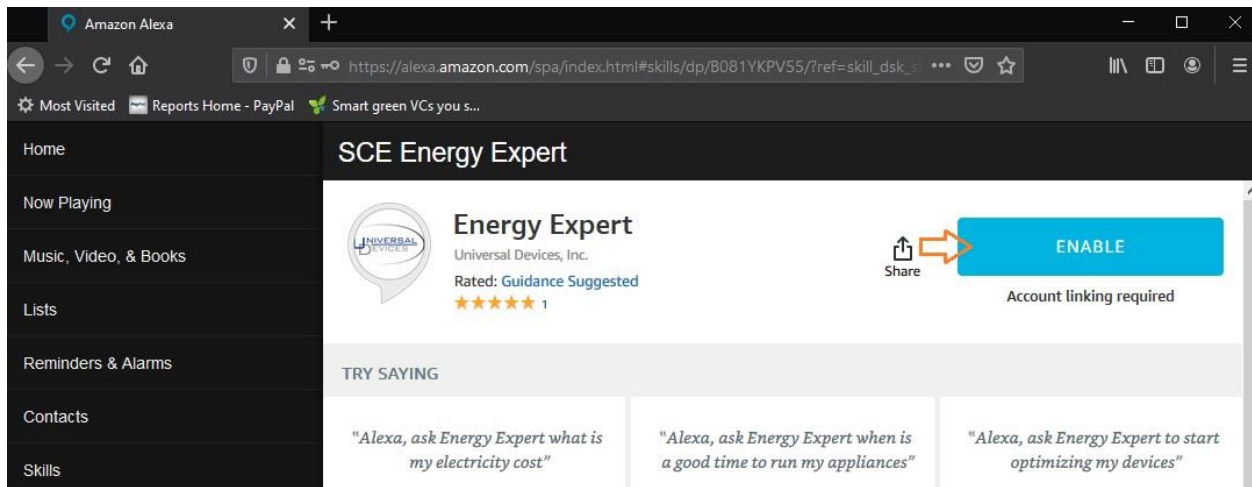
1. Login to your [Alexa account](#)
2. Click on the **Skills** link at the left
3. Click **Your Skills** button at the top right



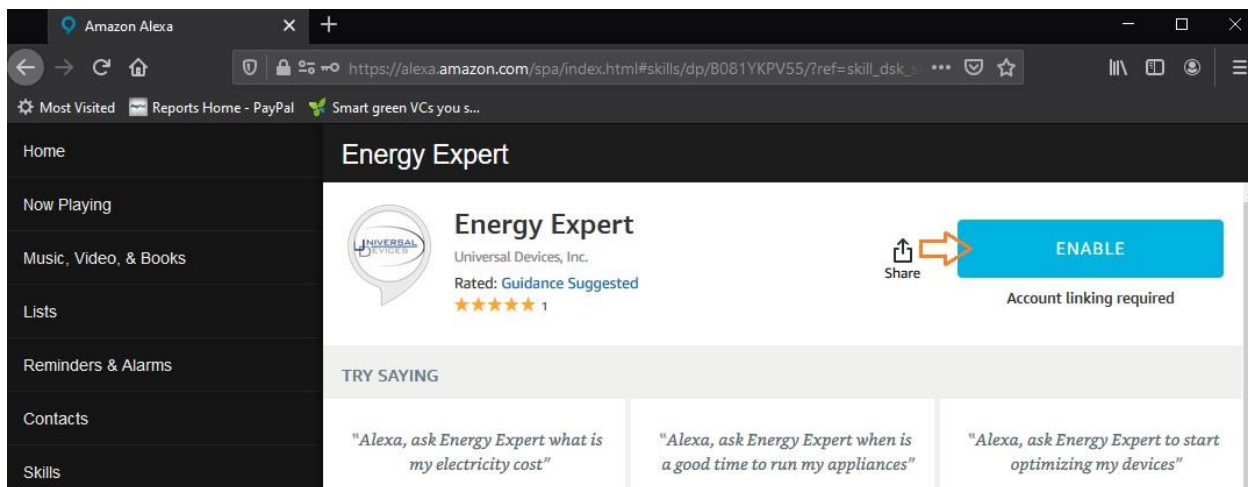
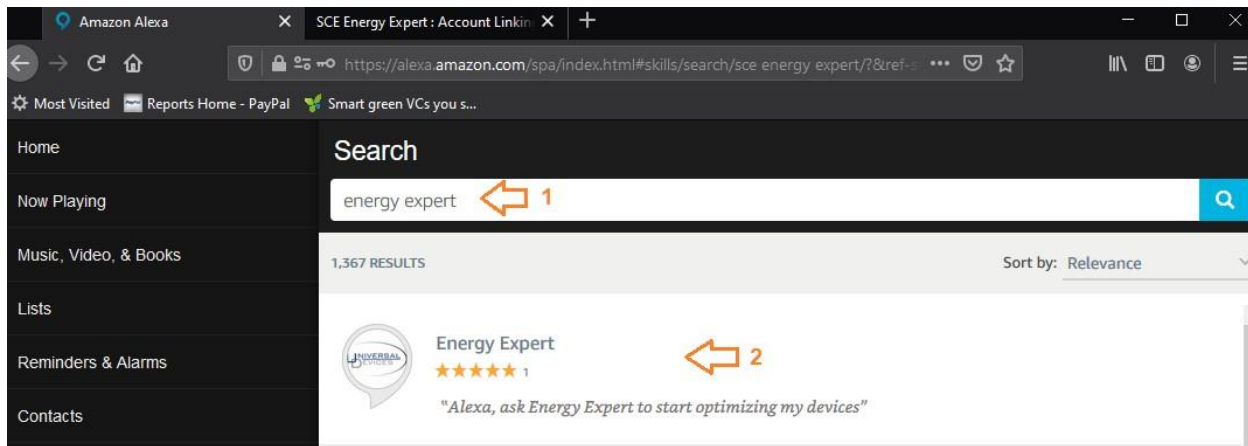
4. If you already see either **SCE Energy Expert** or **Energy Expert** skill, please click on it
  - a) Click on the **DISABLE SKILL** button on the next screen
  - b) Once disabled, click on the **ENABLE** button on the same screen
  - c) If you are not logged in to your Alexa account, you will be asked to login
  - d) In the next screen, please do make sure you turn on Alexa Notifications (blue button) and **Save Permissions**
  - e) You will be asked to login to your ISY Portal account to link your Alexa account

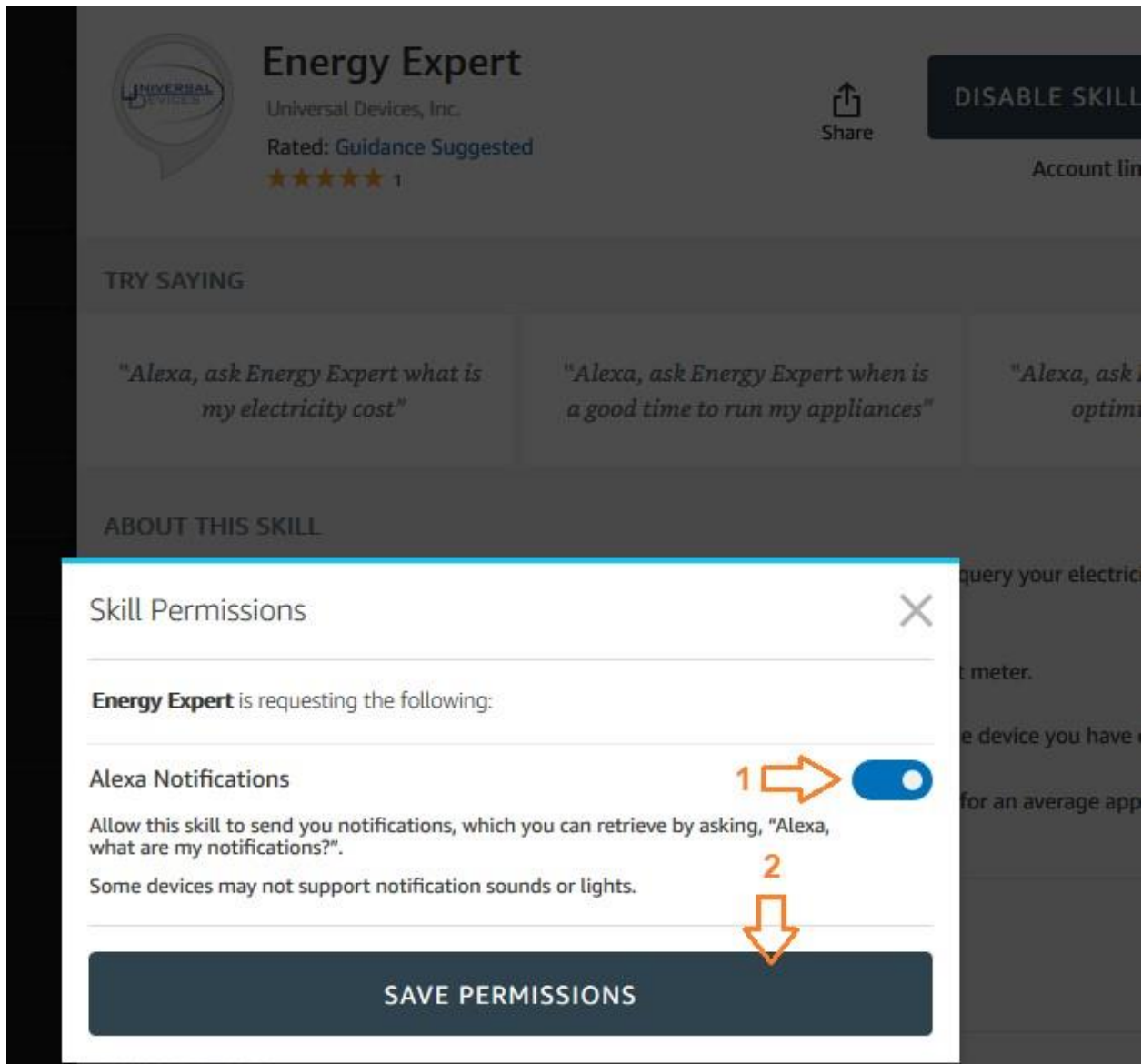
The screenshot shows the Alexa Skills page. The left sidebar contains navigation options: Home, Now Playing, Music, Video, & Books, Lists, Reminders & Alarms, Contacts, Skills, Smart Home, Things to Try, Settings, and Help & Feedback. The main content area is titled 'Your Skills' and includes a search bar 'Find in your skills'. Below the search bar, there are three statistics: 4 ENABLED SKILLS, 0 JUST UPDATED, and 0 FIND MORE SKILLS. The 'RECENTLY ADDED' tab is selected, showing two skills: 'Energy Expert' with a sample phrase 'Alexa, ask Energy Expert what is my electricity cost?' and 'ISY Optimized for Smart Home V3' with a sample phrase 'Alexa, turn on the kitchen lights?'. An orange arrow points to the 'Energy Expert' skill.

The screenshot shows the details for the 'SCE Energy Expert' skill. The page title is 'SCE Energy Expert'. The skill is provided by 'Universal Devices, Inc.' and is 'Rated: Guidance Suggested' with a 1-star rating. There is a 'Share' icon and a 'DISABLE SKILL' button with a 'SETTINGS' button next to it. A warning message states: 'Disabling this skill will unlink your account'. Below this, there is a 'TRY SAYING' section with three sample phrases: 'Alexa, ask Energy Expert what is my electricity cost?', 'Alexa, ask Energy Expert when is a good time to run my appliances?', and 'Alexa, ask Energy Expert to start optimizing my devices?'. An orange arrow points to the 'DISABLE SKILL' button.



5. If you don't see **Energy Expert** or **SCE Energy Expert**
  - a. Search for it
  - b. Click on **Energy Expert**
  - c. Click on the **ENABLE** button
  - d. If you are not logged in to your Alexa account, you will be asked to login
  - e. In the next screen, please do make sure you turn on Alexa Notifications (blue button) and **Save Permissions**
  - f. You will be asked to login to your ISY Portal account to link your Alexa account



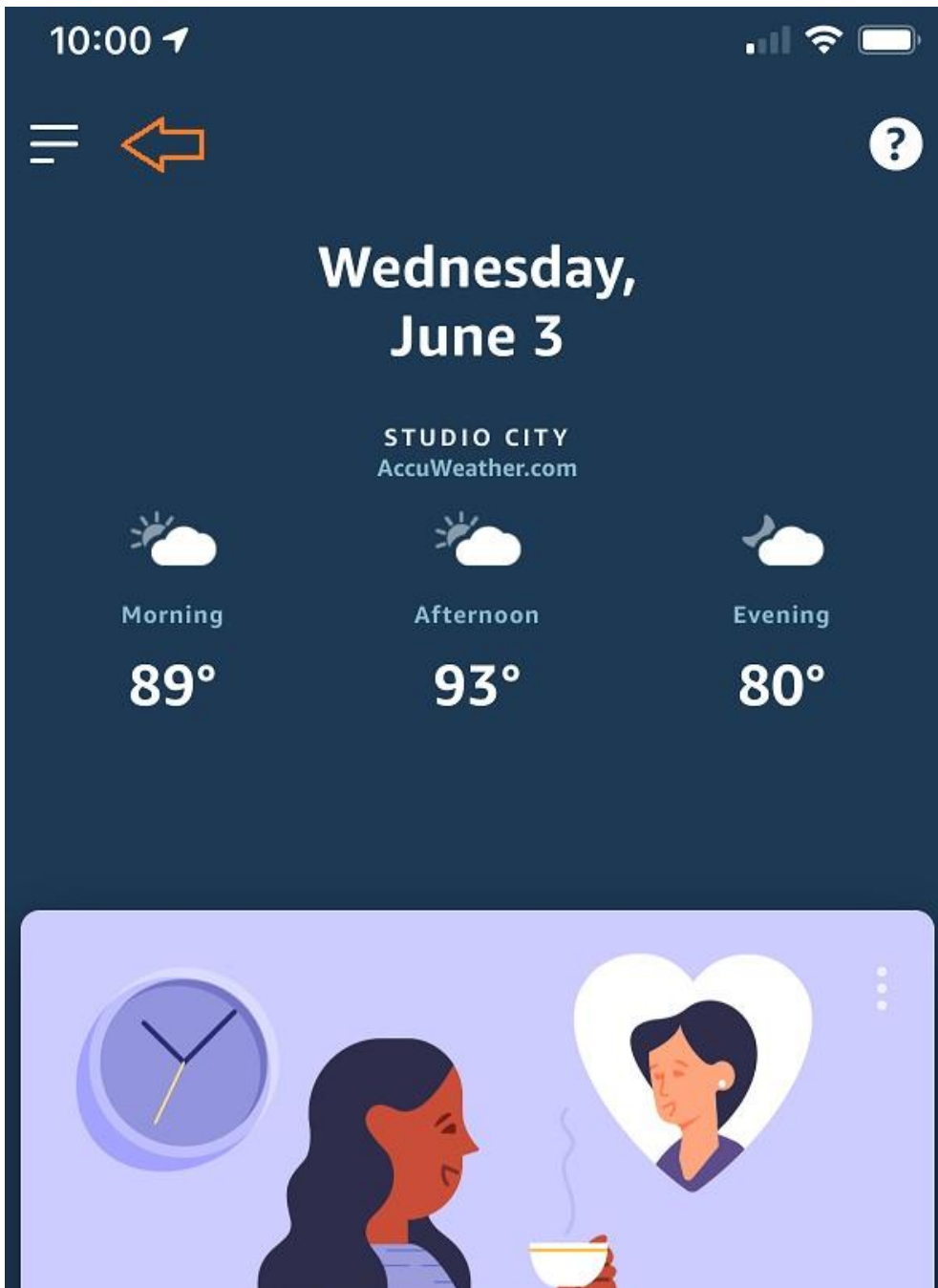


Once linked, say:

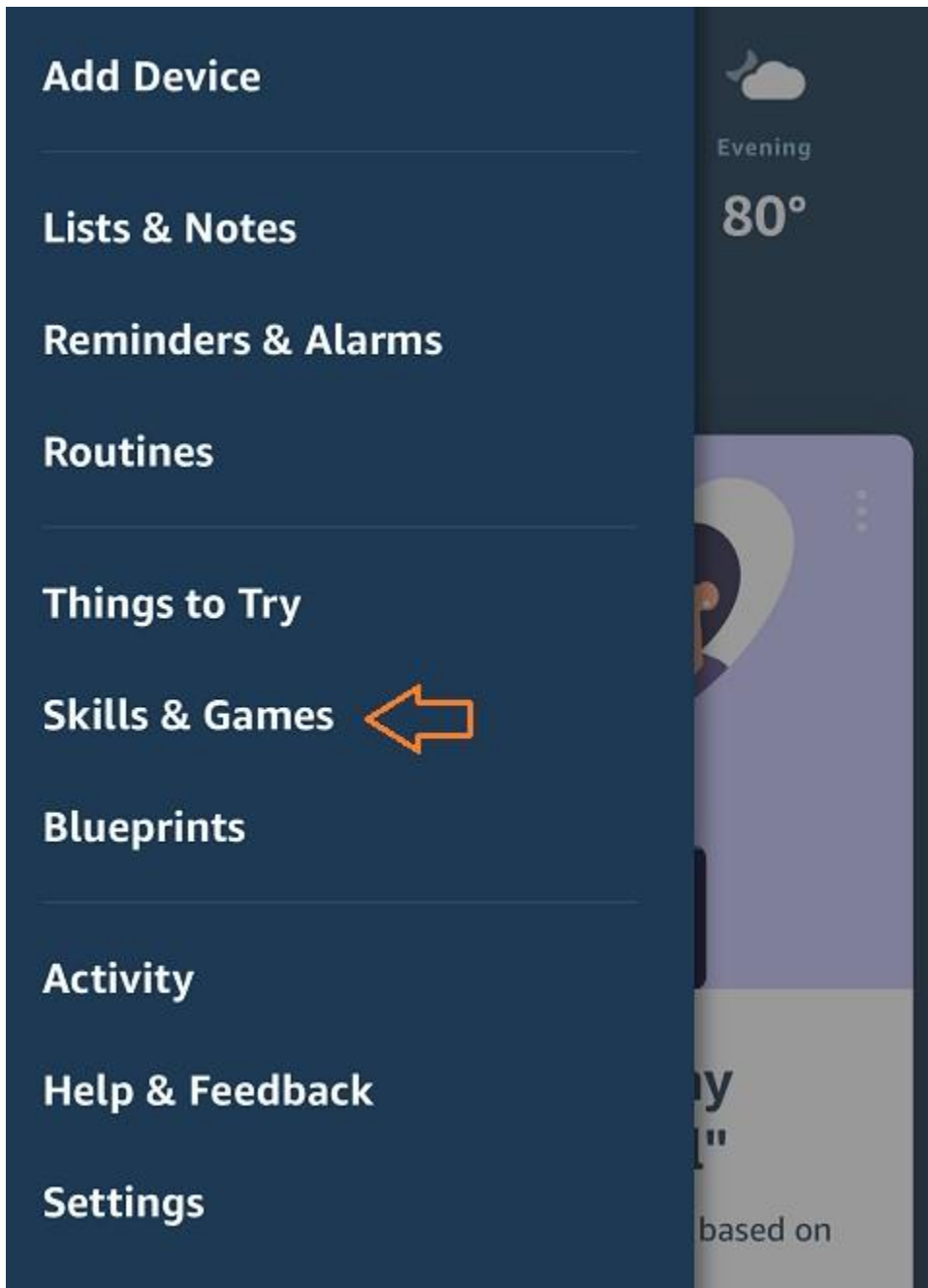
- Alexa, open Energy Expert
- Help

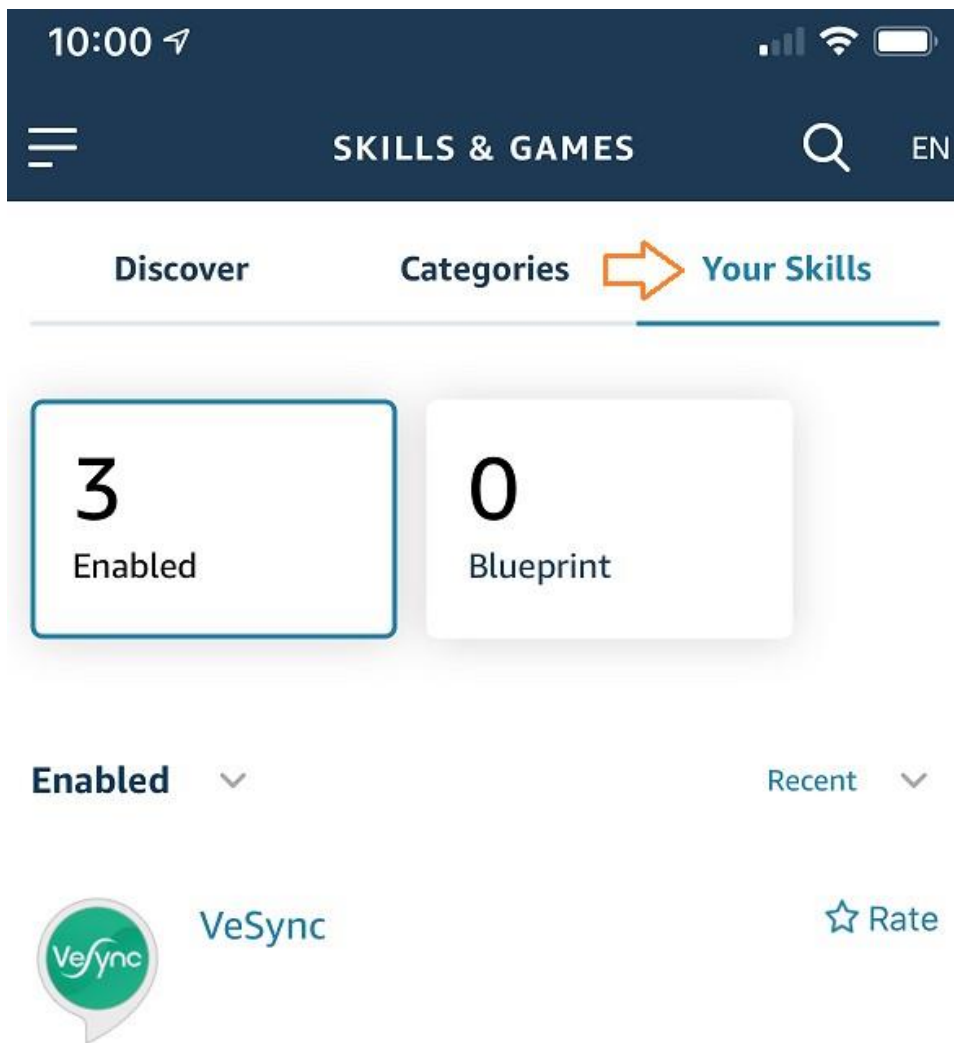
## GETTING STARTED USING ALEXA IPHONE APP

1. Please make sure you can access your Alexa account using the [Alexa IOS App](#)
1. Click on the **Menu** at the top left
2. Click on **Skills & Games** menu item
3. Click on **Your Skills** at the top right





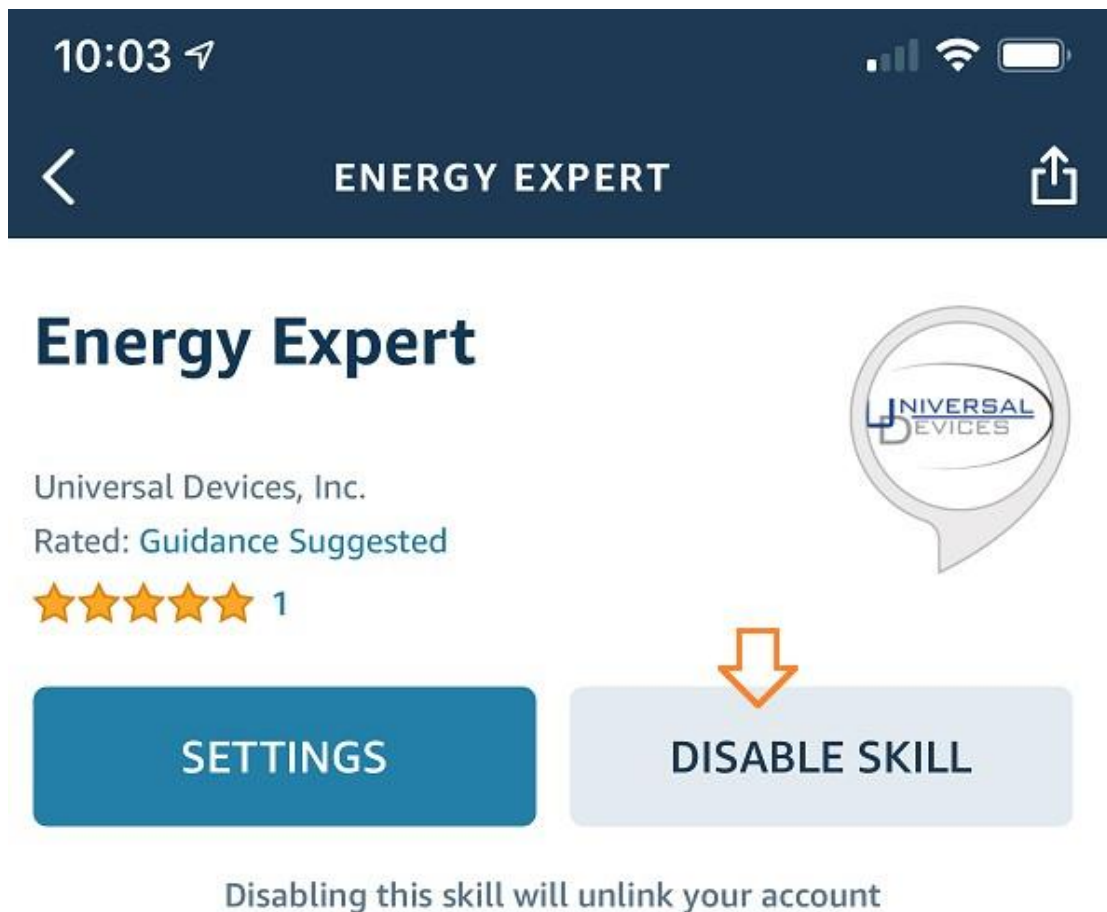




***“Alexa, turn on the kitchen lights.”***

Alexa, meet VeSync and your new outlet.

4. If you already see **Energy Expert** or **SCE Energy Expert** skill, please
  - a. Click on it
  - b. Click on the **DISABLE SKILL** button on the next screen
  - c. Once disabled, click on the **ENABLE TO USE** button on the same screen
  - d. If you are not logged in to your Alexa account, you will be asked to login
  - e. In the next screen, please do make sure you turn on Alexa Notifications (blue button) and **Save Permissions**
  - f. You will be asked to login to your ISY Portal account to link your Alexa account



The screenshot shows the top of a mobile app interface. At the top, there is a dark blue header bar with the time '10:03' on the left, and signal, Wi-Fi, and battery icons on the right. Below the header, a white navigation bar contains a back arrow on the left, the text 'ENERGY EXPERT' in the center, and a share icon on the right. The main content area has a white background. On the left, the text 'Energy Expert' is displayed in a large, bold, dark blue font. Below it, 'Universal Devices, Inc.' is written in a smaller font, followed by 'Rated: Guidance Suggested' and a row of five yellow stars with a '1' next to them. To the right of this text is a circular logo for 'UNIVERSAL DEVICES' with a speech bubble shape around it. Below the logo and text are two buttons: a blue button labeled 'SETTINGS' and a light blue button labeled 'DISABLE SKILL'. An orange arrow points down to the 'DISABLE SKILL' button. Below the buttons, the text 'Disabling this skill will unlink your account' is centered.

10:03 ↗

ENERGY EXPERT

## Energy Expert

Universal Devices, Inc.  
Rated: Guidance Suggested  
★★★★★ 1

UNIVERSAL DEVICES

SETTINGS

DISABLE SKILL

Disabling this skill will unlink your account

### Start By Saying

*“Alexa, ask Energy Expert what is my electricity cost”*

*“Alexa, ask Energy Expert when is a good time to run my appliances”*



# Energy Expert



Universal Devices, Inc.

Rated: Guidance Suggested

★★★★★ 1



Account linking required

This skills is the voice interface to the SCE Pilot App. Once the system is set up, you can query your electricity costs, asks when is a good time to run your appliances, and other useful energy related requests.

When you ask for your total electricity use, the energy u...

[See More](#)



## Account Permissions

SCE Energy Expert is requesting the following permissions. If you grant these permissions, this skill can use this information for all users of your devices.



## Alexa Notifications



Allow this skill to send you notifications, which you can retrieve by asking, "Alexa, what are my notifications?".

Some devices may not support notification sounds or lights.



SAVE PERMISSIONS

5. If you don't see **Energy Expert** or **SCE Energy Expert**
  - a. Search for it
  - b. Click on **Energy Expert**
  - c. Click on the **ENABLE TO USE** button
  - d. If you are not logged in to your Alexa account, you will be asked to login
  - e. In the next screen, please do make sure you turn on Alexa Notifications (blue button) and **Save Permissions**
  - f. You will be asked to login to your ISY Portal account to link your Alexa account



# Search

Keyword or skill name

Energy Expert 

3 Results

Sort: Relevance 

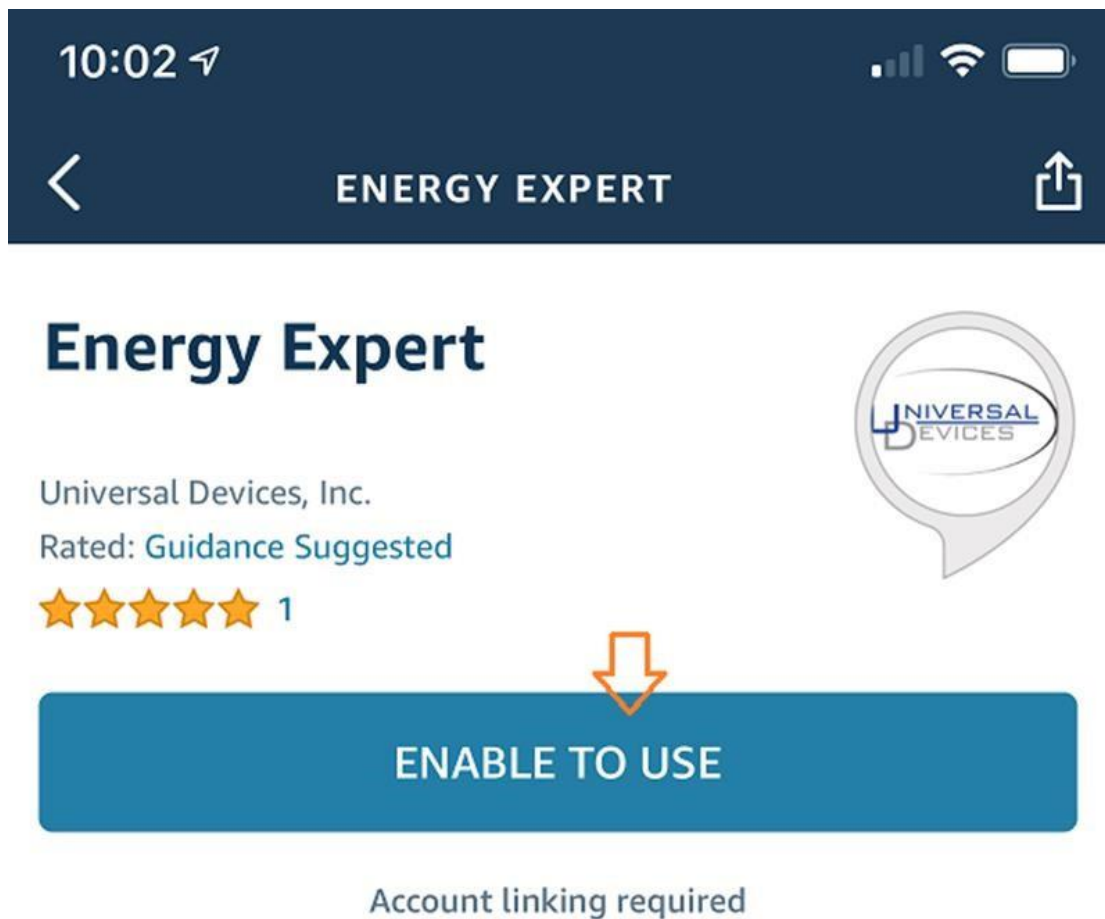


Energy Expert

*"Alexa, ask Energy Expert to start optimizing my devices"* 

Smart Home

★★★★★ 1



10:02 ↗

← ENERGY EXPERT ↗

## Energy Expert

Universal Devices, Inc.  
Rated: **Guidance Suggested**

★★★★★ 1

**ENABLE TO USE**

Account linking required

This skills is the voice interface to the SCE Pilot App. Once the system is set up, you can query your electricity costs, asks when is a good time to run your appliances, and other useful energy related requests.

When you ask for your total electricity use, the energy u...

[See More](#)





## Account Permissions

SCE Energy Expert is requesting the following permissions. If you grant these permissions, this skill can use this information for all users of your devices.



## Alexa Notifications



Allow this skill to send you notifications, which you can retrieve by asking, "Alexa, what are my notifications?"

Some devices may not support notification sounds or lights.



SAVE PERMISSIONS

Once linked, say:

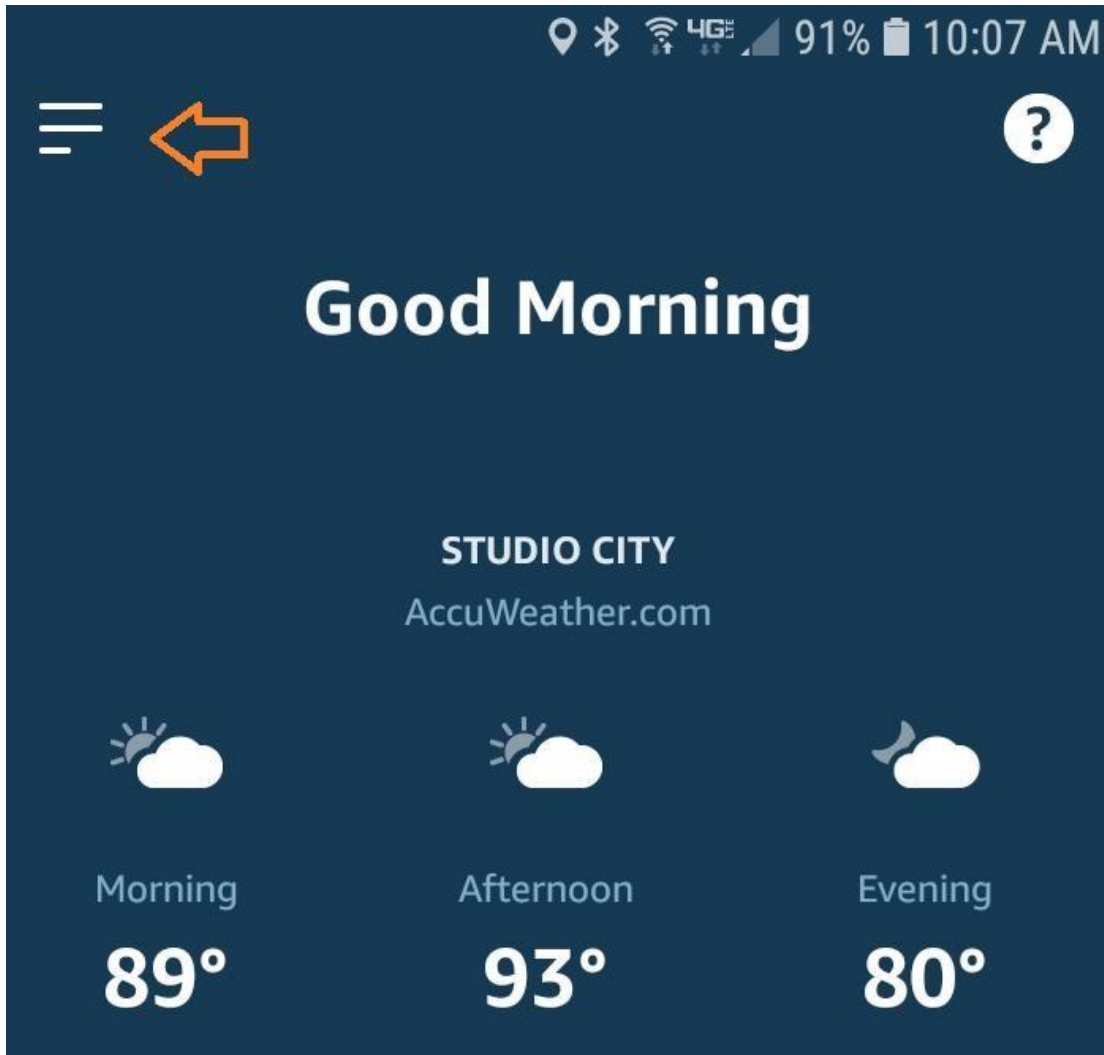
- Alexa, open Energy Expert
- Help

## GETTING STARTED USING ALEXA ANDROID APP

6. Please make sure you can access your Alexa account using the [Alexa Android App](#)
7. Click on the **Menu** at the top left
8. Click on **Skills & Games** menu item



9. Click on **Your Skills** at the top right



**Add Device**

---

**Lists & Notes**

**Reminders & Alarms**

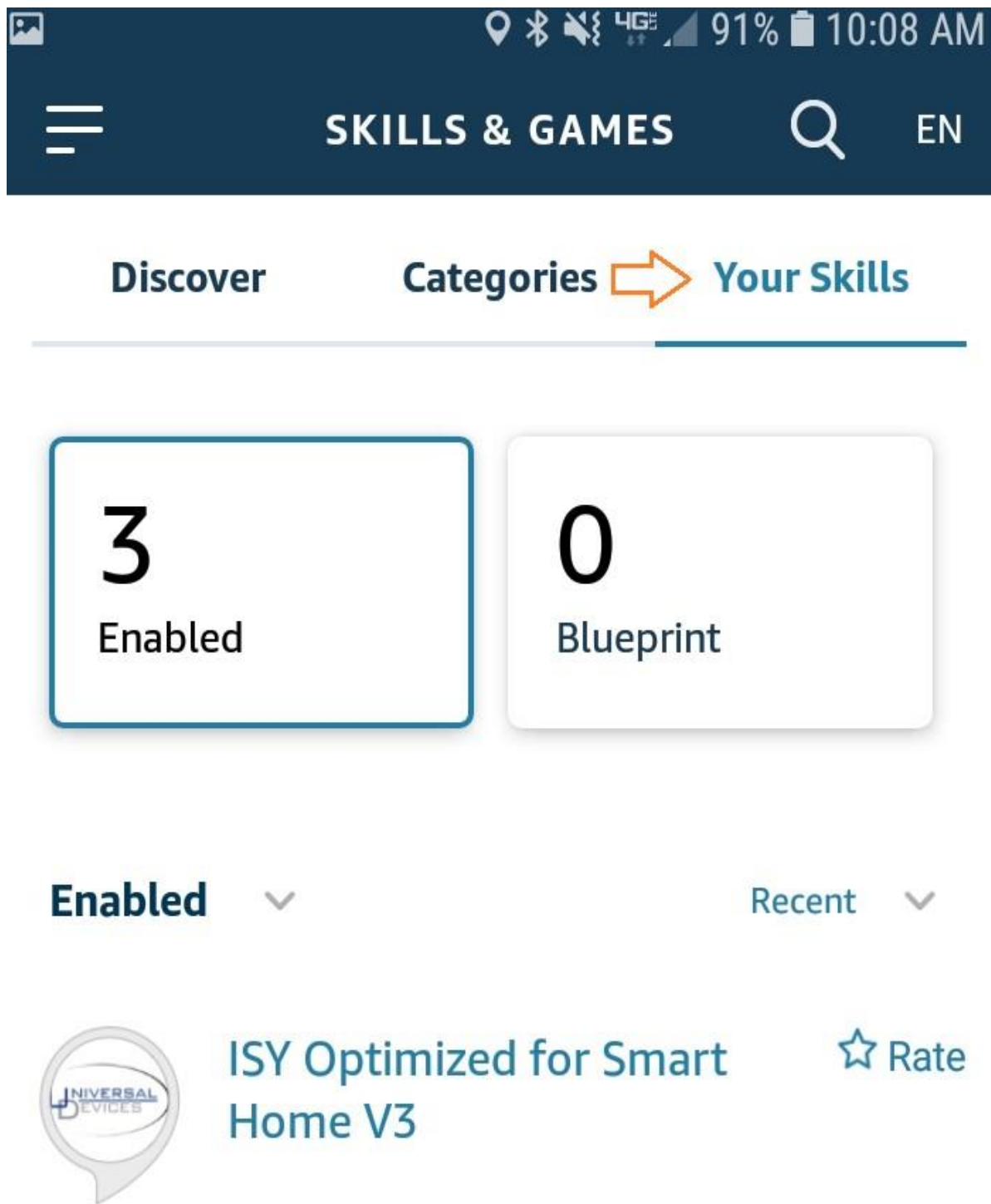
**Routines**

---

**Things to Try**

**Skills & Games** 

**Blueprints**



10. If you already see **Energy Expert** or **SCE Energy Expert** skill, please
- Click on it
  - Click on the **DISABLE SKILL** button on the next screen
  - Once disabled, click on the **ENABLE TO USE** button on the same screen
  - If you are not logged in to your Alexa account, you will be asked to login

- e. In the next screen, please do make sure you turn on Alexa Notifications (blue button) and **Save Permissions**
- f. You will be asked to login to your ISY Portal account to link your Alexa account



# Energy Expert

Universal Devices, Inc.

Rated: Guidance Suggested



Disabling this skill will unlink your account



# Energy Expert



Universal Devices, Inc.

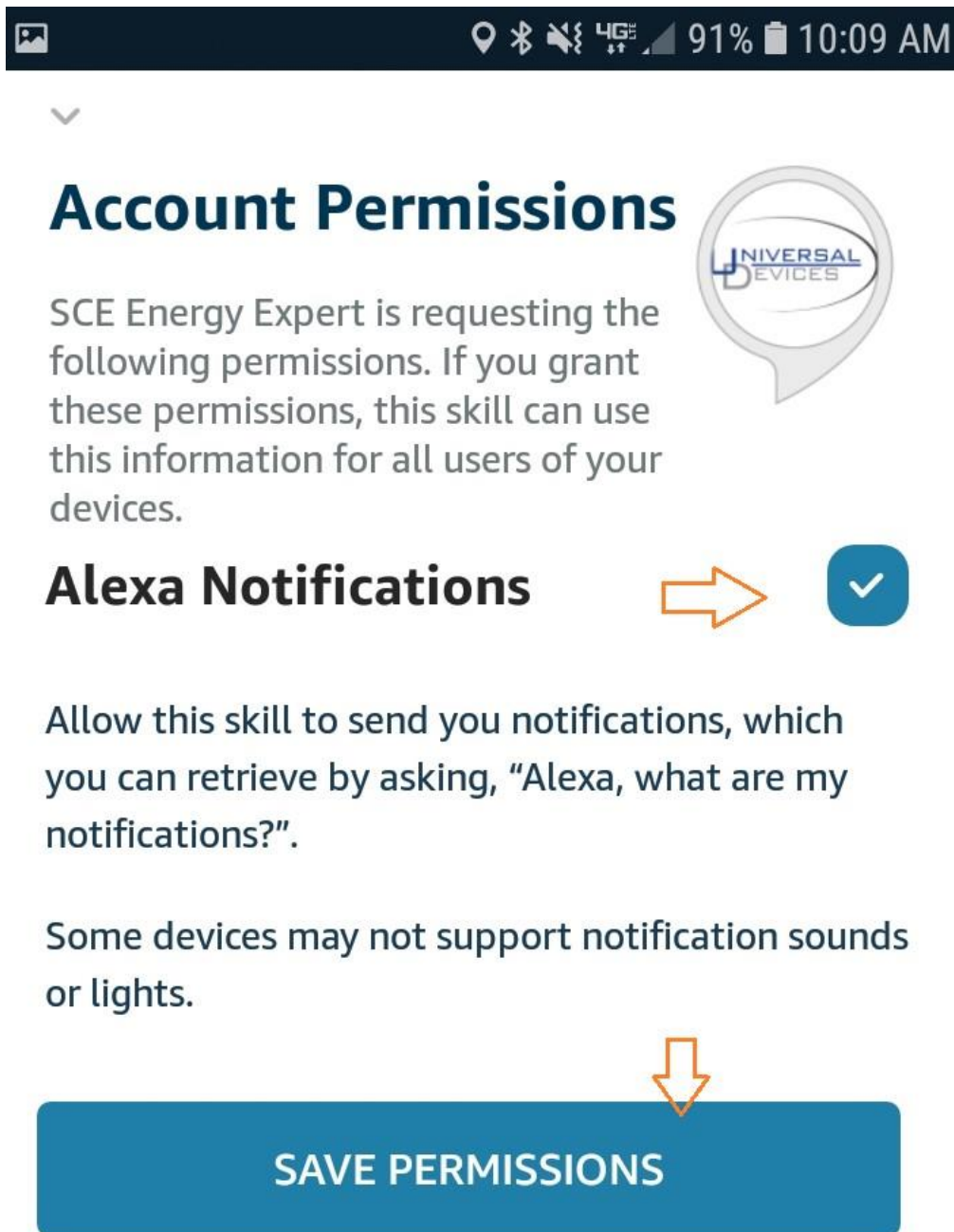
Rated: Guidance Suggested



Account linking required

---

This skills is the voice interface to the SCE Pilot



The screenshot shows a mobile interface for granting permissions to a skill named 'SCE Energy Expert'. At the top is a status bar with icons for location, Bluetooth, airplane mode, 4G LTE signal, 91% battery, and the time 10:09 AM. Below the status bar is a dropdown arrow. The main heading is 'Account Permissions' in large blue font, with a 'UNIVERSAL DEVICES' logo to its right. A paragraph explains that the skill is requesting permissions for all users of the device. Below this is the 'Alexa Notifications' section, which includes an orange arrow pointing right and a blue checkmark icon. The text asks for permission to send notifications and provides an example query. A second orange arrow points down to a large blue button labeled 'SAVE PERMISSIONS'.

Account Permissions

SCE Energy Expert is requesting the following permissions. If you grant these permissions, this skill can use this information for all users of your devices.

Alexa Notifications

Allow this skill to send you notifications, which you can retrieve by asking, "Alexa, what are my notifications?".

Some devices may not support notification sounds or lights.

SAVE PERMISSIONS

11. If you don't see **Energy Expert** or **SCE Energy Expert**

- a. Search for it
- b. Click on **Energy Expert**
- c. Click on the **ENABLE TO USE** button
- d. If you are not logged in to your Alexa account, you will be asked to login
- e. In the next screen, please do make sure you turn on Alexa Notifications (blue button) and **Save Permissions**
- f. You will be asked to login to your ISY Portal account to link your Alexa account



# Search

Energy Expert 



3 Results

Sort: Relevance 



Energy Expert

***"Alexa, ask Energy Expert to start optimizing my devices"*** 

Smart Home

★★★★★ 1





# Energy Expert

Universal Devices, Inc.

Rated: Guidance Suggested



Account linking required

---

This skills is the voice interface to the SCE Pilot



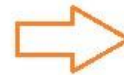


## Account Permissions

SCE Energy Expert is requesting the following permissions. If you grant these permissions, this skill can use this information for all users of your devices.



## Alexa Notifications



Allow this skill to send you notifications, which you can retrieve by asking, "Alexa, what are my notifications?"

Some devices may not support notification sounds or lights.



**SAVE PERMISSIONS**

Once linked, say:

- Alexa, open Energy Expert
- Help

# HELP | SUPPORT | FEEDBACK

[Universal Devices Support Team](#)

# APPENDIX D CUSTOMER SURVEY

Customer Survey

## Smart Speaker Pilot Survey – May 2020

### Topline Report

#### Background

The Smart Speaker Pilot survey was developed to assess the value of the smart speaker for SCE's customers. With this pilot, customers received Alexa-enabled smart speakers to assist with managing their energy over a period of 12 months (April 2020 through March 2021). Energy management techniques included using Alexa to set their thermostats.

The insights from the survey will help SCE evaluate customer experiences with the smart speaker and identify opportunities for improving these experiences as well as speaker's capabilities.

#### Methodology

The study was conducted every quarter starting in Q2 2020 and post-pilot through an online survey using the Verint platform. The first survey wave was conducted in May 2020.

#### Survey Statistics

	Wave 1 (Q2 2020)
Fielding Period	4/30/20 – 5/15/20
Invitations Sent	102
Completed Surveys	64
Completion Rate	63%

#### Conclusions and Recommendations

Overall, pilot participants were satisfied with their Alexa smart speaker experience, because the device was easy to use, worked accurately, provided convenience and comfort, and helped many users reduce their energy usage. Another indicator of their positive experience was that they said they were likely to continue using it after the pilot.

However, there is significant room for improvement. The most common barriers are users' lack of or low familiarity with the device (especially for energy-related purposes) and its intermittent failure to accurately execute commands. Particularly, due to their limited knowledge about the speaker, respondents considered it less efficient when it came to helping them better manage their usage and save money on their bills.

Therefore, it is recommended that SCE focus improvement efforts on better educating participants about the speaker's energy-related functions and how to use them, as well as enhancing the device's capabilities to execute commands.

Some potential solutions include, but are not limited to:

- Providing participants a printed guide with the most common energy-related speaker uses and commands.

- Providing participants an educational video on how to use the device to better manage their usage and realize more savings.
- Offer an app that can recommend products or services to further increase savings by analyzing customer data.
- Include an option to measure changes in usage and savings during winter and spring seasons in Southern California.

Overall, the Smart Speaker Pilot appears to be a successful program, with the potential to help customers gain the most from the smart speaker by better managing their usage and maximizing their energy savings.

### **Key Insights**

- *Overall experience* with the smart speaker is satisfying at 69% but there's a significant room for improvement.
- In general, *familiarity* with the speaker is low – only about a quarter of respondents (23%) were *very- or extremely familiar* with the device before they participated in the pilot.
- Only about a half (51%) *owned a smart speaker before* participating in the pilot.
- The most common general use of the device is to *listen to streaming music* (83%).
- Overall, the energy-related aspects of the speaker are rated highly – *Ease of use* (mean: 3.9) and *Accuracy of commands completion* (mean: 3.8).
- The most satisfying features of the device (based on 5-pt. agree/disagree scale) are:
  - Provides convenience (4.3)
  - Makes home more comfortable (4.0)
  - Helps save time (4.0)
- The speaker is considered less efficient when it comes to *helping participants better manage their usage* (3.6) and *helping them save money on their bill* (3.5).
- The most common energy-related use of the device is for *lights* (84%) and *thermostats* (72%). Particularly, the speaker is used mostly to *turn lights on or off* and *set thermostat levels* (71% and 61% respondents use these features often or always).
- 41% of participants reported that their usage decreased as a result of using the speaker.
- Nearly 40% contacted SCE via *live rep* or *sce.com*. The most common reasons for contacting SCE are to *get more information about the smart speaker study* (40%) and/or *bill* (40%).
- The vast majority (89%) did not have any issues with the device.
- Most participants (80%) are likely (very- or extremely) to continue using the speaker after the pilot.

## **Participants' Demographic Profile**

- Nearly all participants (91%) live in a single-family home and most (88%) own it.
- Respondents are primarily Caucasian (39%).
- The majority (74%) are well educated with *at least a college* degree.
- Nearly all (91%) are *at least 35 years old*.
- Almost half (45%) have a high annual income of *at least \$100,000*.
- Participants are relatively equally distributed in terms of *gender* (52% male vs. 42% female).

## **Verbatim Analysis**

Common themes from the open-ended comments:

### **Reasons for High Satisfaction (4 & 5 ratings) with Smart Speaker Experience**

- Fast and easy speaker setup.
- Speaker works smoothly.
- Speaker provides convenience by enabling participants to control lights and room temperature as well as understand energy usage.

### **Reasons for Low Satisfaction (1 thru 3 ratings) with Smart Speaker Experience**

- Speaker is not used much for energy-related purposes; participants mainly use it to turn lights on or off.
- Speaker does not recognize devices or voice command or does not give clear answers.





### **Suggestions to Improve Smart Speaker Experience**

- Provide a printed guide for beginners with some common commands and speaker uses.
- Provide a video that explains how the speaker can help customers save energy and costs.
- Offer an app that can recommend products or services to further increase savings by analyzing customer data.
- Include an option to measure change in usage/savings during winter/spring seasons in Southern California.
- Follow up once a month with participating customers to check on their experience with the speaker.
- Provide explanation on how the installed devices work together to show the purpose and value of the study.
- Prior to the study, ask participants to identify the appliances/devices they use most or very often.

## Detailed Findings



**Speaker Familiarity.** How familiar were you with smart speakers before you participated in SCE's Smart Speaker Demonstration study?

(respondents could only choose a **single** response)

Response	20%	40%	60%	80%	100%	Frequency	Count
<b>Not at all familiar</b>						<b>39.4%</b>	<b>28</b>
Somewhat familiar						38.0%	27
Very familiar						14.1%	10
Extremely familiar						8.5%	6
<b>Valid Responses</b>							<b>71</b>









**Owned Smart Speaker before Pilot.** Did you own a smart speaker before you participated in the Smart Speaker Demonstration study?

(respondents could only choose a **single** response)

Response	20%	40%	60%	80%	100%	Frequency	Count
<b>Yes</b>						<b>51.4%</b>	<b>36</b>
No						48.6%	34
<b>Valid Responses</b>							<b>70</b>

**Smart Speaker Uses.** What did you most often use the smart speaker for? Select all that apply.

(respondents were allowed to choose **multiple** responses)

Response	20%	40%	60%	80%	100%	Frequency	Count
<b>Listen to streaming music</b>						<b>83.3%</b>	<b>30</b>
Listen to radio						27.8%	10
Check the weather						55.6%	20
Ask a question						58.3%	21
Set an alarm						52.8%	19
Set a timer						61.1%	22
Control smart home devices						36.1%	13
Other (please specify)						5.6%	2
<b>Valid Responses</b>							<b>36</b>

**Overall Satisfaction with Smart Speaker Experience.** First, please think about your experience with the smart speaker for energy-related purposes. Overall, how satisfied are you with this entire experience?

(respondents could only choose a **single** response)

Response	20%	40%	60%	80%	100%	Frequency	Count
1 – Not at all satisfied						1.5%	1
2						5.9%	4
3						23.5%	16
<b>4</b>						<b>39.7%</b>	<b>27</b>
5 – Completely satisfied						29.4%	20
<b>Mean</b>							<b>3.9</b>
<b>Valid Responses</b>							<b>68</b>

**Smart Speaker Aspects Rating.** How would you rate the following aspects of the smart speaker from an energy-related standpoint?

(respondents could only choose a **single** response for each topic)

		1 - Poor	2	3	4	5 - Excellent	Total	Mean
Ease of use	Count	2	3	15	<b>25</b>	23	68	3.9
	% by Row	2.9%	4.4%	22.1%	<b>36.8%</b>	33.8%	100.0%	
Accuracy of commands completion	Count	1	2	19	<b>31</b>	15	68	3.8
	% by Row	1.5%	2.9%	27.9%	<b>45.6%</b>	22.1%	100.0%	

**Smart Speaker Statements.** Please indicate how strongly you agree or disagree with the following statements about the smart speaker.

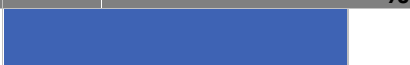





(respondents could only choose a **single** response for each topic)

		Strongly disagree	Disagree	Neutral	Agree	Strongly Agree	Total	Mean
Makes my home more energy efficient	Count	1	4	23	<b>26</b>	13	67	3.7
	% by Row	1.5%	6.0%	34.3%	<b>38.8%</b>	19.4%	100.0%	
Provides convenience	Count	0	2	4	<b>34</b>	27	67	4.3
	% by Row	0.0%	3.0%	6.0%	<b>50.7%</b>	40.3%	100.0%	
Helps me save energy	Count	1	8	20	<b>24</b>	14	67	3.7

	% by Row	1.5%	11.9%	29.9%	<b>35.8%</b>	20.9%	100.0%	
Helps me save money on my electricity bill	Count	2	6	24	<b>25</b>	10	67	3.5
	% by Row	3.0%	9.0%	35.8%	<b>37.3%</b>	14.9%	100.0%	
Helps me better manage my energy usage	Count	2	5	21	<b>27</b>	12	67	3.6
	% by Row	3.0%	7.5%	31.3%	<b>40.3%</b>	17.9%	100.0%	
Makes my home more comfortable	Count	0	2	13	<b>36</b>	16	67	4.0
	% by Row	0.0%	3.0%	19.4%	<b>53.7%</b>	23.9%	100.0%	
Helps me save time	Count	0	1	15	<b>35</b>	16	67	4.0
	% by Row	0.0%	1.5%	22.4%	<b>52.2%</b>	23.9%	100.0%	

**Smart Speaker EE-Related Uses.** During your trial with the smart speaker, which of the following energy-related purposes did you use your smart speaker for? Select all that apply.

(respondents were allowed to choose **multiple** responses)

Response	20%	40%	60%	80%	100%	Frequency	Count
<b>Lights</b>						<b>83.6%</b>	<b>56</b>
Thermostats						71.6%	48
Savings						19.4%	13
Electricity cost						26.9%	18
Electricity usage						46.3%	31
Other (please specify)						1.5%	1
<b>Valid Responses</b>							<b>67</b>

**Smart Speaker Uses.** How often do you use the smart speaker for the following energy-related purposes? You may skip the categories that do not apply to you.



## Smart Speaker Uses - Lights

(respondents could only choose a **single** response for each topic)

		Rarely	Sometimes	Often	Always	Total
Turn lights on/off	Count	8	10	21	<b>24</b>	63
	% by Row	12.7%	15.9%	33.3%	<b>38.1%</b>	100.0%

## Smart Speaker Uses - Thermostats

(respondents could only choose a **single** response for each topic)

		Rarely	Sometimes	Often	Always	Total
Set thermostat levels	Count	14	9	<b>22</b>	14	59
	% by Row	23.7%	15.3%	<b>37.3%</b>	23.7%	100.0%
Find out thermostat settings	Count	<b>21</b>	12	13	11	57
	% by Row	<b>36.8%</b>	21.1%	22.8%	19.3%	100.0%
Change thermostat settings	Count	<b>19</b>	13	12	14	58
	% by Row	<b>32.8%</b>	22.4%	20.7%	24.1%	100.0%
Set comfort level	Count	<b>20</b>	19	10	9	58
	% by Row	<b>34.5%</b>	32.8%	17.2%	15.5%	100.0%
Change comfort level	Count	<b>22</b>	16	12	7	57
	% by Row	<b>38.6%</b>	28.1%	21.1%	12.3%	100.0%
Set heating/cooling levels	Count	<b>18</b>	14	14	11	57
	% by Row	<b>31.6%</b>	24.6%	24.6%	19.3%	100.0%
Find out heating/cooling settings	Count	<b>20</b>	13	16	8	57
	% by Row	<b>35.1%</b>	22.8%	28.1%	14.0%	100.0%
Change heating/cooling settings	Count	<b>18</b>	12	17	9	56
	% by Row	<b>32.1%</b>	21.4%	30.4%	16.1%	100.0%

## Smart Speaker Uses - Savings

(respondents could only choose a **single** response for each topic)

		Rarely	Sometimes	Often	Always	Total
Set savings level	Count	<b>37</b>	11	9	3	60
	% by Row	<b>61.7%</b>	18.3%	15.0%	5.0%	100.0%
Change savings level	Count	<b>39</b>	14	2	3	58
	% by Row	<b>67.2%</b>	24.1%	3.4%	5.2%	100.0%

## Smart Speaker Uses – Electricity Cost

(respondents could only choose a **single** response for each topic)

		Rarely	Sometimes	Often	Always	Total
Find out overall current electricity cost	Count	<b>34</b>	17	6	2	59
	% by Row	<b>57.6%</b>	28.8%	10.2%	3.4%	100.0%
Find out overall past electricity cost	Count	<b>40</b>	16	1	2	59
	% by Row	<b>67.8%</b>	27.1%	1.7%	3.4%	100.0%
Find out current electricity cost for appliance(s)	Count	<b>33</b>	18	4	3	58
	% by Row	<b>56.9%</b>	31.0%	6.9%	5.2%	100.0%
Find out past electricity cost for appliance(s)	Count	<b>38</b>	17	1	2	58
	% by Row	<b>65.5%</b>	29.3%	1.7%	3.4%	100.0%

## Smart Speaker Uses – Electricity Usage

(respondents could only choose a **single** response for each topic)

		Rarely	Sometimes	Often	Always	Total
Find out overall current electricity usage	Count	<b>31</b>	19	5	3	58
	% by Row	<b>53.4%</b>	32.8%	8.6%	5.2%	100.0%
Find out overall past electricity usage	Count	<b>36</b>	18	2	2	58
	% by Row	<b>62.1%</b>	31.0%	3.4%	3.4%	100.0%
Find out current electricity usage for appliance(s)	Count	<b>31</b>	22	3	3	59
	% by Row	<b>52.5%</b>	37.3%	5.1%	5.1%	100.0%

Find out past electricity usage for appliance(s)	Count	<b>38</b>	18	1	1	58
	% by Row	<b>65.5%</b>	31.0%	1.7%	1.7%	100.0%

### Smart Speaker Uses – Other Energy-Related Purposes

(respondents could only choose a **single** response)

Response	20%	40%	60%	80%	100%	Frequency	Count
<b>Rarely</b>						<b>43.1%</b>	<b>25</b>
<b>Sometimes</b>						<b>43.1%</b>	<b>25</b>
Often						10.3%	6
Always						3.4%	2
Not Answered							6
<b>Valid Responses</b>							<b>58</b>

**Usage Changed.** Has your electricity usage changed as a result of using the smart speaker?

(respondents could only choose a **single** response)

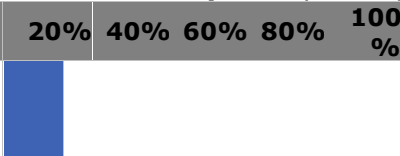
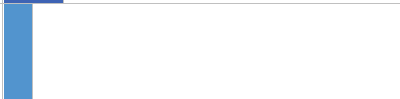

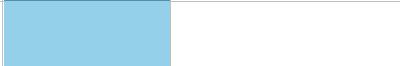


Response	20%	40%	60%	80%	100%	Frequency	Count
Yes, my electricity usage increased						0.0%	0
<b>Yes, my electricity usage decreased</b>						<b>40.6%</b>	<b>26</b>
No, my electricity usage stayed about the same						28.1%	18
I'm not sure if my electricity usage changed						31.3%	20
<b>Valid Responses</b>							<b>64</b>

**Contacted SCE.** Did you contact SCE during your participation in the smart speaker demonstration study?

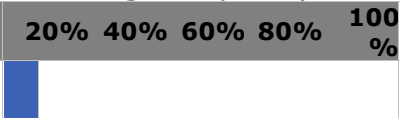


(respondents could only choose a **single** response)

Response	20%	40%	60%	80%	100%	Frequency	Count
Yes, I called and used the automated phone system						0.0%	0
Yes, I called and spoke to a live representative						12.5%	8
Yes, I visited SCE's website, sce.com						26.6%	17
<b>No, I did NOT contact SCE</b>						<b>60.9%</b>	<b>39</b>
<b>Valid Responses</b>							<b>64</b>

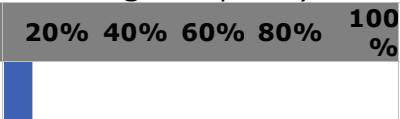



**Reason for Contacting SCE.** Why did you contact SCE? Select all that apply.(respondents were allowed to choose **multiple** responses)

Response	20%	40%	60%	80%	100%	Frequency	Count
Get more generic information about the smart speaker itself						12.0%	3
Needed technical support for using the smart speaker						4.0%	1
<b>Get more information about the smart speaker study</b>						<b>40.0%</b>	<b>10</b>
<b>Get more information about my bill</b>						<b>40.0%</b>	<b>10</b>
Get more information about my savings						12.0%	3
Other (please specify)						12.0%	3
<b>Valid Responses</b>							<b>25</b>

**Had Smart Speaker Issues.** Did you have any issues with the smart speaker?(respondents could only choose a **single** response)

Response	20%	40%	60%	80%	100%	Frequency	Count
Yes						6.3%	4
<b>No</b>						<b>89.1%</b>	<b>57</b>
Not sure						4.7%	3
<b>Valid Responses</b>							<b>64</b>

**Smart Speaker - Likely to Continue Using.** How likely are you to continue using the smart speaker for energy-related purposes after the study is completed?(respondents could only choose a **single** response)

Response	20%	40%	60%	80%	100%	Frequency	Count
Not at all likely						4.7%	3
Somewhat likely						15.6%	10
Very likely						35.9%	23
<b>Extremely likely</b>						<b>43.8%</b>	<b>28</b>
<b>Valid Responses</b>							<b>64</b>

**Home Type.** What type is your home?(respondents could only choose a **single** response)

Response	20% 40% 60% 80% 100%	Frequency	Count
<b>Single family home</b>		<b>90.6%</b>	<b>58</b>
Duplex		1.6%	1
Condominium / townhouse		7.8%	5
Mobile home		0.0%	0
Other (please specify)		0.0%	0
Prefer not to answer		0.0%	0
<b>Valid Responses</b>		<b>64</b>	

**Own or Rent Home.** Do you own or rent your home?(respondents could only choose a **single** response)

Response	20% 40% 60% 80% 100%	Frequency	Count
<b>Own</b>		<b>87.5%</b>	<b>56</b>
Rent		9.4%	6
Prefer not to answer		3.1%	2
<b>Valid Responses</b>		<b>64</b>	

**Ethnicity.** Which of the following best describes your ethnic background?(respondents could only choose a **single** response)

Response	20% 40% 60% 80% 100%	Frequency	Count
<b>White or Caucasian</b>		<b>39.1%</b>	<b>25</b>
African American or Black		1.6%	1
Asian or Pacific Islander		21.9%	14
Native American		1.6%	1
Hispanic or Latino (including Spanish, Mexican or Puerto Rican)		17.2%	11
Multi-ethnic or multi-racial		1.6%	1
Other, Non-Hispanic (please specify)		4.7%	3
Prefer not to answer		12.5%	8
<b>Valid Responses</b>		<b>64</b>	

**Education.** What is the highest level of education you have completed?(respondents could only choose a **single** response)





Response	20% 40% 60% 80% 100%	Frequency	Count
Some high school or less		0.0%	0
High school graduate		1.6%	1
Some college		18.8%	12
Vocational or technical school		1.6%	1
<b>College graduate</b>		<b>43.8%</b>	<b>28</b>
Graduate school or advanced degree		29.7%	19
Prefer not to answer		4.7%	3
<b>Valid Responses</b>			<b>64</b>

**Age.** What is your age group?(respondents could only choose a **single** response)

Response	20% 40% 60% 80% 100%	Frequency	Count
18 to 24 years old		0.0%	0
25 to 34 years old		4.8%	3
<b>35 to 44 years old</b>		<b>25.4%</b>	<b>16</b>
45 to 54 years old		23.8%	15
55 to 64 years old		23.8%	15
65 years old or older		17.5%	11
Prefer not to answer		4.8%	3
Not Answered			1
<b>Valid Responses</b>			<b>63</b>




**Income.** Which of the following includes your total annual pre-tax household income?(respondents could only choose a **single** response)

Response	20% 40% 60% 80% 100%	Frequency	Count
Less than \$25,000		1.6%	1
\$25,000 but less than \$50,000		7.8%	5
\$50,000 but less than \$75,000		6.3%	4

\$75,000 but less than \$100,000		15.6%	10
<b>\$100,000 but less than \$150,000</b>		<b>25.0%</b>	<b>16</b>
\$150,000 or more		20.3%	13
Prefer not to answer		23.4%	15
<b>Valid Responses</b>			<b>64</b>

**Gender.** What is your gender?

(respondents could only choose a **single** response)

Response	20% 40% 60% 80% 100%	Frequency	Count
<b>Male</b>		<b>51.6%</b>	<b>32</b>
Female		41.9%	26
Prefer not to answer		6.5%	4
Not Answered			2
<b>Valid Responses</b>			<b>62</b>