Energy Savings of Tier 2 Advanced Power Strips in Residential AV Systems

Project Number ET13PGE1441

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Abbreviations and Acronyms

AESC	Alternative Energy Systems Consulting
APS	Advanced power strip
AV	Audio/video – specifically refers to residential entertainment system
CalPlug	California Plug Load Research Center
CPUC	California Public Utilities Commission
DEER	Database for Energy Efficient Resources
EE	Energy efficiency
ET	Emerging technologies
EUL	Estimated useful life
IOU	Investor owned utility
IPMVP	International Performance Measurement and Verification Protocol
IR	Infrared
MFR	Multi-family residence
M&V	Measurement and verification
OS	Occupancy sensor
PG&E	Pacific Gas and Electric
RF	Radio frequency
SDG&E	San Diego Gas and Electric
SFR	Single-family residence
SVS	Savings verification system

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EXECUTIVE SUMMARY

PROJECT GOAL

This project was designed to assess the energy savings potential of Tier 2 advanced power strips (APS) in residential audio/video (AV) applications and to support market adoption of the technology. The project goals were to measure and quantify the energy savings and demand reduction associated with Tier 2 APS devices, their usability, and customer acceptance. The study was motivated by the large, unaddressed standby energy consumption of consumer electronics and the potential to contribute towards California's strategic energy efficiency goals. The results could inform program development, consumers, product design, and help increase APS adoption.

PROJECT DESCRIPTION

In this study, two Tier 2 APS models with similar control strategies were studied in 98 residential homes in SDG&E territory. However, the results are not intended as a product comparison, but rather to provide information on Tier 2 APS products in general. One model uses infrared (IR) remote control sensing and power monitoring of the total controlled AV load as the input for user activity while the other uses IR signals and occupancy sensing (IR-OS) along with monitoring of the TV receptacle power. Both models eliminate standby loads of controlled AV devices and save additional energy by cutting power when no user activity is detected for a default timer setting. The field study was conducted over two phases (phase 1 report published under ET14SDG8031) which determined energy savings and demand reduction using two alternative methods: a simulated savings approach and a pre-post installation approach.

During a baseline period AV load, remote control IR signals and OS signals are recorded on an interval basis. The simulated approach uses the baseline energy usage data and user activity signals to calculate what the savings would have been if the APS had been active. This is done by simulating the control strategy on the baseline data. After the baseline period is complete, the APS is installed or activated, initiating the post-installation period. During the post period, AV load is recorded on the same interval basis in order to establish consumption and load when with the APS is active. The pre-post method simply compares the load and consumption before and after APS installation to determine savings.

Both methods complement each other in order to provide the best possible estimate of energy savings in the typical residential home. The IR model was studied in phase 1 and phase 2 at 94 total sites using the simulated approach while pre-post monitoring was conducted during phase 1 at 9 sites. The IR-OS model was studied in phase 2 using both the simulated and pre-post methods at 52 and 56 sites, respectively. This report synthesizes the results from both phases. In addition to the M&V field study, a scaled direct install field placement and customer surveys were performed to gain insight into customer acceptance and direct installation persistence.

PROJECT RESULTS

The test results indicate that the technologies are successful at achieving energy savings and demand reduction. Standby loads of controlled devices are greatly reduced and additional savings are achieved by turning off AV systems when they have been left on but are not in active use. The following table lists the annual baseline energy and savings of controlled AV loads for each model using each savings estimate method.

Baseline usage [kWh] (N=98)	IR simulated savings [kWh] (N=94)	IR pre-post savings [kWh] (N=9)	IR-OS simulated savings [kWh] (N=52)	IR-OS pre-post savings [kWh] (N=56)
432	214 (50%)	125 (29%)	118 (27%)	110 (25%)

Demand savings were also calculated for the sites with on-peak demand reduction listed in the following table.

Baseline on-peak demand [W] (N=98)	IR simulated on-peak demand reduction [W] (N=94)	IR pre-post on-peak demand reduction [W] (N=9)	IR-OS simulated on-peak demand reduction [W] (N=52)	IR-OS pre-post on-peak demand reduction [W] (N=56)
60	24	25	16	10

Installation and operation are simple and intuitive, contributing to a high rate of persistence after installation. The customer surveys found that 84% of direct installed APS devices remained in place 6-8 weeks after installation. Additionally, the majority of those surveyed said they were satisfied or very satisfied with the product. Using these persistence rates and the energy savings findings, the estimated California market potential with 100% market penetration is about 2,700-5,010 GWh/year energy savings and 246-586 MW on-peak demand reduction.

RECOMMENDATIONS

Based on the guaranteed energy savings with proper installation, high persistence rate, and unaddressed wasteful energy use, Tier 2 APS devices should strongly be considered for program implementation. Analysis of possible program design and delivery channels can maximize the chances of a successful outcome. Based on interpretation of the methods and results, program designers and evaluators will need to decide how to weight the results for each method and model. The results are not intended as a product comparison and could potentially be used in combination in order to have the largest sample size and best estimates. Additionally, program evaluation and future M&V should consider using these findings and standardized testing to mitigate the costs and complexities of field monitoring, should it be required. The APS devices themselves will require continued development and modification as consumer electronics evolve with new networking, control methods, and functions.

INTRODUCTION

The results presented in this report provide energy savings information on a class of audio/video (AV) advanced power strips (APS). The study's purpose is to help inform program design, product development, public understanding, and future efforts. This work was performed by Alternative Energy Systems Consulting (AESC) on behalf of Pacific Gas and Electric's (PG&E) Emerging Technologies (ET) program in cooperation with San Diego Gas and Electric's (SDG&E) ET program. AESC is an energy engineering practice specializing in energy efficiency, utility programs, technology assessments, demand optimization, measurement and verification, and other related subjects. The PG&E and SDG&E ET programs are dedicated to increasing exposure, understanding, and the success of emerging or underutilized energy efficiency and demand management technologies in support of California's strategic energy goals. Additionally, TechniArt, a longstanding utility program service and marketing provider, performed and managed a direct install scaled field placement which resulted in customer feedback which are integrated into this report.

The APS devices under study were designed to reduce wasted standby and excess energy consumption of AV systems. Unnecessary standby loads, also sometimes called phantom or vampire loads, are the small demands of plug-in electronic appliances and devices that exist even though the devices are turned off. In most cases, these standby loads are not powering any critical processes and therefore result in wasteful energy consumption, unnecessary energy costs, and avoidable environmental impacts. Common devices with standby loads include cell phone chargers, televisions, computer peripherals, cable boxes, coffee machines, game consoles, printers, desktop computers, speakers, and other similar consumer products.

Although newer generations of products are slowly beginning to have embedded controls and designs that improve energy efficiency, there remain few, well-known options to consumers who wish to address this excess consumption in their homes. As such, there is definite market potential for products that allow control and elimination of standby loads in common consumer electronics. Two of the most common sets of consumer products with standby loads are computer workstations and AV systems. This study explores the function, customer acceptance, and benefits of two APS devices designed for simple integration into the AV environment. These two APS devices are both categorized as Tier 2, a classification that differentiates the product from Tier 1 which typically has a less complex control strategy.

Assessment Objectives

The goals of this technology assessment were to identify the demand reduction, energy savings, operational benefits, market potential, and qualitative characteristics of Tier 2 APS devices used in residential AV applications. To this end, several objectives were established:

- Measure and verify energy savings and demand reduction of Tier 2 APS devices using both pre-post and simulated savings methods.
- Perform statistical analysis of data to identify possible trends, correlations with various demographic parameters, and statistical metrics.
- Integrate survey results from parallel scaled field placement to determine market potential.
- Generate a technology assessment report and study that follows IPMVP standards.

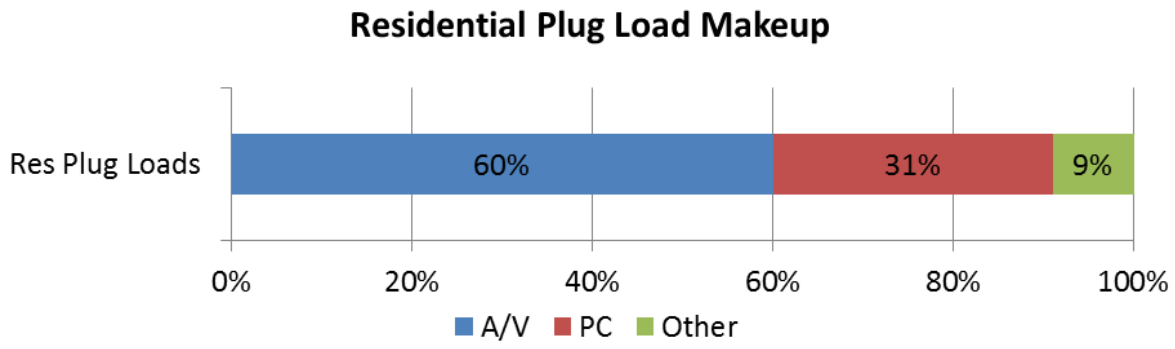
In order to accomplish these objectives, an M&V plan was developed and implemented at host customer sites in SDG&E territory during both project phases.

Background

This report contains the findings from an ET effort that took place over two phases. Phase 1, performed in 2014 for SDG&E, comprised a field trial of a Tier 2 APS with a control strategy that uses infrared (IR) remote control signals and AV system power as the control algorithm inputs. The Phase 1 report goes into great detail on the existing literature related to advanced power strips and AV systems (Valmiki, 2015). In order to provide context, some of that literature survey is reiterated here.

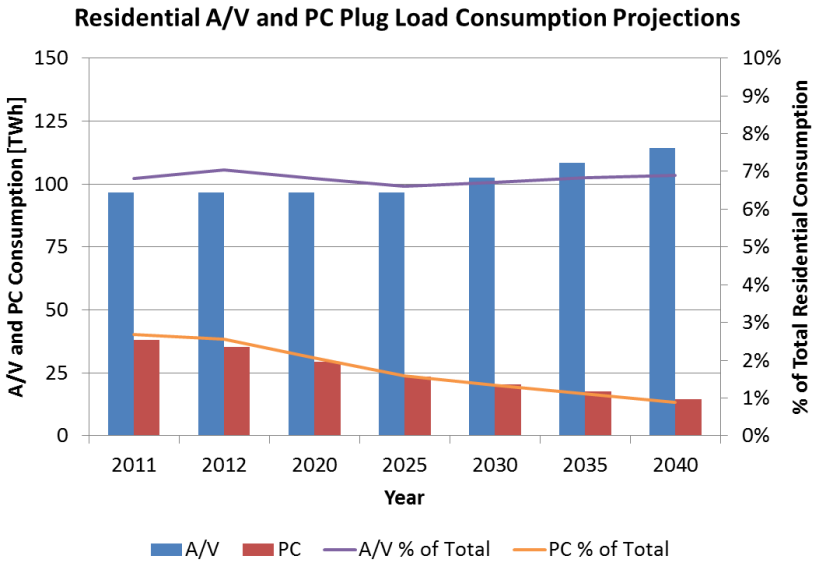
After excluding kitchen appliances and lighting, a study performed for Southern California Edison (SCE) in 2010 found that about 60% of the remaining residential plug load consumption came from AV devices (Peters, 2010). Figure 1 illustrates this, suggesting that along with PC workstations, AV systems are a good target for energy efficiency measures since an effective product could address one of the largest end uses existing in nearly every home. One study showed that this 60% in the average California household amounts to about 685 kWh per year (Wang, 2014). This figure includes televisions, stereos, set-top boxes, DVD players, and video game consoles.

Figure 1 – Residential plug load end-uses, excluding kitchen appliances and most lighting (Peters, 2010)



Furthermore, recent data and projections from the U.S. Energy Information Administration suggest that residential AV system consumption should continue to increase over the next several decades as shown in Figure 2 (Conti, 2014). This implies that standby loads from AV use will continue to provide an energy savings opportunity for the foreseeable future.

FIGURE 2 - RESIDENTIAL AV PLUG LOAD CONSUMPTION TREND (CONTI, 2014)



The AV devices that constitute this consumption include a number of common devices such as televisions, cable boxes, DVD players, game consoles, and streaming content devices. A 2011 study performed by the New York State Energy Research and Development Authority determined the average number of AV plug load devices in the typical US home, as shown in Table 1, was about 7.6 (Kessler, 2011). However, this may have shifted since then as streaming devices such as Roku, Amazon Fire TV, Apple TV, and Google Chromecast have gained popularity.

TABLE 1 - AV AND PC DEVICE FREQUENCY PER US HOME (KESSLER, 2011)

DEVICE	AVERAGE FREQUENCY PER HOUSEHOLD
Television	2.9
Set-top Box	1.8
DVD, VCR, or BluRay	2.1
Video Game Console	0.6
Audio System	0.2

CURRENT TECHNOLOGY

The most common incumbent technology are typical power strips which are simple devices with some combination of overload protection, surge protection, manual switching, and power splitting. Common power strips have no energy saving capabilities unless the user actively

turns the strip off when connected plug loads are not in use. This type of strip is present in the vast majority of AV applications.

Tier 1 APS devices designed to reduce standby loads are available to consumers and have been included in some utility program efforts. However, their market penetration remains low and studies have shown that savings are not as high as their Tier 2 counterparts. Tier 1 APS devices generally utilize one of the following energy savings strategies:

- Timeclock programming
- Occupancy sensor (OS)
- Master/controlled

The timeclock programmed power strip uses manually-programmed schedules to determine when controlled receptacles should be energized. This type of APS is best suited to an office workstation or appliances that have regular schedules of use. The OS approach uses an occupancy sensor to determine when a user is present. When a user is detected, the equipment will remain energized for use. When no motion is detected for a certain amount of time (30 minutes, for example), all controlled equipment will be de-energized. The last and most common type of Tier 1 APS is the current sensing, master/controlled design. This type of APS has a master receptacle which is monitored by current-sensing instrumentation. When the master device current drops below a certain threshold, it is assumed to be in standby or turned off. When this happens, the controlled receptacles are all de-energized. This strategy typically uses the television or computer as the master device and assumes that all peripheral devices are unused whenever the computer or television is off.

Previous studies and utility deemed values in various settings have identified savings ranging from 23 to 89 kWh/year for Tier 1 APS models. Table 2 lists the savings results for each of the sources found in the literature survey. The studies almost exclusively used the master/controlled APS type. Many studies commented on large variation in savings from strip to strip due to the large variability associated with combinations of possible connected equipment and uncontrollable user behavior, such as moving plugs.

TABLE 2 - LITERATURE SURVEY OF TIER 1 APS SAVINGS

SOURCE	APS TYPE	APPLICATION	SAVINGS [KWH]
(SDG&E, 2013)	Master/Controlled	Res AV	26
(Malik L. a., 2011)	Master/Controlled	Res AV	34
(BPA, 2013)	Master/Controlled	Res AV	43
(Kessler, 2011)	Master/Controlled	Res AV	75
(BPA, 2013)	Master/Controlled	Res AV	43
(Malik L. , 2012)	Master/Controlled	Omitted	89
(Malik L. , 2012)	Master/Controlled	Omitted	75
(BPA, 2013)	Occupancy Sensor	Omitted	67

EMERGING TECHNOLOGY

EMERGING TECHNOLOGY DESCRIPTION

The emerging technology under study is the Tier 2 APS product class. Two models of APS were selected for evaluation as representatives of this type of device, although the study's intent is not a product comparison. The two models are designated as either IR or IR-OS models based on the user activity inputs of the designs. Although they could be applied in various settings, they were only tested in residential environments as that is the vast majority of the market potential and most typical application. Each model has both always on receptacles and controlled receptacles that are de-energized based on the control strategy. The controlled receptacles are all operated on the same circuit with a single relay that opens, cutting power to all the controlled AV devices as one.

Both models are designed to eliminate standby loads when AV equipment has been turned off and to reduce excess usage that results from leaving AV equipment on when not in use. For example, the APS would turn off the controlled AV devices when the timer reaches zero if a child left the room unattended or if the user fell asleep while watching TV. Both models use inputs of AV power and user activity to determine when power should be cut to the controlled plug loads. The IR model measures total controlled AV load while the IR-OS model measures only the TV receptacle load. The user activity inputs are monitored with a sensor that is placed next to the TV and plugs into the APS. This sensor provides feedback to the user by blinking an LED whenever a user signal is seen. The IR signal can be from any IR remote control button. Differences between various buttons (power, volume, channel, etc.) are not recognized nor relevant. Most TV remote controls send IR signals, although some other controllers use radio waves (RF), Bluetooth, Wi-Fi, or wired signaling instead. These will not trigger the current generation of Tier 2 APS devices. The IR-OS model also looks for motion as a user activity signal.

Both models eliminate standby loads on the controlled devices by cutting power to these devices whenever the AV system has been turned off. The APS determines whether the AV system is on by measuring the TV or total AV system power and comparing it to a threshold (the IR-OS model looks at TV power while the IR model looks at total plug load of all controlled devices). If the power is above the threshold, the AV system is designated as "on" and vice versa. Savings are also accumulated during an "active savings" situation which occurs when the power strip determines that the AV system has been left on but is not being used or watched anymore. Both models use a countdown timer that is always counting down to zero whenever the AV system is in use; the timer resets whenever it sees user activity and begins counting down again. If the timer reaches zero, the power strip opens the relay and cuts power to the controlled plug loads after warning the user with a blinking LED (in the IR model) or a blinking LED and buzzer (in the IR-OS model).

In both models, when the power strip is dormant prior to using the AV system, the user must simply press any IR button on the remote control to close the switch on the power strip before

turning on AV devices as normal. At this point, the countdown timer control sequence is initiated once again.

Although the control strategy is very similar for both models, there are some differences. Table 3 identifies the shared and unique features of each APS model under study. Additionally, unique features in each model are explained further in the next two sections.

TABLE 3 - IR AND IR-OS MODEL FEATURES

Feature	IR model	IR-OS model
Automatic AV power threshold	X	
Automatic TV power threshold		X
IR algorithm input	X	X
OS algorithm input		X
Overload protection	X	X
60 minute timer	X	
75 minute timer		X
120 minute timer	X	
135 minute timer		X
8 hour once-off manual/music mode	X	
8 hour once-off auto/music mode		X
LED signal prior to active shutdown	X	X
Audio buzzer prior to active shutdown		X
Always on receptacles	X	X

The estimated useful life (EUL) for an APS is about 5-10 years, based on a presentation by Bonneville Power Administration (BPA, 2013), DEER estimates[1], and estimates of lifespan and persistence from industry experts. With expected unit price costs, payback well under the EUL is assured with the published energy savings estimates.

IR MODEL

The IR model has several features that differentiate it from the IR-OS model:

- The threshold is compared to the total combined power of the controlled AV devices to determine whether the system is on or off. As a result, there is no master device and controlled devices can be arranged in any order.
- The APS uses only remote control IR signals as user input.
- The model comes in two options. The first is a wall pack that sits flat against and is screwed into the wall outlet with three always on receptacles and one controlled

[1] DEER EUL ID: Plug-OccSens

receptacle. A standard power strip or outlet splitter is then plugged into the controlled receptacle for all the controlled devices. The second is a power strip that has both always-on receptacles and controlled receptacles.

- The countdown timer can be set to 60 minutes or 120 minutes with a 60 minute default setting and a 10 minute visual LED blinking warning of impending active shutdown if the timer reaches zero. There is also a once-off 8 hour music/extended viewing mode.

Figure 3 shows a drawing of the wall pack option and an example arrangement.

FIGURE 3 - IR WALL PACK EXAMPLE ARRANGEMENT AND STRIP MODEL

IR-OS Model

The IR-OS model has several features that differentiate it from the IR model. These include:

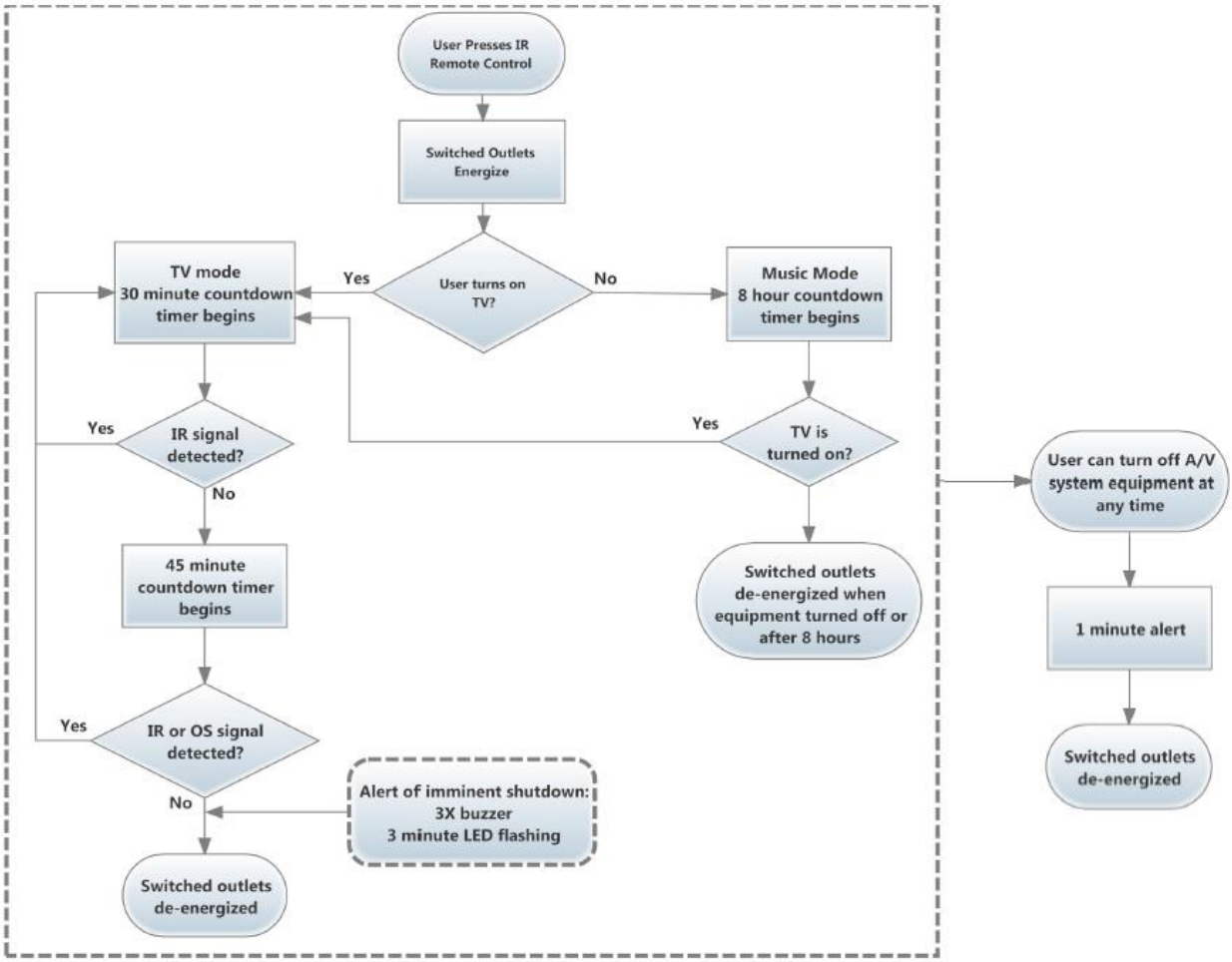
- The threshold is compared to only the TV power to determine whether the system is on or off. As a result, the TV must be plugged into a specific controlled receptacle while the remainder may be for any other device in any order.
- The control algorithm uses remote control IR signals and occupancy motion sensing (OS) for user activity input. The OS signals are triggered by movement if the TV is on and the countdown timer has reached a certain limit.
- The control logic is contained in this sensor, allowing for changes to control strategy, if needed.
- The countdown timer can be set to 75 minutes or 135 minutes with 75 minute as the default. For each timer setting, the multisensor begins looking for OS motion sensing after 45 minutes or 75 minutes of IR inactivity, respectively. A 3 minute visual LED blinking and soft audible chirp signals the user of impending active shutdown if the timer reaches zero. There is also an automatic, once-off 8 hour music mode that begins if devices without the TV are turned on. The default timer begins if the TV is turned on during music mode.

Figure 4 shows the IR-OS model with various labeled features.

Figure 4 - IR-OS model

Figure 5 shows the control logic for the IR-OS model. The IR model is similar but skips the OS sensing portion and has a 10 minute active shutdown warning instead of the IR-OS 3 minute warning.

FIGURE 5 - IR-OS MODEL CONTROL LOGIC



TIER 2 APS LITERATURE SURVEY

There have been limited studies on Tier 2 APS devices as of this publication date. Table 4 lists the results of these tests which vary between about 258 to 348 kWh saved per year (48%-54% of baseline). Note that they all used the simulated savings methodology to test only the IR model described above. The methodology was replicated in this study and is described in the following M&V plan section. This methodology was developed and proposed by CalPlug at the University of California, Irvine as a solution for standardization of Tier 2 APS testing with appropriate rigor and technical defensibility (Wang, 2014).

TABLE 4 - LITERATURE SURVEY TIER 2 APS SAVINGS

SOURCE	APS TYPE	APPLICATION	SAVINGS [KWH]
(BPA, 2013)	IR and RMS Power Sensing	Res AV	321
(EnergyConsult, 2012)	IR and RMS Power Sensing	Res AV	258
(Wang, 2014)	IR and Load Sensing	Res AV	280
	IR and RMS Power Sensing	Res AV	348
(Valmiki, 2015)	IR and RMS Power Sensing	Res AV	234

TARGET MARKETS AND BARRIERS

Tier 2 APS devices are well suited to many environments wherever AV or PC systems are installed. The most cost effective applications could be large scale installations at buildings that have many AV systems, such as dormitories or hotels. However, since the market for this technology is so large, single-family residences (SFR) and multi-family residences (MFR) are the primary target for this technology in AV settings.

The California and IOU territory residential AV market sizes can be estimated with the available literature. Assuming that each household has about 2.25 times the AV system potential as those studied in this effort[2], an AV penetration of 100% (KEMA, 2009), and using the most recent U.S. Census statistics for California (United States Census Bureau, 2013), the potential market size is listed in Table 5.

TABLE 5 - ESTIMATED MARKET SIZE

Territory	# Households	# AV Systems
PG&E	4,615,700	10,385,200
SCE	4,839,600	10,889,100
SDG&E	1,071,600	2,411,000
California	12,542,500	28,220,500

Barriers to the market penetration and effectiveness of APS devices primarily derive from customer resistance, the rapid turnover rate of consumer electronics, and high cost relative to standard power strips. Customer acceptance of APS devices will depend highly on the usability and simplicity of the technology. For instance, users may resist spending money and time learning how to use yet another device that has no obvious and immediate benefit to

[2] 2.25 = 1 full equivalent AV system to those found in this study plus a second and third AV system with 0.75 and 0.5 the same potential. Three total AV systems drawn from the literature (Kessler, 2011). The reduced potential savings for the second and third sets are due to reduced usage and number of AV peripherals from primary AV system.

them while complicating something as common as watching TV. Additionally, there are few options available to consumers; competing manufacturers and vendors of Tier 2 APS devices include Bits Limited, Embertec, and TrickleStar.

This customer resistance has led utilities to explore direct install and give away demand side management (DSM) program options. However, this type of DSM approach has its own questions and barriers. The rapidly changing electronics market, consumer behavior, variability in user patterns and APS acceptance, and unpredictable user interaction with APS devices all add uncertainty to the design and implementation of utility programs (N. O'Neill, 2010).

TECHNICAL APPROACH AND TEST METHODOLOGY

The test plan for both phases of the study was based on two complementary approaches for determining energy savings values. One method was a standard pre-post test that measured energy consumption at the AV system before and after the installation of the Tier 2 APS. The other method simulated savings based on data collected during the baseline period and was based on research and suggested test protocol from CalPlug at UC Irvine. The two methods complement each other as each has strengths and weaknesses. Most host sites were subject to both methods, although some sites only allowed one of the two methods. Note that phase 1 studied only the IR model while phase 2 studied both the IR and IR-OS models as shown in Table 6.

TABLE 6 - METHODS APPLIED DURING EACH PHASE FOR EACH APS MODEL

	Phase 1	Phase 2
IR simulated savings	X	X
IR pre-post savings	X	
IR-OS simulated savings		X
IR-OS pre-post		X

The distinguishing features of each method are as follows:

Simulated savings method

- Developed by CalPlug to address uncertainty associated with behavior variation from pre to post periods and to reduce overall time needed for monitoring.
- Eliminates potential variation in usage patterns between pre and post timespans because only one period is used.
- May not fully account for user interaction with APS when system is turned off (since shutdown is only simulated after baseline data collection). An LED warning light flashes continually when countdown timer reaches zero in order to prompt user response as in actual APS use.
- Allows for comparison with previous studies.

Pre/post savings method

- Includes all user interaction effects and feedback with APS controls and functions.
- Cannot control variability in usage patterns between pre and post timespans (daily host uses and total use time of AV system)
- Simple approach that can easily be replicated for various models without equipment and instrumentation modification for M&V purposes.

Only controlled AV devices were included in all stages of the test. In other words, only the demand and energy consumption of devices that were on switching outlets were measured. This results in accurate percent energy savings. However, this also means that consumption calculations do not include devices that would remain always energized. These could include modems, computers, set top boxes, game consoles, or other devices that the host customer did not want to be turned off. As a result, the AV baseline values are representative of only the controlled devices; these figures may deviate from other studies or total AV consumption that includes these other excluded devices. The selection of controlled devices at each site was chosen cooperatively through recommendations by the installer and input from the host, just as would occur during a direct install program.

Host Sites

The host sites consisted of 42 and 56 SDG&E customers during phase 1 and phase 2, respectively. Host sites were selected differently for each phase. For phase 1, participants were SDG&E employees and their friends and family. For phase 2, participants were SDG&E customers in three zip codes selected as a representative subset of SDG&E territory. In both cases, the customers were solicited through a brief ET email explaining the purpose and premise of the test and the host responsibilities. After the participants expressed interest, some basic demographic information was gathered prior to scheduling site visits. Initial customer information surveyed included number and ages of residents, home type, quantity and type of AV devices at main TV, and whether the home is rented or owned. These answers were not be used to screen host sites as random selection would be the most unbiased and representative process. Rather, sites were taken on a first-come basis. The only host sites that were rejected or excluded were those with intractable installations.

The number of sites used for each type of APS and their demographic breakdown for the testing are listed in Table 7.

Table 7 – M&V host site population, demographics, and dataset sizes for combined Phase 1 and 2

	IR	IR-OS	California (US Census, 2013)
Number of baseline sites	98	56	n/a
Number of post-monitored sites	9	56	n/a
Number of simulated sites	94	52	n/a
Average number of controlled AV devices	3.6	3.4	n/a
Number of MFR sites	28 (29%)	16 (29%)	35%
Number of SFR sites	70 (71%)	40 (71%)	65%
Number of households with children	37 (38%)	24 (43%)	37%
Average number of residents	3.1	3.1	2.9
Average self-reported weekly TV hours	33	34	n/a

INSTRUMENTATION

The instrumentation used for the study was different for each phase, although both sets of instrumentation measured largely the same variables for use with equivalent analyses. All power and energy measurements were for the combined controlled load and excluded any devices that were not on switched receptacles. AESC tested and vetted all instrumentation by comparing measurements with calibrated instrumentation and in-office testing. The instrumentation for each phase is outlined in the following two sections.

Phase 1 Instrumentation The phase 1 study of the IR APS model used a proprietary savings verification system (SVS) that was constructed by the vendor for the baseline and simulation variable monitoring. A HOBO plug load logger was used for post-installation monitoring. Table 8 lists the instrumentation used for phase 1.

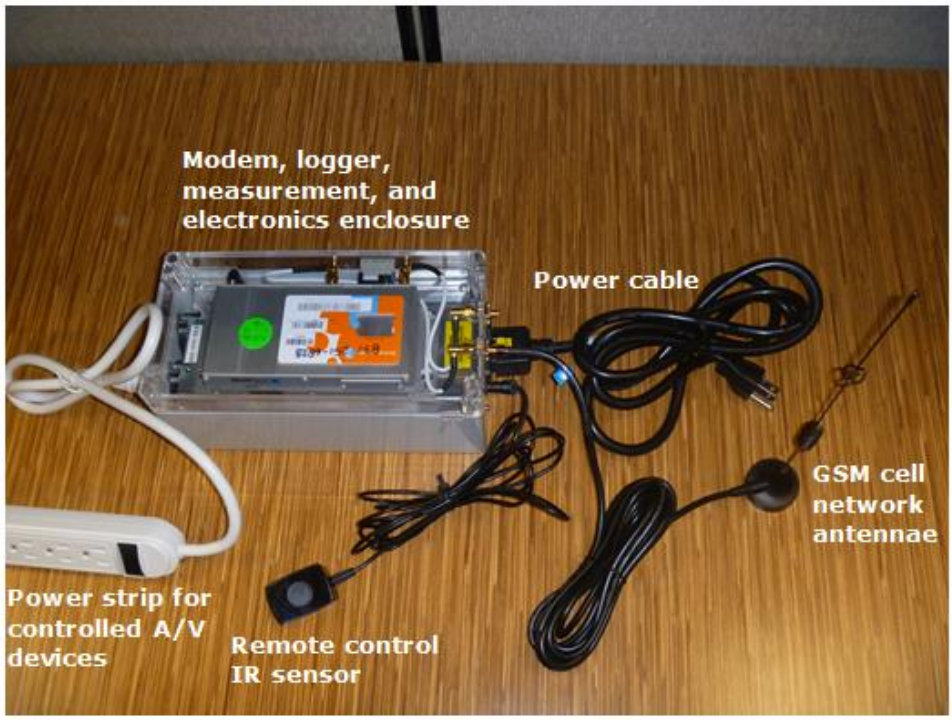
TABLE 8 – PHASE 1 INSTRUMENTATION

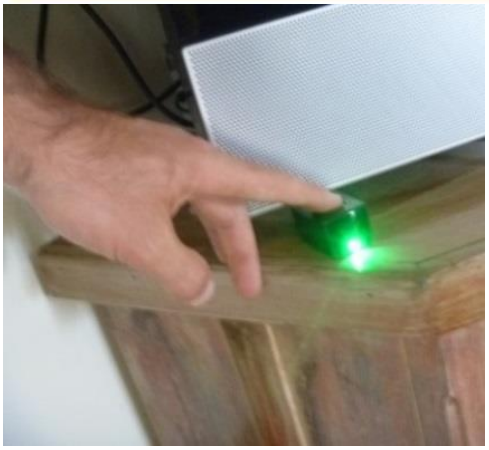
Pre-post method measurements	Equipment	Units	Accuracy	Interval
Baseline energy and demand Post energy and demand	SVS unit HOBO UX120-018	V, A, kWh, Watts V, A, pf, kWh, Watts	2% 0.5%	1 second 1 minute
Baseline and simulated method measurements	**Equipment**	**Units**	**Accuracy**	**Interval**
Baseline energy and demand Baseline user activity for use in savings simulation	SVS unit SVS unit	V, A, kWh, Watts IR Pulses	2% 1 pulse	1 second 1 second

The SVS unit monitors and records AV system voltage and current for true RMS power along with remote control IR activity. The design was based on CalPlug metering suggestions developed for the standardization of APS monitoring. The SVS unit does not turn off power to any connected loads and only serves as a measurement device without affecting power supply. The measurement system records the following values at 1 second intervals and transmits data to external vendor servers every 8 hours via cell phone networks:

- Timestamp
- IR activity (stored as amplitude each second, anything greater than 0 indicates IR signals)
- Voltage
- Current
- RMS Power
- Cumulative energy consumption and simulated energy savings

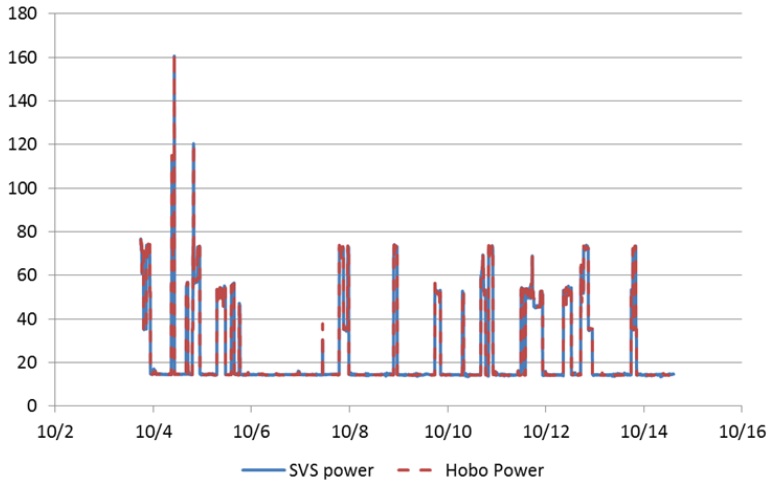
FIGURE 6 - PHASE 1 INSTRUMENTATION





The SVS accuracy was verified using an independent, calibrated HOBO plug load logger in series with the SVS unit. Figure 7 shows this accuracy verification. When compared to the calibrated HOBO logger, the SVS instrumentation had an average absolute and percent error of less than 0.5 Watts and less than 2%, respectively. This observed measurement error is well within acceptable bounds and should serve as validation of the instrumentation's accuracy.

FIGURE 7 - VERIFICATION OF SVS UNIT ACCURACY



Phase 2 Instrumentation

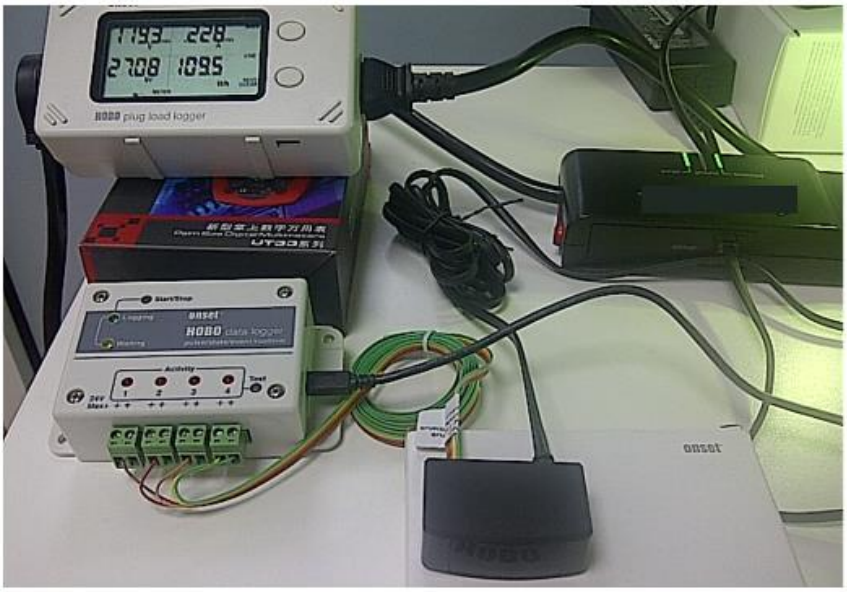
For phase 2, baseline and post-installation AV system demand of the controlled equipment was measured and logged using a HOBO plug load logger located in series with the AV system power strip. Additionally, for the simulated approach, a modified APS in bypass mode was used to produce IR and OS signals which were logged with a HOBO pulse logger during the baseline period. Similar to the phase 1 instrumentation, this bypassed APS only served as a measurement device and power supply without turning off any connected loads or control strategy. The instrumentation is summarized and depicted in Table 9 and Figure 8.

TABLE 9 - PHASE 2 INSTRUMENTATION

Pre-Post method measurements	Equipment	Units	Accuracy	Interval
Baseline energy and demand	HOBO UX120-018	V, A, pf, kWh, Watts	0.5%	1 minute
Post energy and demand	HOBO UX120-018	V, A, pf, kWh, Watts	0.5%	1 minute

Baseline and simulated method measurements	Equipment	Units	Accuracy	Interval
Baseline energy and demand	HOBO UX120-018	V, A, kWh, Watts	0.5%	1 minute
Baseline user activity for use in savings simulation	Modified APS & HOBO UX120-017	IR & OS Pulses	1 pulse	1 minute

FIGURE 8 – PHASE 2 INSTRUMENTATION



TEST PLAN: BASELINE

The baseline consumption at each host site was measured in order to establish normal usage and patterns. No attempt to control or alter behavior was made and the hosts were expressly told to just behave normally. The flashing LED light for the simulation instrumentation was described and users were told that they could stop the flashing by pressing any button to reset the timer. The AV devices to be controlled were isolated and combined to a single power strip for monitoring. This single power strip was either plugged into the SVS unit (phase 1) for monitoring or used the bypassed APS (phase 2). In both cases, the controls were disabled during baseline, AV devices were not switched off with the APS, and power supply to the AV devices was continuous.

The selection of the controlled devices was based on installer recommendations and input from the customer. Recent generation Xbox and PlayStation models were excluded due to their updating during inactive times, sensitive hard drives, and recommended APS practices. Additionally, cable and satellite service set top boxes were not included as a controlled device at any site. The typical controlled devices included combinations of the following:

- Television (required)
- Stereo/CD player
- Speakers/subwoofer/soundbar
- VHS, DVD, or Blu-ray players
- Wii
- Streaming devices (Roku, etc.)
- Game controller chargers
- Wireless headphone chargers
- 1st and 2nd generation Xbox and Playstation (only if host requested)

The total controlled AV system load was measured as one rather than disaggregating amongst each AV device type. This was done for cost mitigation, installation simplicity, and is reasonable since the APS treats the devices as one collection. The APS devices were installed at the host site's main TV unless otherwise requested by the host. Additionally, only one AV system per home was monitored in order to gain a broader understanding across as many homes and behavior patterns as possible.

The annual baseline consumption is simply calculated using the ratio of monitoring time to annual time.

$$Annual\ Energy = \frac{8760\ hours}{Monitored\ Hours} * Measured\ Energy$$

Baseline monitoring spanned 1 to 4 weeks. During phase 1, sections of data were not properly transmitted using the cell phone network, thus phase 1 sites had shorter periods. Monitoring period length is discussed in the Appendix.

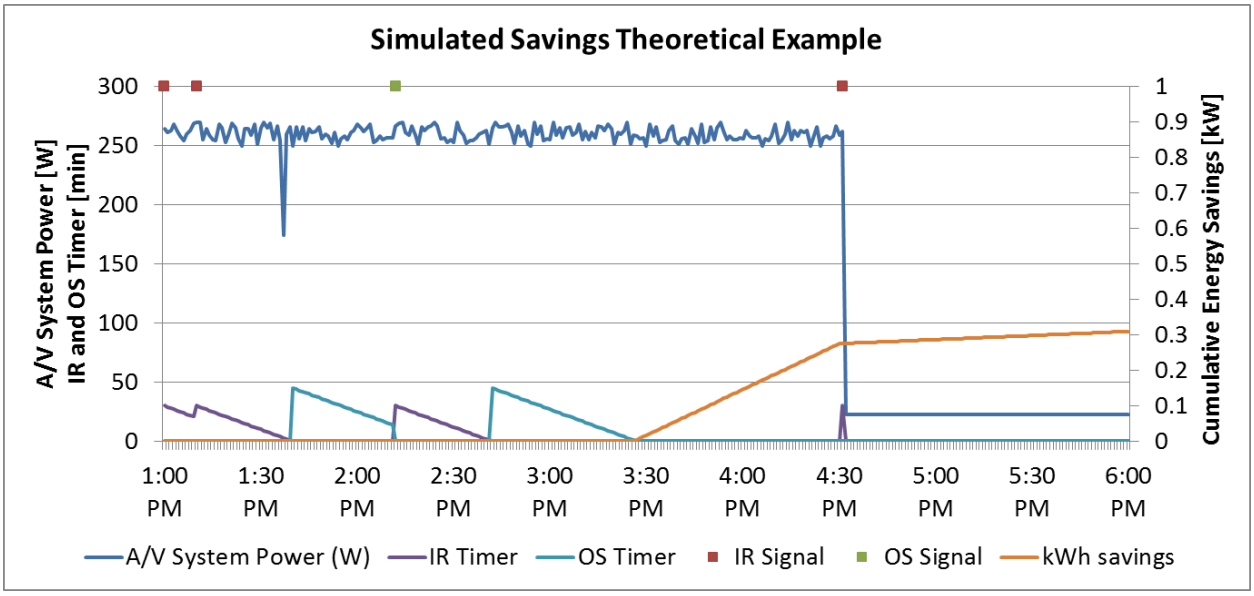
Test Plan: Simulated Savings

In order to address the variability in user behavior and to propose a standard method of testing APS devices, CalPlug devised a test approach that calculates simulated savings. This method was applied to 42 host sites during phase 1 for the IR model after data collection with the SVS test instrumentation. The simulation method was also applied to 52 sites during phase 2 for both the IR and the IR-OS models. The method uses a single period of monitoring to calculate both baseline and what the savings would have been over that same time if an APS had been installed. In the case of the two Tier 2 APS models under study, this involves measuring baseline AV power and consumption while simultaneously measuring signals from remote controls and motion sensors. In the case of the IR model, the SVS unit measures AV power and IR signals from its IR sensor. In the case of the IR-OS model, the modified APS sends IR and OS pulse signals to a logger while another plug load logger measures power of the combined AV load.

In the simulated approach, the savings and demand reduction were calculated by applying the APS control strategy analytically to the baseline data. The user activity will dictate when the APS timer reaches zero and simulated energy savings will begin to accumulate. Whenever there is an IR or OS signal observed, a timer counter is reset in the simulation. Whenever the timer reaches zero, the simulation logs a de-energized state, thus accumulating energy savings.

This simulation method applied to baseline data is illustrated in Figure 9.

FIGURE 9 - EXAMPLE OF SIMULATED SAVINGS CALCULATION USING MEASURED BASELINE POWER AND IR-OS SIGNALS



This simulation was performed for each site across the entire baseline measurement period to estimate savings. All sites in phase 1 were used to simulate the IR model while all sites in phase 2 were used to simulate both the IR and the IR-OS model. Although a range of timer settings were simulated, the simulations primarily focused on using the default timer settings (75 minutes + 3 minute warning for IR-OS and 60 + 10 minute warning for IR).

Energy savings are calculated as the difference between the annualized consumption during baseline and the simulated savings modes.

$$Energy\ Savings\ (kWh) = Baseline\ Energy\ Usage\ (kWh) - Controlled\ Energy\ Usage\ (kWh)$$

TEST PLAN: PRE-POST SAVINGS

The alternate and more common pre-post savings approach was performed at 9 IR model sites during phase 1 and 56 IR-OS sites during phase 2. This method compared demand and energy consumption between the baseline and post-installation periods. In the phase 1 IR case, the SVS unit was replaced by the actual IR APS model while keeping the combination of AV devices consistent. Similarly, in phase 2, the bypassed APS device was replaced with an actual, functioning IR-OS APS model while keeping the AV devices consistent. In both cases, the host customer was given a demonstration and instructions on the use of the APS at installation.

Energy savings were calculated with a simple comparison between the annualized energy consumption before and after installation. The baseline period was measured as described in the Test Plan: Baseline section. Similar to the baseline monitoring, controlled AV load and consumption was monitored with the Tier 2 APS installed for 2 to 4 weeks.

Survey Plan

In order to understand the persistence and customer reactions of the APS devices installed through a direct install field placement, surveys were administered to the customers involved in the parallel effort by TechniArt and Illume. Please refer to Appendix 4: Scaled Field Placement Survey Report for details.

RESULTS

The study results are presented from both phases, with combined sample sizes, where appropriate. As stated elsewhere, the purpose of this report is not to form a product comparison, but rather to better understand Tier 2 APS devices in general. Since the IR-OS model was only studied in phase 2, the respective results are limited to that phase and sample size using both the simulated and pre-post methods. The IR model was studied using the simulated approach during both phases, resulting in a larger sample size across both trials. However, the IR model was only studied with the pre-post method at 9 sites during phase 1.

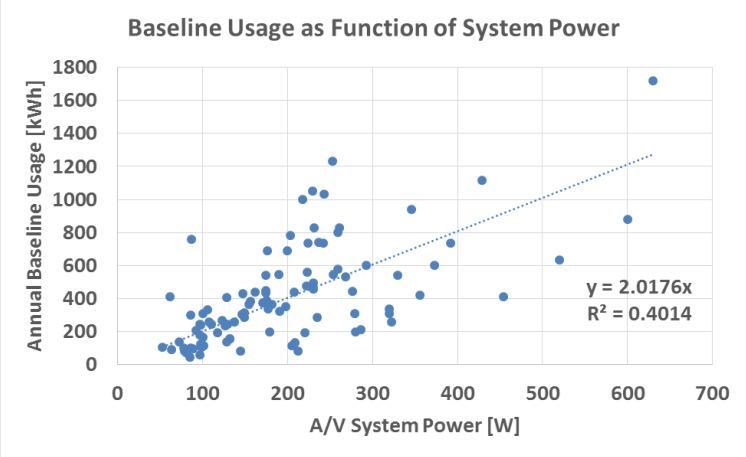
The baseline, simulated energy savings, pre-post energy savings, and average demand reduction during on-peak hours are presented. Any error bars shown in figures correspond to a 90% confidence interval assuming a Gaussian distribution. All energy consumption and savings values are annualized and all demand reduction was calculated for DEER on-peak hours only[3]. Note that although average demand will decrease, peak demand will not reduce because the demand while the AV system is on does not change.

Survey results from the scaled field placement are summarized and combined with the energy savings figures to present the overall market potential. Finally, recommendations for future direction and conclusions are drawn. All results are presented with the goal of informing utility programs, consumers, and future generations of APS and other plug load control devices.

ENERGY AND DEMAND SAVINGS

The average annual baseline usage across all host sites was 432 kWh for the controlled AV devices only (other uncontrolled AV devices may increase total AV usage, but were not included in the study). Figure 10 shows the relationship between annual baseline usage and the full load AV demand during the monitoring period.

FIGURE 10 - ANNUAL BASELINE USAGE AS A FUNCTION OF AV SYSTEM POWER AT FULL LOAD



[3] DEER on-peak time is defined as 2 PM to 5 PM (CPUC, 2013).

This shows that each AV system watt under normal operating conditions corresponds to about 2.02 kWh of consumption per year, on average. This may be particularly useful in evaluating programs if monitoring is prohibitive or infeasible. However, it is important to know that this corresponds to controlled AV devices only; power and consumption from non-controlled devices are not included in this factor.

Figure 11 and Figure 12 show the baseline consumption and savings for each type of APS as tested during each phase. The savings depicted here are for the default timer settings of each strip. Note that although there is a large difference between the simulated savings for the two models, there is very little difference between the pre-post savings. Again, the pre-post savings for the IR model come from a sample of 9 sites due to limitations of the field study.

FIGURE 11 - USAGE AND SAVINGS FOR THE IR MODEL DEFAULT SETTING DURING PHASE 1 (NOTE 60 MINUTE TIMER + 10 MINUTE WARNING DELAY FOR ACTIVE SHUTDOWN)

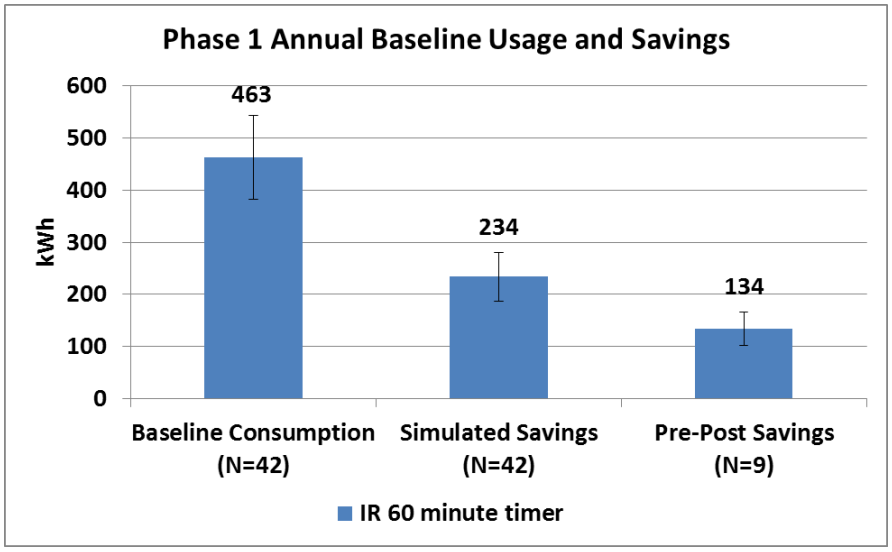


FIGURE 12 - USAGE AND SAVINGS FOR EACH APS MODEL DEFAULT SETTING DURING PHASE 2 (NOTE 75 IR-OS TIMER INCLUDES 3 MINUTE ACTIVE SHUTDOWN DELAY AND 60 MINUTE IR TIMER INCLUDES 10 MINUTE DELAY)

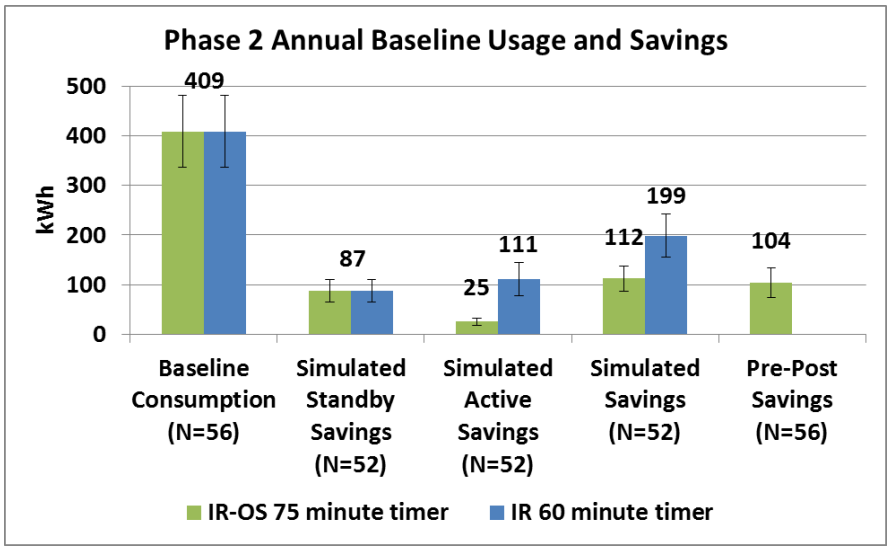


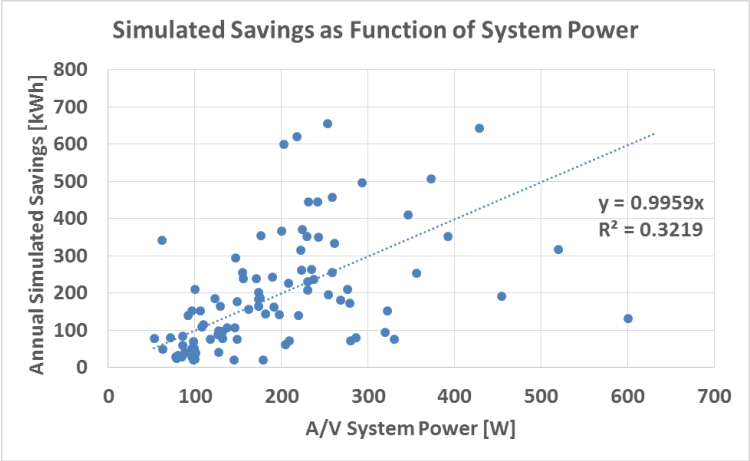
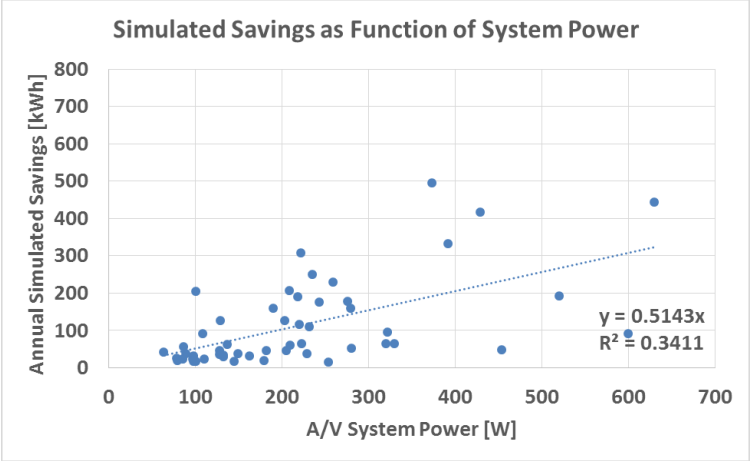
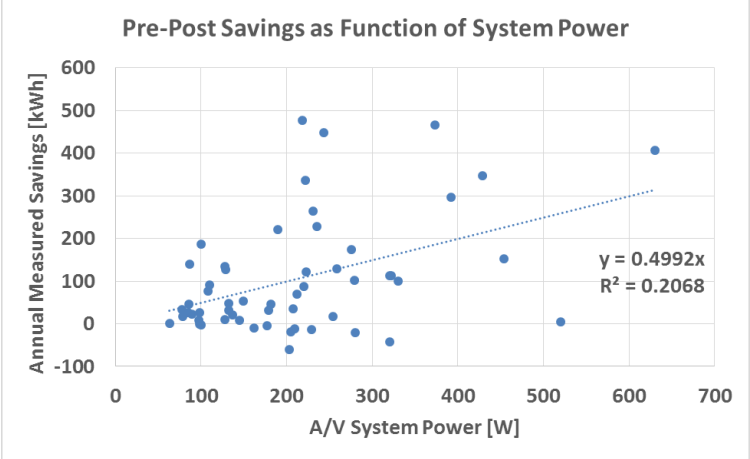
Table 10 lists the results across both phases and models, as well as normalized results combining the two phases. Since the baseline usage varied slightly from phase 1 to 2, the results were normalized to the average baseline. These normalized values should be the final savings estimates for each model and method with consideration given to the sample sizes and other experimental factors.

TABLE 10 - BASELINE USAGE AND SAVINGS FOR EACH PHASE, EACH MODEL, AND COMBINED PHASES

Phase	Baseline usage [kWh]	IR simulated savings [kWh]	IR pre-post savings [kWh]	IR-OS simulated savings [kWh]	IR-OS pre-post savings [kWh]
Phase 1	463	234 (51%)	134 (29%)	n/a	n/a
Phase 2	409	199 (49%)	n/a	112 (27%)	104 (25%)
Combined and normalized	432	214 (50%)	125 (29%)	118 (27%)	110 (25%)

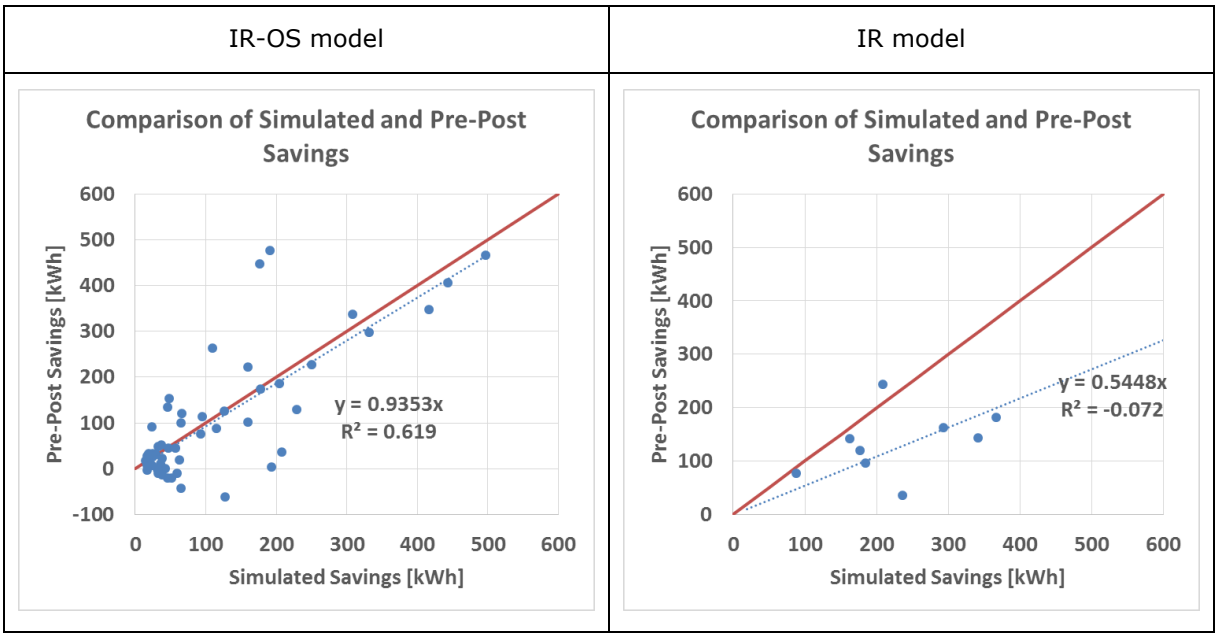
Similar to Figure 10, it is useful to determine the average savings per watt of controlled AV load. This could provide a basis for program evaluation and host potential using spot measurements rather than extended, expensive monitoring. In Figure 13 the results show that the IR model garners about 1.0 kWh of savings per watt of peak controlled AV load, based on the simulated results. There were not enough pre-post results for the IR model to establish a similar correlation (only 9 sites were post-monitored with the IR model). The results show that the IR-OS model garners about 0.5 kWh of annual savings per watt of peak controlled AV load and is consistent across the simulated and pre-post methods.

FIGURE 13 - SAVINGS AS FUNCTION OF AV SYSTEM POWER

IR Model Simulated	
IR Model Pre-Post	Not enough data for correlation
IR-OS Model Simulated	
IR-OS Model Pre-Post	

The confounding feature of this study is that there is agreement between the simulated and pre-post savings for the IR-OS model but not for the IR model. For instance, Figure 14 shows the relationship between the alternate approaches for each model. The IR-OS methods have strong agreement as indicated by the slope close to 1. In contrast, the IR methods have poor agreement as indicated by the slope of only 0.5. This suggests that pre-post savings are consistently lower than the simulated method, although this conclusion is derived from a small pre-post sample size of 9 sites. The very few data points (N=9) for the IR pre-post test lead to a poor correlation (R2=-0.1). Based on this, further testing may be warranted and could clarify this unresolved uncertainty.

FIGURE 14 - COMPARISON OF SIMULATED AND PRE-POST SAVINGS (RED LINE INDICATING PERFECT UNITY AGREEMENT)



The average on-peak demand and demand reduction are listed in Table 11 and plotted with 90% confidence intervals in Figure 15. All values were normalized to the overall baseline from the total 98 sites.

TABLE 11 – BASELINE DEMAND AND DEMAND REDUCTION

Baseline on-peak demand [W] (N=98)	IR simulated on-peak demand reduction [W] (N=94)	IR pre-post on-peak demand reduction [W] (N=9)	IR-OS simulated on-peak demand reduction [W] (N=52)	IR-OS pre-post on-peak demand reduction [W] (N=56)
60	24	25	16	10

FIGURE 15 - BASELINE DEMAND AND DEMAND REDUCTION

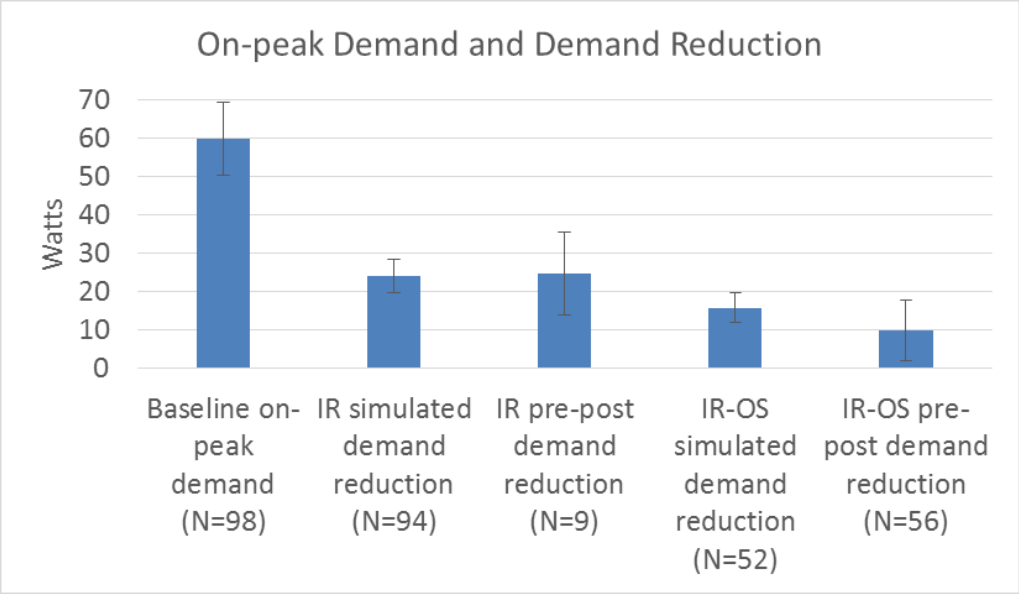


Figure 16 and Figure 17 show the average weekday demand and demand reduction for each model. Note the high variability in the IR pre-post profile due to the small sample size. Demand increases as the day progresses with a peak around 8 PM and demand reduction stays relatively constant.

FIGURE 16 - WEEKDAY BASELINE DEMAND PROFILE AND HOURLY DEMAND REDUCTION (IR MODEL)

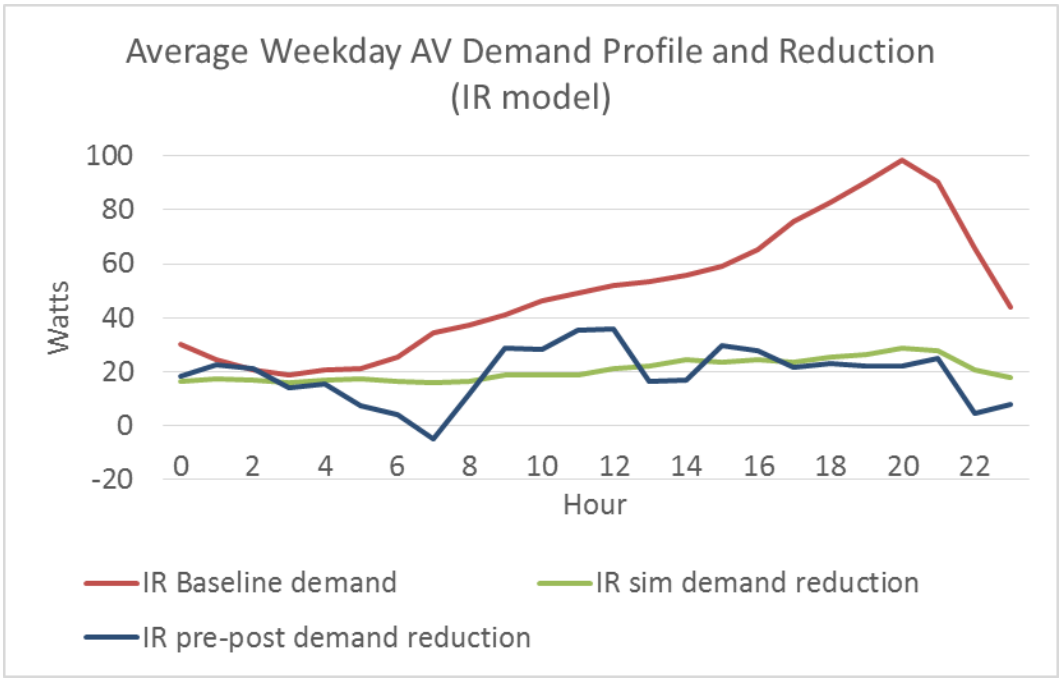
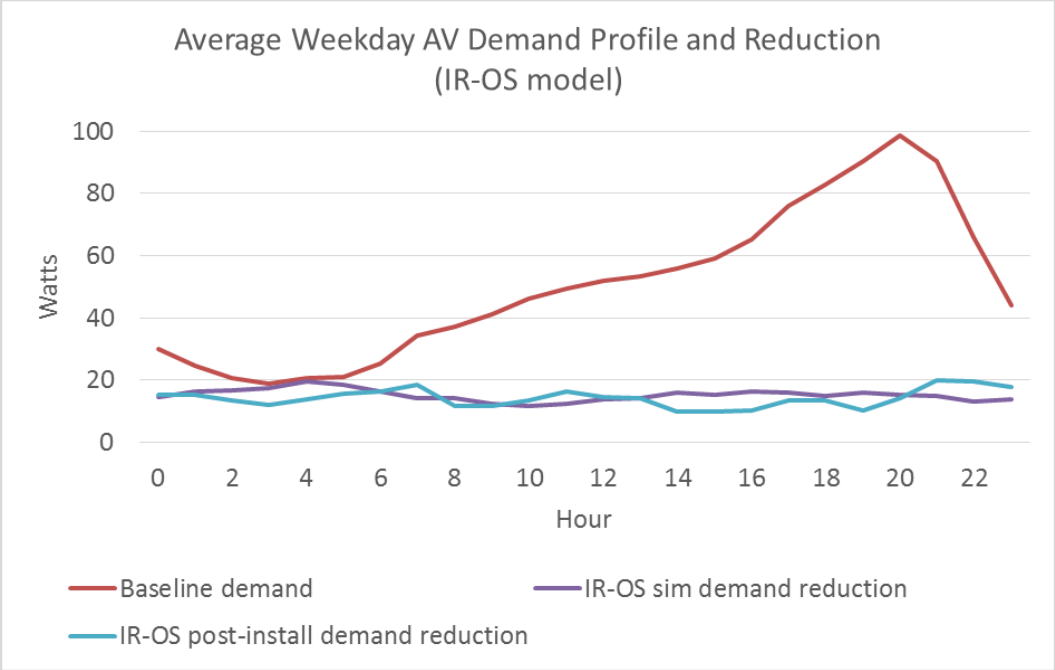


FIGURE 17 - WEEKDAY BASELINE DEMAND PROFILE AND HOURLY DEMAND REDUCTION (IR-OS MODEL)



SURVEY RESULTS

The survey of customers who received either the IR or IR-OS APS resulted in information that can aid in program design and market potential evaluation. These results include information on measure persistence, product features, user impression, and demographic-specific findings. For instance, the survey found that the overall average persistence rate for the APS installations was about 84%. The entire qualitative survey report is replicated in Appendix 4: Scaled Field Placement Survey Report.

MARKET POTENTIAL

Correlations between savings and household demographics were explored, but no significant relationships were observed. The intention was to establish the best target residential customer segments and a more detailed market potential study using California household demographics. However, since there were no defensible correlations with any of the demographic data points that were gathered, it is most appropriate to treat the California population as a single group when developing a program and market potential. At best, the survey results do show that older customers may be less likely to adopt the technology and households with children are more eager to install additional strips.

Using the market size in Table 5 and savings values listed in Table 10 and Table 11, the total energy and demand savings potential were estimated. Table 12 lists the estimated potential for California and the IOUs using the simulated and pre-post approaches. The total energy savings potential is for complete market penetration with 80-87% persistence rate determined by the customer survey.

The estimates provide a range in order to capture the different energy savings findings for each model. However, it may be inappropriate to use these figures as a comparison. Rather, using both models in a program could potentially improve the outcome by giving the customers a choice and diversifying the offering.

TABLE 12 - ESTIMATED CALIFORNIA AND IOU MARKET POTENTIAL WITH 100% PENETRATION, ACCOUNTING FOR PERSISTENCE RATE[4]

Territory	# AV systems	Energy savings potential [GWh/yr]		On-peak demand reduction potential [MW]	
		IR	IR-OS	IR	IR-OS
PG&E	10,385,200	1,080-1,850	990-1,070	207-215	60-145
SCE	10,889,100	1,130-1,930	1,040-1,120	217-226	95-152
SDG&E	2,411,000	250-430	230-250	48-50	21-34
California	28,220,500	2,930-5,010	2,700-2,900	562-586	246-393

There was a slight difference in persistence between the two models as determined by the scaled field placement customer surveying. Although every attempt was made to weight the persistence rates by demographics for each model's population, there were some demographic differences between the two populations that could not be accounted for. Additionally, the IR model was surveyed longer after installation, on average. Although the overall average persistence rate for all installations was found to be 84%, adjustments in weighting based on the persistence sensitivity to demographics suggested that there were indeed inherent differences in persistence between the two products. Thus the market potential uses 83% and 87% persistence for the IR and IR-OS models, respectively. However, any program that opts to use a single deemed savings or persistence rate should use 84% for the product class unless additional data becomes available.

The total energy savings potential amounts to about 4% of California residential energy consumption, which is slightly less than previous estimates of standby load consumption in the residential market. Note that these results are based on a range of savings results due to the alternate simulation and pre-post methods.

Simple payback was not calculated since there was large variation in market prices and may not represent unit cost for future programs. The annual cost savings based on an assumed blended rate of $.015/kWh and the savings listed in Table 10 is about $17-$18 and $19-$32 for the IR-OS and IR models, respectively.

[4] Range due to varying energy savings estimates from each method, simulated and pre-post.

DISCUSSION AND CONCLUSIONS

Tier 2 APS devices are proven to be effective at reducing consumption and demand in residential AV settings with a high degree of success. However, despite this proven success the market penetration, availability, and awareness of such devices remains low. This could largely be due to few available models relative to standard power strips, resistance to perceived complication of home electronic systems, concerns of AV device failure, relatively low billing savings per installation, and high cost compared to standard strips. Given these factors and the large market potential, it would be worth pursuing a larger pilot or full program should the economic and societal benefits of a utility program be deemed positive.

Installing the APS is simple and straightforward in most cases and would be easy for the typical homeowner or a direct install service provider. Some AV systems are too complex or intractable for installation, but those are relatively rare cases. Once installed, use of the APS is very intuitive and needs very little training. Host sites routinely became accustomed to its use after only one or two times of turning on the AV system. This intuitive operation is important when trying to encourage market transformation of an entrenched consumer product segment like power strips.

Persistence of installed power strips in the scaled field placement was about 80% and 87% for the IR and IR-OS models, respectively. However, normalizing these persistence rates based on age demographics of the test populations may slightly alter these rates. Additionally, continued monitoring of any future programs can provide improved understanding of measure persistence over a long time and with a larger population. The primary reason for removal after installation was active shutdowns of the AV system while the customer was still using it or wanted it to remain on. Examples of this would be customers who leave their TVs on for pets, don't use IR remote controls, like to leave the TV on all day, and other such situations.

Energy and demand savings of the APS installations were determined using two complementary methods. Each method has advantages and disadvantages and equally compelling arguments can be made for both. Considering this, results were presented for both methods. Program developers are encouraged to weight each method's results equally unless they see reason to favor one over the other. The primary concern with the simulated method is that the approach may not fully account for user interaction with the APS since the loads are never actually switched off. The primary concern with the pre-post method is that behavioral patterns may have a significant degree of variation between pre and post periods that is difficult to mitigate without larger sample sizes and longer monitoring periods.

Two models of Tier 2 AV APS devices with similar control strategies were tested; the purpose of this was not to provide a product comparison but rather to have a better understanding of the Tier 2 APS product class and its offerings, in general. Depending on the savings calculation method and the APS model, the average annual savings are between 110 and 214 kWh (25%-50%). Considering the widespread and almost ubiquitous consumer market, this technology presents a large energy savings opportunity in California and elsewhere.

RECOMMENDATIONS

Since the market potential for this device is so large and is not expected to change in the coming years, a supporting program could save substantial energy in an unaddressed end-use in California.

Future steps towards market adoption could include the following:

- Standardized method of testing future APS products without extended M&V studies such as this one.
- Program evaluation protocols that do not involve extended, costly monitoring at individual homes.
- A more robust product sensor design that is less likely to be lost or removed from remote control line of sight.
- Incorporate RF or Bluetooth remote sensing to match new AV equipment such as streaming content devices and game consoles. This could increase persistence rates.
- Consider using both APS models in a program in order to diversify offering and improve overall persistence rate by giving customers options. The differing designs could be offered with tiered rebates or as a single product class, depending on future program design analysis.
- Improve understanding of persistence rates with continued monitoring of any future program and follow-up surveying.
- Conduct additional pre-post testing of the IR model to improve sample size and certainty, as needed.

APPENDICES

APPENDIX 1: MONITORING PERIOD LENGTH AND VARIABILITY

One concern with monitoring energy use with a high dependence on behavior and irregular patterns is the length of the monitoring periods. If the monitoring period is too short, results could be inaccurate as they don't fully incorporate the daily variation in use patterns. On the other hand, lengthy monitoring periods are difficult due to host site patience, expense, and project timelines. This study made every attempt to strike a balance between these two competing motivations.

The monitoring period lengths for each site are plotted in Figure 18 and Figure 19.

FIGURE 18 - BASELINE PERIOD DURATION FOR EACH SITE

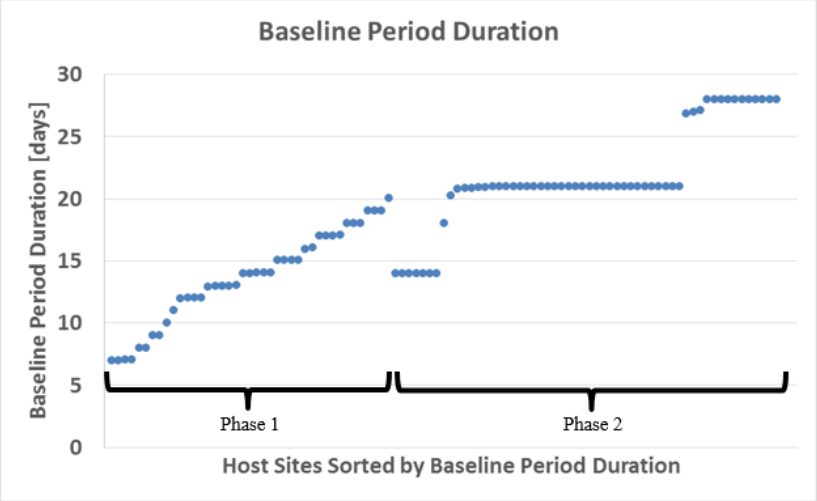
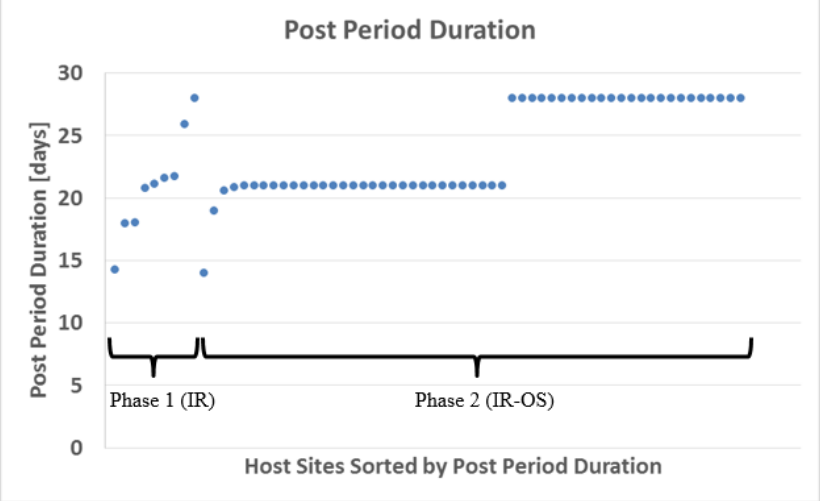


FIGURE 19 - POST PERIOD DURATION FOR EACH SITE



Several analyses were performed in order to validate the accuracy of the results and the monitoring period length. First and foremost, whenever possible confidence intervals for each site were established based on daily variations in use and savings. These 90% confidence intervals provide a statistical measure of user variability. Tighter confidence intervals imply more consistent user behavior and sufficient monitoring length while larger confidence intervals suggest the opposite. Some of the sites had high variability; however, removing these sites from the dataset did not alter the overall average baseline usage and savings findings. Figure 20, Figure 21, and Figure 22 show the baseline usage, post usage, and simulated savings for each site with confidence intervals based on daily variation at each individual site.

FIGURE 20 - BASELINE USAGE WITH 90% CONFIDENCE INTERVALS BASED ON DAILY VARIATION, WHERE POSSIBLE

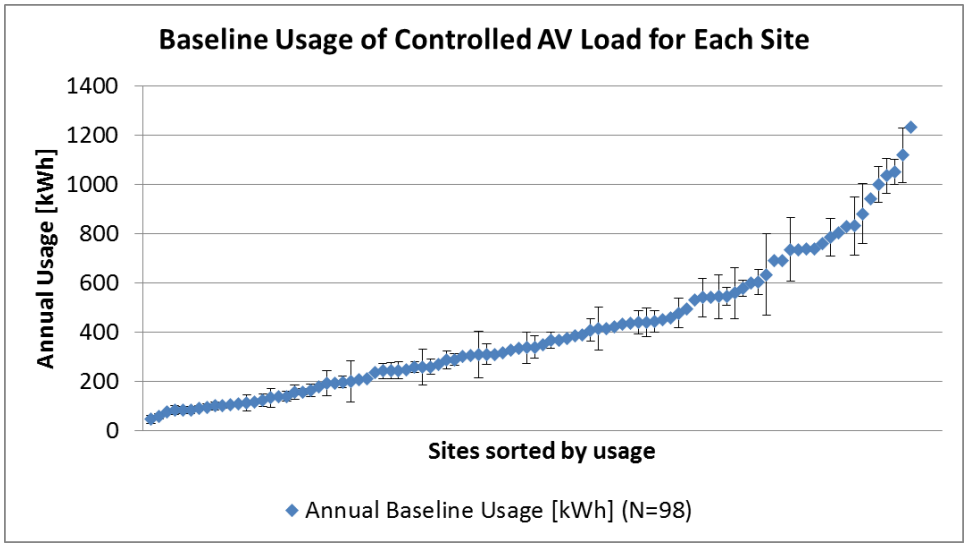


FIGURE 21 - POST ANNUAL USAGE WITH 90% CONFIDENCE INTERVALS BASED ON DAILY VARIATION, WHERE POSSIBLE

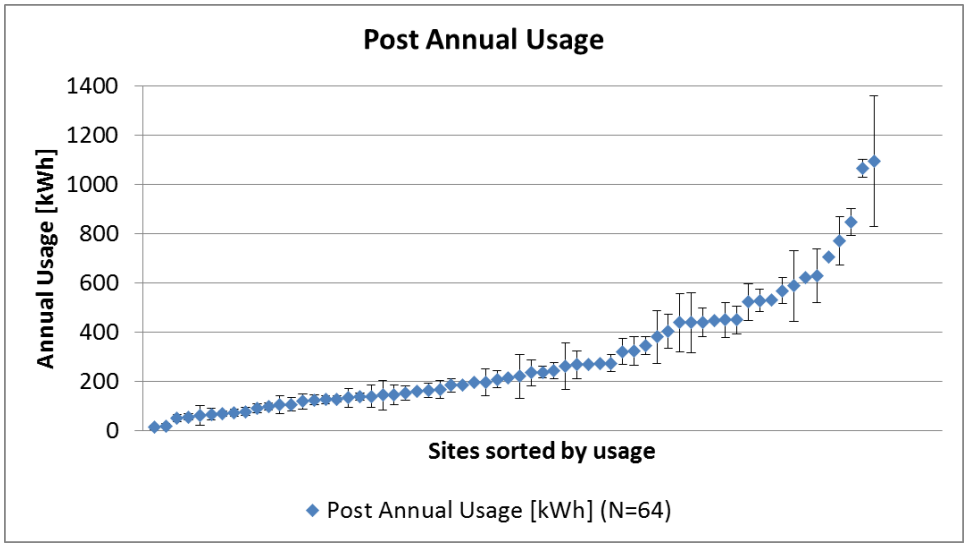
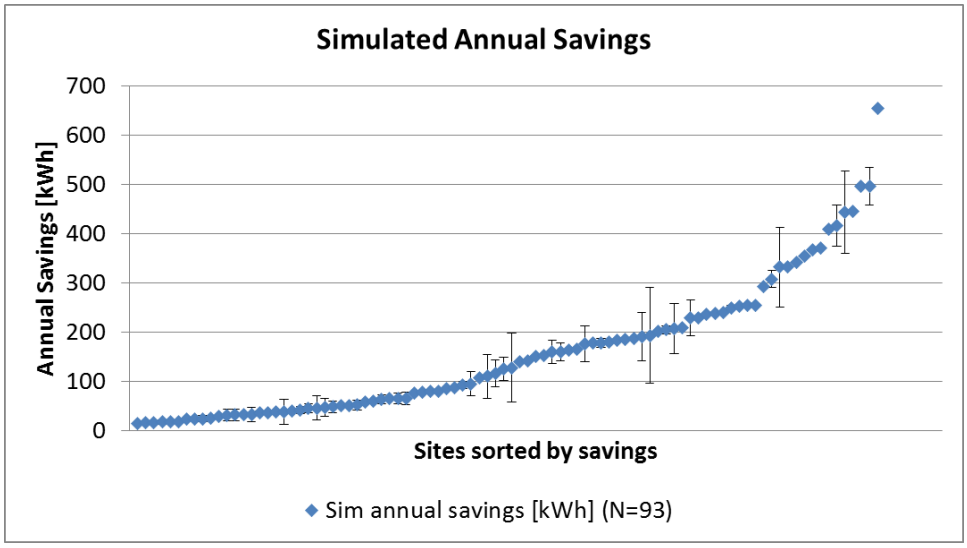
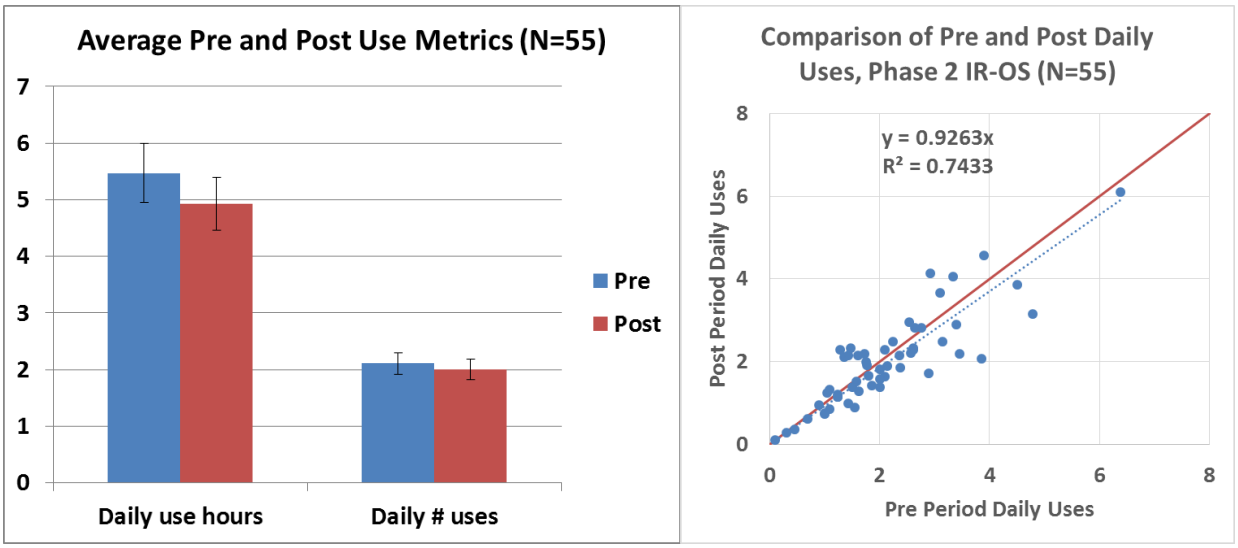


FIGURE 22 - SIMULATED SAVINGS WITH 90% CONFIDENCE INTERVALS BASED ON DAILY VARIATION, WHERE POSSIBLE



Another method of ensuring consistent behavior patterns between the pre and post periods is by looking at the number of daily uses and use time. Figure 23 shows the average number of uses and average use time across all sites in phase 2 for the baseline and post periods. This is to assure that the pre-post savings calculated for the IR-OS model are derived from periods with similar usage patterns for fair comparison. The nearly identical number of uses suggests that overall use patterns in the total population remained consistent from pre to post. The second plot comparing pre and post daily uses also reinforces this conclusion. Additionally, the slight decrease in average use time implies successful active savings.

FIGURE 23 - DAILY USES AND USE TIME FOR PHASE 2 IR-OS PRE-POST TESTING



Only a small sample of sites were selected for pre-post monitoring during phase 1 with the IR model. Thus, it is important to confirm that the usage patterns were consistent across pre and post periods and that the sample was representative of the larger population. Figure 24 shows the average number of uses and average use time across the 9 sample sites that were

selected for IR model pre-post testing in phase 1. This is to assure that the pre-post savings calculated for the IR model are derived from periods with similar usage patterns for fair comparison. Similar to the larger population that was used for the IR-OS pre-post testing, the comparison in use patterns from pre to post periods suggests that overall user behavior and AV system use frequency was consistent.

FIGURE 24 - DAILY USES AND USE TIME FOR PHASE 1 IR PRE-POST TESTING

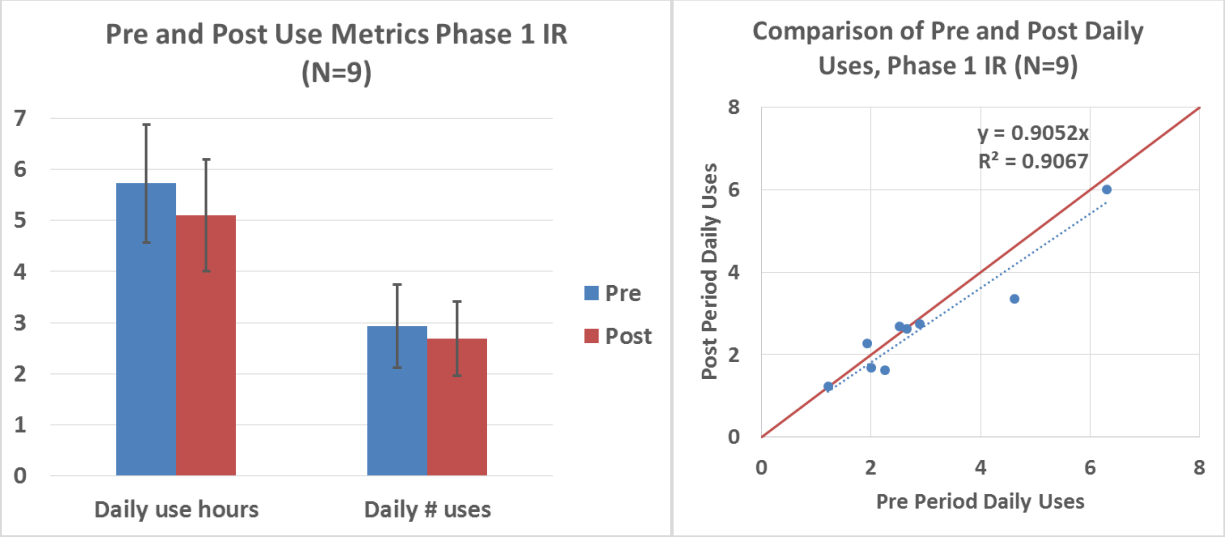


Table 13 lists some of the demographic data collected for the total IR population and the sample population used for pre-post testing. Although the number of controlled devices, number of residents, and baseline energy were relatively consistent, the sample population did have fewer residents who stay home and no households with children.

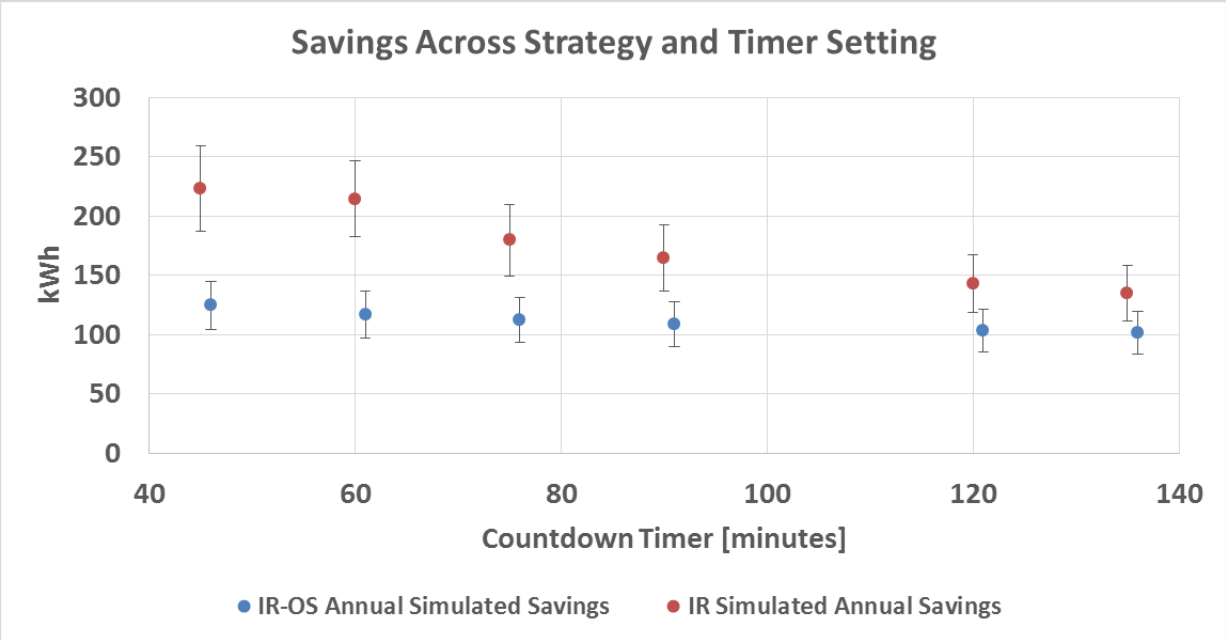
TABLE 13 - DEMOGRAPHICS OF IR SIMULATED SITE POPULATION AND PRE-POST TESTING SAMPLE POPULATION

	IR total population (N=98)	IR pre-post sampling (N=9)
Average number of controlled AV devices	3.6	3.8
Number of MFR sites	28 (29%)	4 (44%)
Number of SFR sites	70 (71%)	5 (56%)
Number of households with children	37 (38%)	0 (0%)
Average number of residents	3.1	2.7
Average self-reported weekly TV hours	33	36
Stay at home (parent/retiree/work from home/etc.)	65%	44%
Baseline annual energy [kWh]	432	461

Appendix 2: Sensitivity to Active Shutdown Timer Setting

In addition to simulating the default timer settings, a range of timer settings were simulated. This was primarily motivated by the fact that each APS model has different timer settings and to illuminate the sensitivity of savings to timer settings. Figure 25 shows that the IR model savings have higher sensitivity to timer settings than the IR-OS model. This due to the additional OS sensor recognizing user activity that the IR model does not consider.

Figure 25 - Savings for a range of timer settings



APPENDIX 3: SURVEY OF M&V HOST SITES

Initial Screening:

1	Do you have vacation plans within the next 6 weeks?	
2	Do you live in an apartment/multi-family building or a standalone house?	
3	Do you rent or own?	
4	Number of residents in household	
5	Ages of residents (please list)	
6	Please list the A/V equipment you have at your main TV (DVD, Xbox, PS, Roku, AppleTV, Wii, Stereo, Powered Speakers, etc.)	
7	What type of TV is your main TV? (Cathode Ray Tube, Rear/Digital Projection, LCD, LED, Plasma)	
8	Do you have cable TV or satellite TV service?	

Baseline (pre-period) install visit survey:

Tier 2 APS M&V Host Customer Survey

Host Customer:

Topics to be answered at baseline installation:

Date:
Type of building:
Number of TVs in house. Where is the monitored one located?
List of A/V equipment and age of each. Controlled/uncontrolled as installed on strip.

Device	Make/Model	(Un)controlled	Active Power	Standby Power

Do you plan on replacing or adding any A/V equipment and when?

How many hours of TV use per week?

Do you unplug or turn off the power strip switch when not in use?

APS (post-period) install visit survey:

Tier 2 APS M&V Host Customer Survey

Host Customer:

Topics to be answered at APS installation:

Date:

List of A/V equipment and age of each. Controlled/uncontrolled as installed on strip.

Device	Make/Model	(Un)controlled	Active Power	Standby Power

Was the blinking LED light intrusive or disruptive?

Did it ever start blinking on its own, that you noticed?

Final (data collection) visit survey:

Tier 2 APS M&V Host Customer Survey

Host Customer:

Topics to be answered at data collection:

Date:

List of A/V equipment and age of each. Controlled/uncontrolled as installed on strip.

Device	Make/Model	(Un)controlled	Active Power	Standby Power

Was the blinking LED light intrusive or disruptive?

Did it ever start blinking on its own, that you noticed?

Did the strip ever turn off equipment while you were actively using it?

Would you like to keep the strip installed where it is (move for customer if desired)?

APPENDIX 4: SCALED FIELD PLACEMENT SURVEY REPORT

The following is a reformatted recreation of the final scaled field placement customer survey report written by Illume and included with their permission.

ILLUME

Tier 2 Advanced Power Strips: Survey Results

Prepared for:
TechniArt
Pacific Gas & Electric
San Diego Gas & Electric

February 2016

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Foreword

This report documents the key findings and detailed results of a study commissioned by TechniArt on behalf of San Diego Gas & Electric and Pacific Gas and Electric (referred to as the utilities). The primary objective of the study was to explore customers' experiences with and drivers of persistence of Tier 2 Advanced Power Strips.

Two manufacturers were included in the field trial. The Tier 2 Advanced Power Strips were installed within three specified zip codes in three waves, from October 2014 through July 2015.

It is important to note that while the field trial included devices from different manufacturers, neither the field trial nor the study were designed to test the differences in response and/or persistence between those manufacturers. Rather, any differences by manufacturer identified within the report are intended to highlight key findings related to potential drivers of persistence in the category (e.g., age of population serviced and differences in time frame between installation and survey).

There are numerous variables that can drive persistence, including delivery channel (e.g., direct installation, kits, rebates), demographics (age, children in household, income), time of product installation, time of survey, targeting approach, and differences in technologies. Testing the differences in persistence and other metrics by any of these design and delivery variables requires a planned field trial and study design. Program implementers may wish to consider a field trial that focuses on certain persistence drivers related to their population or program design.

1 Executive Summary

1.1 Introduction

In 2015, San Diego Gas & Electric (SDG&E) and Pacific Gas & Electric (PG&E) field trialed a Tier 2 advanced power strip (Tier 2 APS) direct install program. The field trial targeted a total of 1,100 homes in SDG&E's service area. The field trial included Tier 2 APS devices through two manufacturers: one that was an infrared model (IR model) and one that was an infrared occupancy sensor model (IR-OS model). TechniArt implemented the field trial.

TechniArt, on behalf of SDG&E and PG&E, contracted with Illume Advising, LLC, (ILLUME) to complete a study to explore customers' experiences with the Tier 2 APS and their actions that could affect measure persistence. Specifically, the following researchable areas were explored:

- Overall satisfaction with the Tier 2 APS;
- Persistence rate;
- Baseline conditions prior to the installation of the Tier 2 APS;
- Modifications to the equipment after installation;
- Customer likes and dislikes about the technology;
- Number, frequency and customer reaction to shutdowns;
- Customer knowledge and understanding of the product;
- Household characteristics.

1.2 Approach

ILLUME administered a 10-minute email survey to a sample of IR model and census of IR-OS model participants. To increase response, follow-up telephone surveys were completed with IR-OS model participants. These surveys were completed approximately 14 to 29 weeks after the IR model power strip was installed and 3 to 13 weeks[5] after the IR-OS model power strip was installed. One hundred twenty-five IR model and 77 IR-OS model customers were surveyed. The data was weighted by manufacturer and retiree status to account for the disproportionate sampling and response by manufacturer and the higher percentage of households with a retired member among survey respondents than in the population of installed households.

1.3 Key Findings

Findings Related to Persistence, Satisfaction, and Product Knowledge

The Tier 2 advanced power strips have an 84% persistence rate. There are a number of factors that affect the persistence rate**.** Television shutdowns negatively affect the persistence, with those having a shutdown being more likely to remove the device. Survey respondents that experienced at least one shutdown had a 78% persistence rate compared

[5] Respondents with fewer than 4 weeks between installation date and survey date were excluded from analysis.

to a 91% persistence rate among respondents that did not. Furthermore, the occurrence of television shutdowns was the most frequently cited reason for removing the Tier 2 APS.

Other drivers that that appear to affect persistence include: age or retiree status of respondent (fewer retired respondents still had the Tier 2 APS installed at the time of the survey) and time between installation and survey (persistence decreased as the length of time between installation and survey increased). The differences in persistence among these variables are not statistically significant and should be viewed as indicators only.

Seventy percent of respondents are satisfied with the Tier 2 advanced power strips; device shutdowns and respondent age appear to affect satisfaction. On a scale of one to seven, where seven is very satisfied, 70 percent of respondents indicated they were satisfied with the Tier 2 APS (rated a five through seven on a seven-point scale) and another 12 percent gave a neutral satisfaction rating of four, resulting in a mean satisfaction rating of 5.2. Having the Tier 2 APS turn off devices when not in use and saving energy are the product features respondents most frequently noted they like best. Furthermore, almost half (47%) reported that there are no features or functionality of the Tier 2 APS that they dislike.

Respondents that experienced having the Tier 2 APS turn off their television during viewing gave the Tier 2 APS significantly lower overall satisfaction ratings. These respondents were also significantly less likely to recommend the Tier 2 APS or say they would purchase another Tier 2 APS for use elsewhere in their home.

Respondents 65 and older rated their satisfaction with the Tier 2 APS lower than the younger respondents. Consequently they are less likely to have recommended or plan to recommend the product, are less likely to purchase another Tier 2 APS, and are more likely to state there are features or functionality they dislike.

Seventy percent of households said they recommended or are likely to recommend the Tier 2 advanced power strip to friends or family, 35% would purchase another for use elsewhere in their home. Forty-one percent of respondents said they have recommended the Tier 2 APS, and of those who have not yet recommended the Tier 2 APS, 48 percent said they are likely to recommend it. Thirty percent also remained undecided at the time of the survey about whether or not they would purchase another Tier 2 APS.

Additional Findings

Respondents have a good understanding of how the Tier 2 advanced power strip works. Sixty percent say they understand how to use the Tier 2 APS very well (rated a six or seven on a seven-point scale) and 55 percent are very confident (rated a six or seven on a seven-point scale) they could set up the Tier 2 APS somewhere else.

Households with children report higher product knowledge and are more likely to purchase another Tier 2 advanced power strip. These households rated their understanding of how the Tier 2 APS works and their confidence in their ability to set it up elsewhere significantly higher than households that do not have children living in them. A significantly higher percentage also said they would purchase another Tier 2 APS, 46 percent compared to 28 percent among households that do not have children.

Compared to respondents that have not experienced shutdowns, respondents that have experienced shutdowns are significantly more likely to know they can make adjustments to the shutdown settings. Seventy-eight percent of respondents that have had a shutdown knew they could adjust the settings compared to half of those that have not had a shutdown.

Respondents have difficulties turning on the devices plugged into the Tier 2 advanced power strip. This may indicate an opportunity for customer education during the direct install process**.** These difficulties were commonly mentioned as both a reason for unplugging the Tier 2 APS and as a feature respondents disliked. Specific difficulties respondents mentioned included having to push an additional button to turn devices on, that the television is slow to turn on and sometimes being uncertain if a device is on.

2 Introduction and Objectives

Under the direction and funded by San Diego Gas & Electric and Pacific Gas & Electric, TechniArt recently field trialed a program that offered customers and direct installed a Tier 2 APS. The field trial targeted a total of 1,100 homes in three zip codes (91911, 92008, 92128).

TechniArt installed the devices in two waves. They first installed the IR model Tier 2 APS devices from October 2014 to January 2015. They then installed the IR-OS model Tier 2 APS devices from April to June 2015. The field trial program had a goal of installing a total of 1,100 power strips (750 IR model and 350 IR-OS model) to assess customer satisfaction and persistence rate. At the time of survey sampling, a total of 870 (604 IR model and 266 IR-OS model) Tier 2 APS devices were installed.

SDG&E provided lists of customers in three zip codes used for door-to-door recruitment for participation in the field trial; customers who had opted out of utility communications were omitted from the targeted homes. In order to qualify, the homes needed to have a television. Respondents from the same zip codes were targeted for installation of both Tier 2 APS manufacturers.

The sponsoring utilities had an objective in having follow up surveys completed with participants in the field trial to gauge their satisfaction with the Tier 2 APS as well as to understand issues related to persistence, plugged in equipment, and overall impression of the device.

The following researchable areas were explored:

- Overall satisfaction with the Tier 2 APS;
- Persistence rate;
- Baseline conditions prior to the installation of the Tier 2 APS;
- Modifications to the equipment after installation;
- Customer likes and dislikes about the technology;
- Number, frequency and customer reaction to shutdowns;
- Customer knowledge and understanding of the product;
- Household characteristics.

3 Approach

3.1 Survey Methodology

The study consisted of a 10-minute email and telephone survey of residential customers. The surveys were completed approximately 14 to 29 weeks after the IR model power strip was installed and 3 to 13 weeks after the IR-OS model power strip was installed. Six respondents with fewer than 4 weeks between installation date and survey date were excluded from the analysis to ensure sufficient time to experience the Tier 2 APS and to allow them time to remove it if they were dissatisfied with it. ILLUME's market research partner, Leede Research, sent emails to elicit participation in a web-based survey with a goal of achieving 75 completed surveys from each manufacturer.

The completion target for the IR model was exceeded, at 125 completed surveys, all through the web-based survey platform. A $10 incentive was used to encourage participation in the survey. These surveys were in field from April 28 through May 10, 2015

Seventy-seven surveys with IR-OS model participants were also completed. Because of the later installation period for the IR-OS model Tier 2 APS, the survey was sent in two waves. The first wave, surveying participants from March 12 and May 30, 2015, was fielded June 10 to June 28, 2015. The second wave, surveying participants from June 1 and June 18 2015, was fielded August 4 through August 21, 2015. Table 1 displays the installation and survey date ranges.

TABLE 1. INSTALLATION AND SURVEY DATE RANGES

	IR model	IR-OS model (Wave 1)	IR-OS model (Wave 2)
Installation date range	October 2014 – January 2015	March 2015 – May 2015	June 2015
Survey date range	April 28 2015 – May 10 2015	June 10-June 28, 2015	August 4 – August 19, 2015
Average number of weeks from install to survey	23	8	9

There were considerably fewer participants in the IR-OS model participant population; therefore, while most surveys were completed online with respondents recruited via email, follow-up telephone surveys were also completed to meet the completion target. Also due to the smaller sample size and a desire to achieve higher than the targeted 75 responses, respondents were offered a higher incentive ($20) for completing the survey[6].

The survey instrument was modified slightly after the IR model survey was fielded to further investigate certain areas based on client feedback[7]. In order to maintain comparability

[6] Literature suggests that differences in incentive levels such as this should not bias results; rather, the implication is better quality data due to higher response.

[7] Additional questions asked: if when changes were made, the television was moved to the wall or an "always on" outlet; if respondents used the power saving feature on their television prior to installation; how important different factors are in satisfaction with the Tier 2

between the two surveys, questions were only added and not modified or removed. The IR model version of the survey is included as Appendix A and the IR-OS model survey is included as Appendix B with additional questions highlighted.

Table 2 provides an overview of the samples and response rates achieved for each manufacturer. As discussed in Section 2, respondents from the same zip codes were targeted for installation of both Tier 2 APS devices and both waves contained similar percentages of respondents in those zip codes.

TABLE 2. SURVEY RESPONSE RATES

	IR model	IR-OS model (Wave 1)	IR-OS model (Wave 2)
Total installation records	604	222	44
Records with contact information	584	220	43
Records with email	564	198	42
Email survey response	125	56	14
Email survey response rate	**22%**	**28%**	**33%**
Number of non-responders and phone only customers	-	164	29
Phone call response	-	7	
Phone call response rate	-	4%	
Overall response rate	**22%**	**29%**	
Removed from analysis: installed < 4 weeks	0	6	
Removed from analysis: didn't provide retiree status in survey	**9**	4	
Final data points included in analysis	**116**	**67**	

APS; if respondents wouldn't purchase another Tier 2 APS why not; and if they would purchase another Tier 2 APS, where it would be used.

3.1 Demographic Analysis and Weighting

Initial comparative analysis of the survey demographics against the population demographics (collected through TechniArt's installation survey) showed potential over-representation of households with a retired member in the IR model survey respondents. Further, survey data analysis indicated lower persistence with older respondents and households with a retired member. This analysis raised the question of whether the data should be weighted by retiree status of the household.

It should be noted that demographic data was missing for about half of the IR model participants, because demographic data was added to the intake survey midway through the IR model installation period. However, assuming that IR model participants with demographic data in the installation survey are not systematically different from those without that data, it appears that there were considerably more retirees in the IR model survey dataset than the IR model population (Table 3). If this is indeed the case, unless weighted, the survey results would over-represent retiree perspectives for the IR model. Due to the sufficient difference in the survey versus population and the disproportionate sampling and response by manufacturer, the decision was made to weight the data by retiree status and manufacturer.

TABLE 3. COMPARISON OF POPULATION AND SURVEYED RETIREE STATUS

	IR model Population (N=352)	IR model Surveyed (n=116)	IR-OS model Population (N=266)	IR-OS model Surveyed (n=67)
Retired	30%	47%	23%	24%
Not retired	70%	53%	77%	76%

Source: Installation and survey data. Note the IR model population excludes 252 cases where retiree status is unknown, and IR model and IR-OS model surveys exclude a handful of cases (n=13) where retiree status is not reported. Percentages of surveyed households with a retiree are not weighted.

Age was not considered for this analysis for two reasons. First, the age information captured in the survey is the age of the respondent, not necessarily the age of household members. Given this data point reflects the response of a single person – rather than a household characteristic – it is not as "clean" of a variable as presence of a retiree in the home (a yes or no response). Second, the population data collected during installation did not include the age of respondent, whereas it did collect presence of a retiree. Review of results by retiree and age showed the two variables are closely aligned; therefore, the ILLUME team was comfortable using retiree as a proxy for older age.

4 Overall Findings

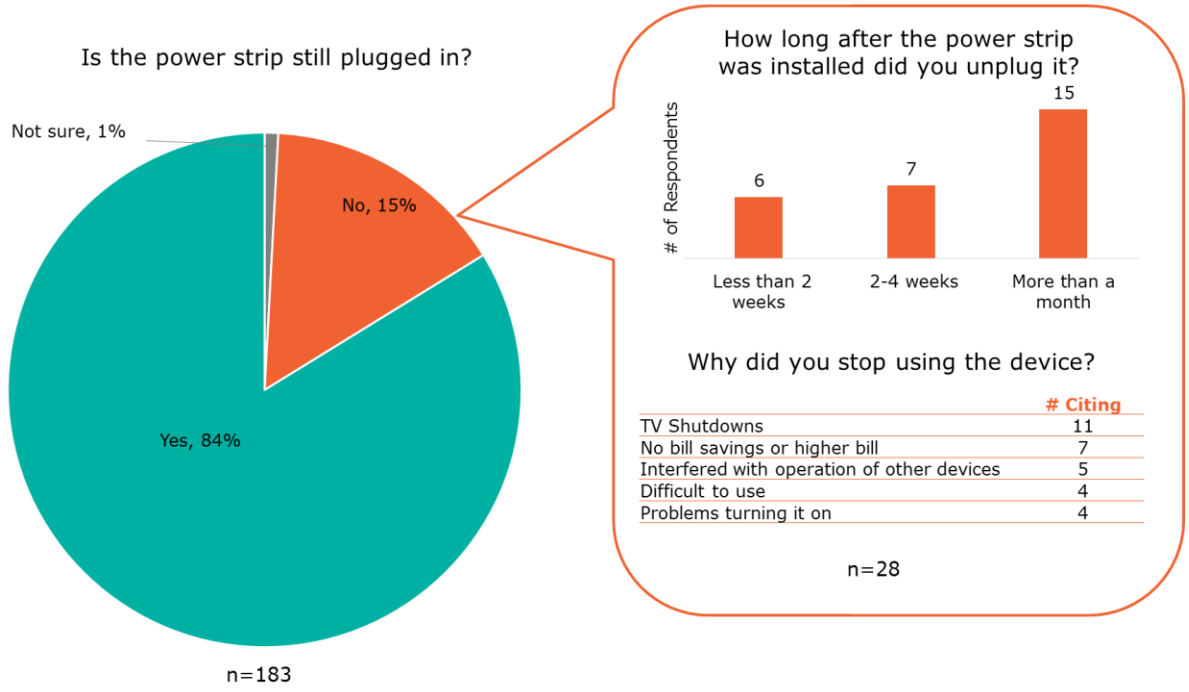
This section of the report presents the key study findings for the Tier 2 APS and consists of four subsections: (1) Persistence; (2) Satisfaction (3) Usage Habits; and (4) Features and Functionality. Note that the analysis represents household experience with the Tier 2 APS (combining IR model and IR-OS model responses).

4.1 Persistence

Persistence Rate

Eighty-four percent of the Tier 2 APS devices were still installed at the time respondents were surveyed. Of those that were removed, 53% (15) were removed more than a month after installation. The incidence of television shutdowns significantly impacted the persistence rate. Respondents that experienced a shutdown had a persistence rate of 78% compared to 91% among those that had not experienced one. Furthermore, television shutdowns were also the most frequently cited reason for removing the Tier 2 APS. This was followed by a lack of savings reflected on the electric bill or a higher electric bill since installation (Figure 1). Customer comments (4) also indicated difficulty in following the instructions given for how to turn on the television and other equipment plugged into the Tier 2 APS.

FIGURE 1. TIER 2 APS PERSISTENCE RATE



There are a number of other factors that could also have an impact on the persistence rate displayed in Table 4. While there are significant differences in persistence rates between respondents that had shutdowns and those that didn't as well as between 45 to 64 year olds and those 65 and older, there are also some additional trends in persistence rates.

Households with retired members tend to have a lower persistence rate as do households that have had the Tier 2 APS installed for longer periods of time. Additionally, whether or not kids under 17 were present in the household did not impact the persistence rate.

TABLE 4. PERSISTENCE RATE WEIGHTED BY MANUFACTURER & RETIREMENT

	n	Installed	Not Installed
Overall	184	84%	15%
Had Shutdown	**177**		
Yes	109	78%*	22%
No	68	91%	8%
Retired Member of Household	**184**		
Yes	53	78%	21%
No	131	86%	13%
Age	**184**		
< 24	5	100%	0%
25 to 44	72	83%	15%
45 to 64	70	87%*	12%
65 and over	32	72%*	28%
Prefer not to say	5	100%	0%
Length of time installed	**173**		
4-10 weeks	43	88%	10%
10-18 weeks	15	83%	17%
18-24 weeks	66	83%	17%
> 24 weeks	49	82%	16%
Kids under 17	**180**		
Yes	78	84%	16%
No	102	84%	16%

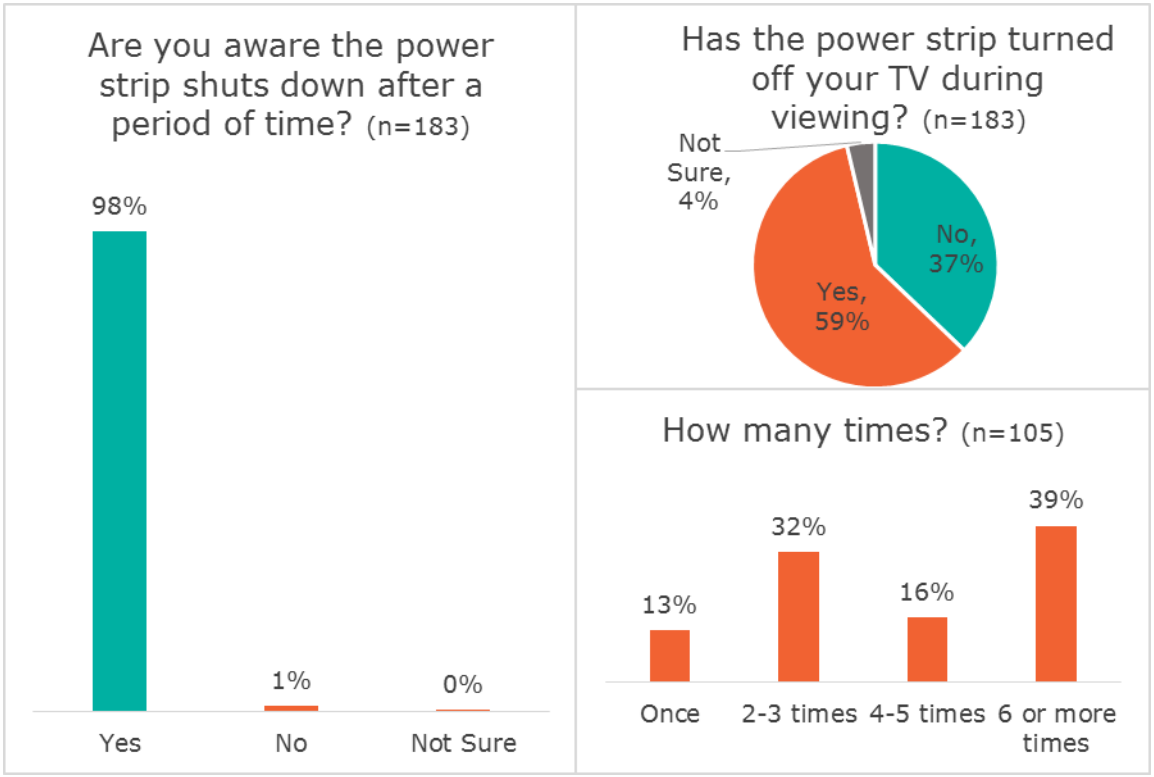
*Difference is significant at p<.10

Device Shutdowns

Nearly all (98%) respondents were aware that the Tier 2 APS shuts down devices after a period of time and most (59%) have experienced this while viewing television (Figure 2). Furthermore, 87 percent of those who experienced a TV shutdown had this happen more than one time, with 39 percent experiencing 6 or more shutdowns. Most respondents that experienced shutdowns simply turned the TV back on (84%), although about 15 percent of those noted that they became angry or frustrated while doing so. There was no difference in

the incidence of shutdowns by the age, number of kids at home or retiree status of the respondents.

FIGURE 2. TIER 2 ADVANCED POWER STRIP TELEVISION SHUTDOWNS



Two-thirds of respondents are aware that they can adjust the shutdown time settings on the Tier 2 APS but fewer than half (40%) who were aware they could adjust the settings made any changes to them. Adjustments to 3-4 hours (43%) and 8 hours (24%) were most common.

Twelve respondents indicated that the Tier 2 APS interfered with their audiovisual activities in some manner other than shutting down. They cited a variety of different problems, with recording problems the only one mentioned by more than one respondent. Four (35%) of the respondents removed the Tier 2 APS as a result of these issues.

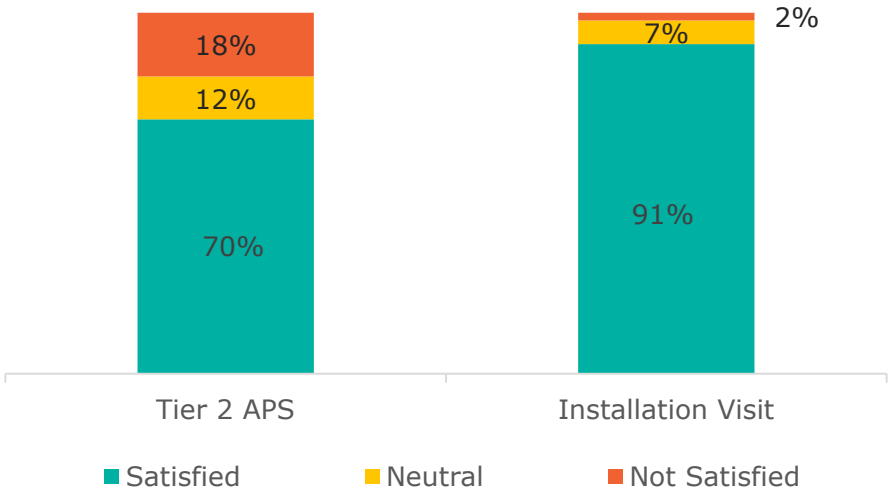
4.2 Satisfaction

Overall Satisfaction

Customers were asked to rate their satisfaction with the device itself as well as the installation visit on a seven-point scale where one is not at all satisfied and seven being very satisfied. The mean satisfaction rating for the Tier 2 APS was 5.2 and the mean satisfaction rating for the installation visit was 6.3. As illustrated in Figure 3, 70% of respondents indicated they were satisfied (rated a five through seven) with the Tier 2 APS and 91% were satisfied with the installation visit, with 95% of the respondents recalling that the installer showed them how to use the Tier 2 APS.

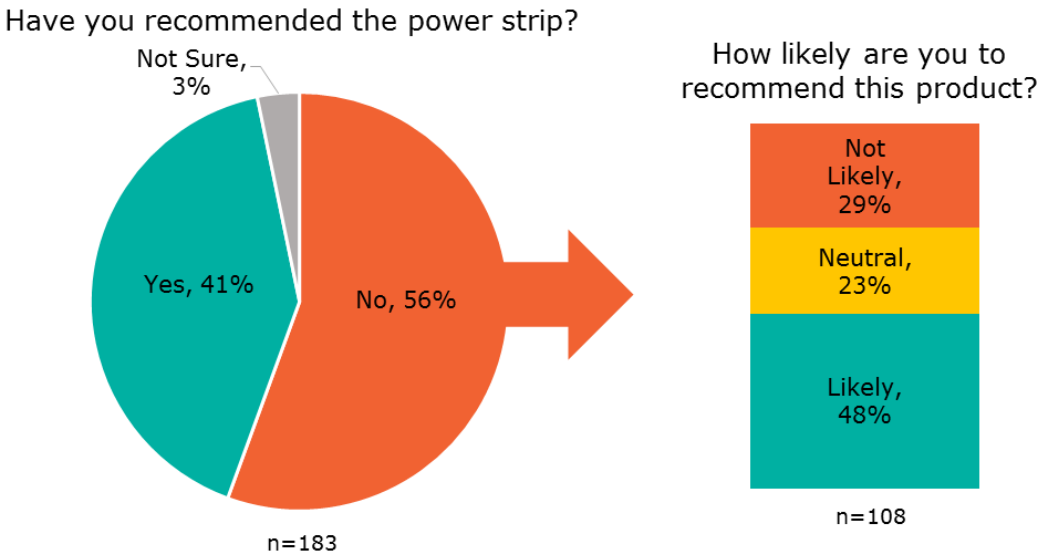
Eighteen percent of respondents indicated they were not satisfied with the Tier 2 APS (rating it a one through three on the seven-point scale). As discussed later in the report, respondents most commonly reported shutdowns as a feature they disliked about the Tier 2 APS, which may have contributed, to the low satisfaction.

FIGURE 3. SATISFACTION WITH THE TIER 2 APS AND INSTALLATION VISIT (N=183)



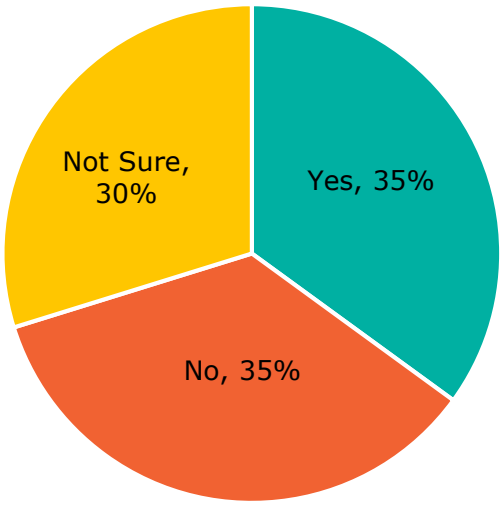
As another measure of satisfaction with the product, customers were also asked if they have, or would, recommend the Tier 2 APS to friends or family. Forty-one percent of the respondents have already recommended the Tier 2 APS. Of those that haven't already recommended the product, 48% stated they are likely (rated a five through seven on a seven-point scale, with seven being very likely) to recommend the product to friends or family. Figure 4 provides more details on the likeliness of respondents to recommend the Tier 2 APS.

FIGURE 4. RECOMMENDATION OF THE TIER 2 ADVANCED POWER STRIP



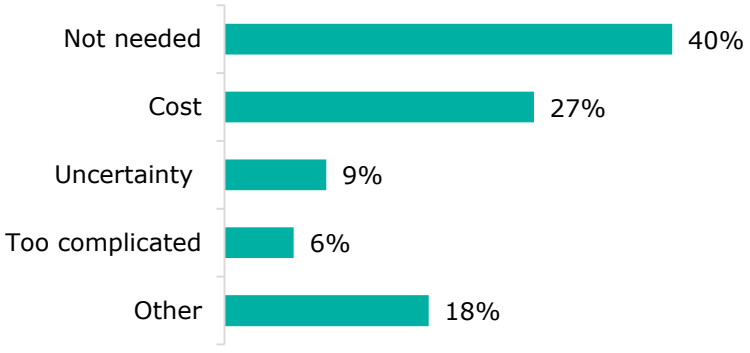
Lastly, respondents were asked if they would purchase another Tier 2 APS for use elsewhere in their home. About a third (35%) said that they would purchase another Tier 2 APS.

FIGURE 5. WOULD YOU PURCHASE ANOTHER ADVANCED POWER STRIP FOR ELSEWHERE IN YOUR HOME? (N=183)



A question was added to the IR-OS model survey in order to gain a better understanding of why respondents would not purchase another power strip for use elsewhere in their home. As shown in Figure 6, the most frequently cited reason was because another Tier 2 APS is not needed (cited by 40%, or 11 respondents), followed by cost (27%, or 8 respondents). The remaining respondents cited a variety of reasons such as uncertainty about the energy savings, advantages or functionality, devices being too complicated or producing too much light, lack of interest or the ability to turn off devices oneself.

FIGURE 6. WOULD YOU PURCHASE ANOTHER ADVANCED POWER STRIP FOR ELSEWHERE IN YOUR HOME? (N=28, IR-OS MODEL SURVEY ONLY)

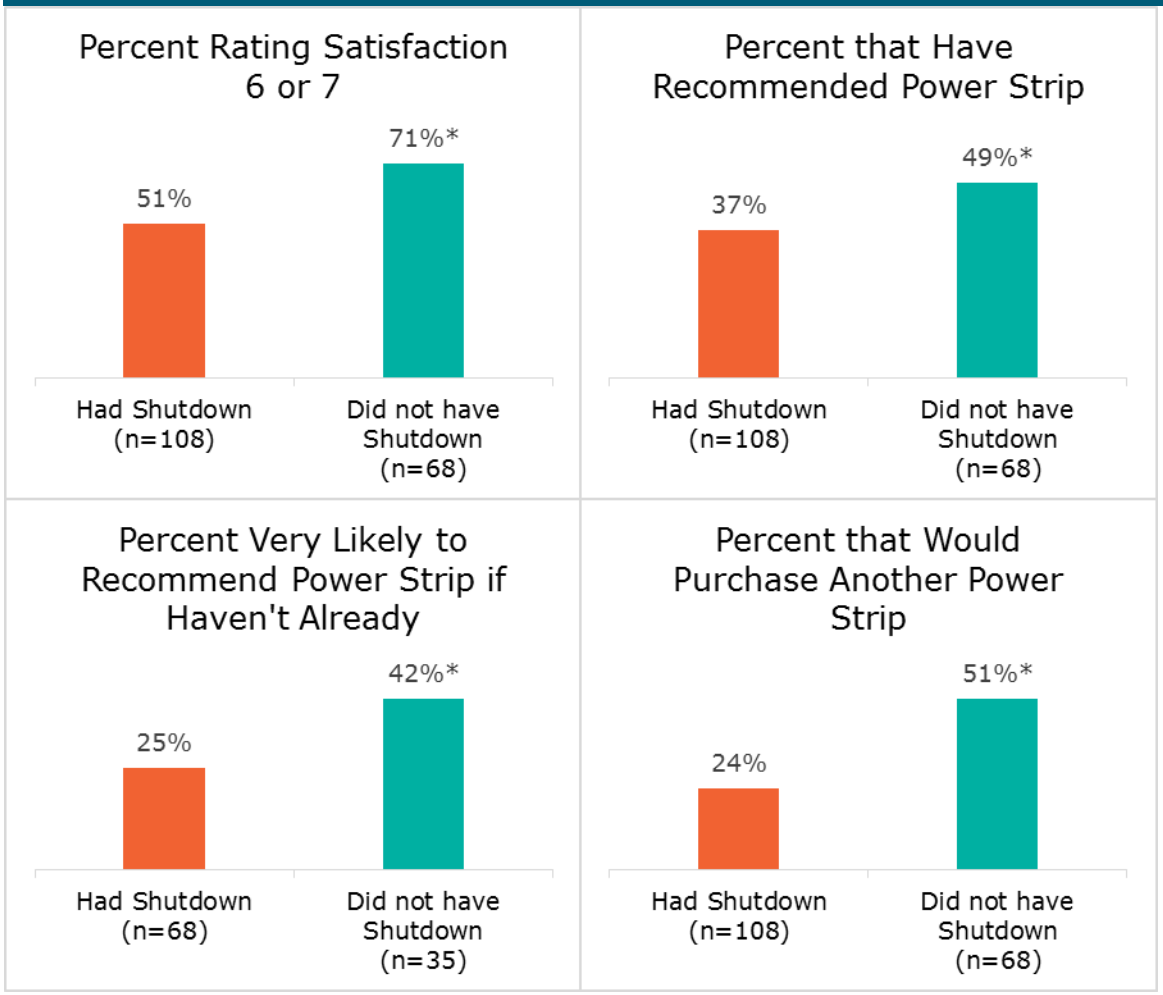


Respondents that said they would purchase another Tier 2 APS were asked in which room they would use it. The most common locations respondents would use another Tier 2 APS are the bedroom (53%) and secondary media room (38%).

Impact of Device Shutdowns on Satisfaction

Device shutdowns have a significant negative effect on product satisfaction. As illustrated below in Figure 7, respondents that experienced a device shutdown while viewing television had significantly lower satisfaction than those that did not experience one. Respondents that experienced shutdowns were also significantly less likely to recommend the advanced Tier 2 APS or say they would purchase another Tier 2 APS for use elsewhere in their home. They were also significantly more likely to state there were product features or functionality they disliked.

FIGURE 7. IMPACT OF DEVICE SHUTDOWNS (N=176)



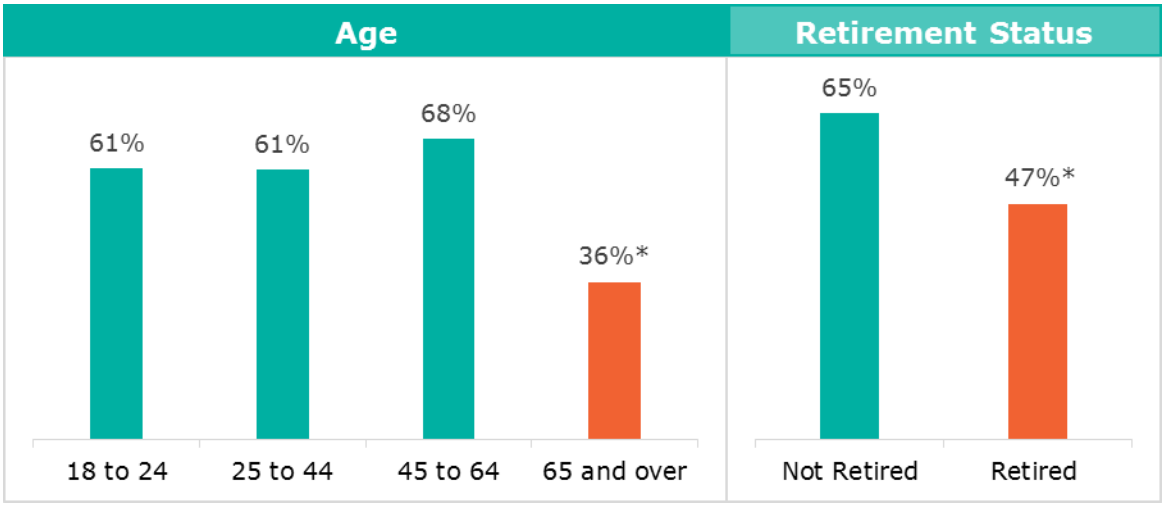
*Difference is significant at p<.10

Satisfaction Among Demographic Groups

Satisfaction is significantly lower among retirees and respondents 65 and older (Figure 8). Those 65 and older rated their satisfaction lower, and were less likely to have recommended the Tier 2 APS already or to recommend it in the future if they haven't already and are less likely to purchase another Tier 2 APS than younger respondents. Similarly, households with

a retired member rated their satisfaction lower and are less likely to recommend the Tier 2 APS if they haven't already.

FIGURE 8. PERCENT VERY SATISFIED (RATED SATISFACTION SIX OR SEVEN ON A SEVEN-POINT SCALE)? (N=183)



*Difference is significant at p<.10

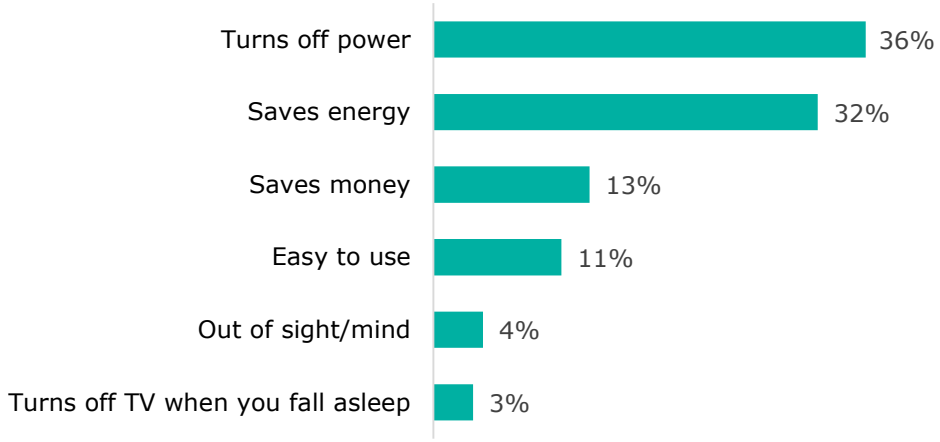
Households with children at home are significantly more likely to purchase another Tier 2 APS for use elsewhere in their home. Nearly half (46%) would purchase another Tier 2 APS compared to roughly one-quarter (28%) of households that do not have children at home.

4.3 Features and Functionality

Product Likes and Dislikes

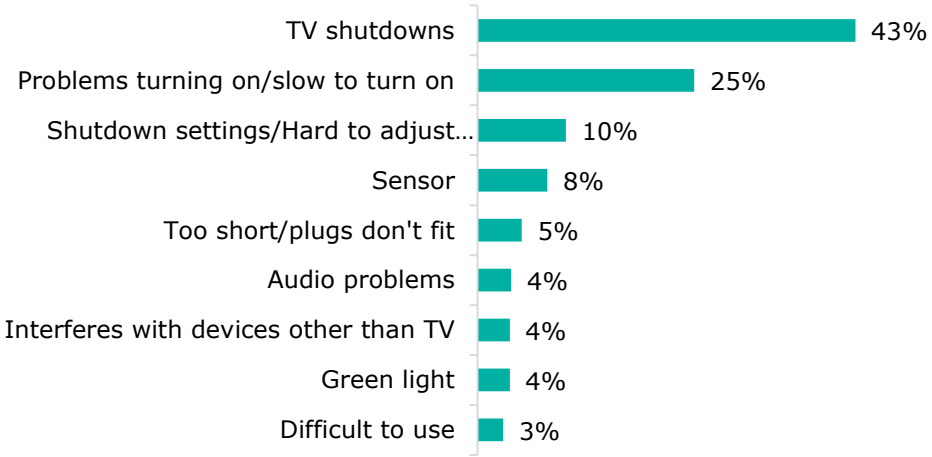
Customers that rated their overall satisfaction with the Tier 2 APS a four or higher on a seven-point scale, with seven being very satisfied, were asked what functionality or features they like best about the device (Figure 9). The fact that the Tier 2 APS turns off the power to devices when they aren't in use was mentioned by 36% of the respondents followed by 32% who specifically stated that they liked saving energy. Saving money and ease of use were next most mentioned at 13% and 11% of the respondents, respectively. Because multiple responses were permitted there is some overlap with respondents mentioning more than one of the top reasons. It is also interesting to note that some respondents saw more unexpected benefits such as using the Tier 2 APS to turn the TV off when they fall asleep or as a timer for kids' television viewing.

FIGURE 9. MOST FREQUENTLY MENTIONED FEATURES RESPONDENTS *LIKE* ABOUT THE TIER 2 ADVANCED POWER STRIP (N=146, MULTIPLE RESPONSES PERMITTED)



All respondents were asked if there were any features or functionality that they disliked. Almost half (47%) responded that there are no features or functionality they dislike. Forty-three percent said there were and the remaining 10% were undecided. As shown in Figure 10 below, the most frequently mentioned drawback was television shutdowns (43%). Among those that cited shutdowns, just over one-quarter (27%) specifically mentioned shutdowns during extended viewing such as when watching movies, recorded TV or sporting events. This was followed by difficulties or slowness when turning on the television or having to use the volume button to turn on TV which was mentioned by 25% of respondents. Specific difficulties respondents mentioned included having to push an additional button to turn devices on, that the television is slow to turn on and sometimes being uncertain if a device is on.

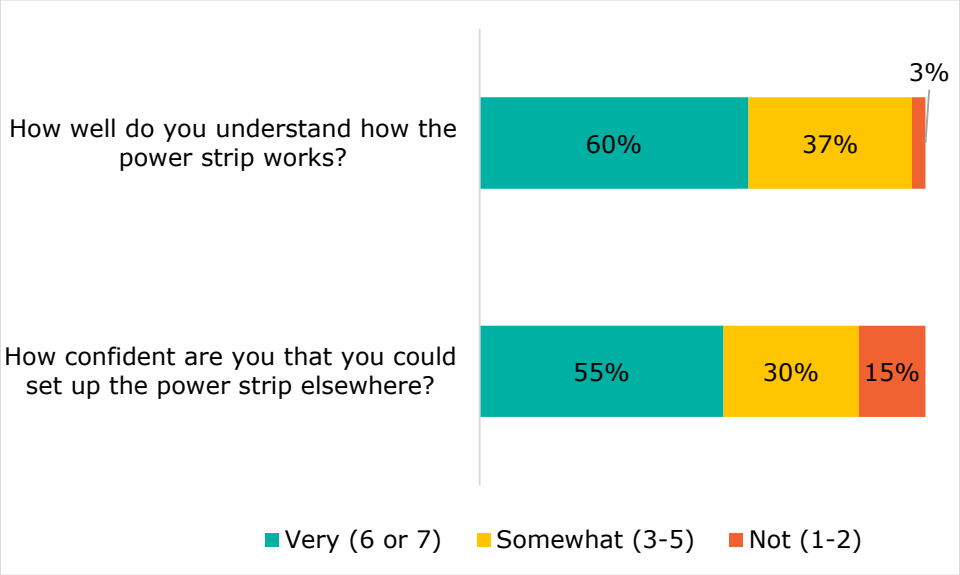
FIGURE 10. MOST FREQUENTLY MENTIONED FEATURES RESPONDENTS *DISLIKE* ABOUT THE TIER 2 ADVANCED POWER STRIP (N=78, MULTIPLE RESPONSES PERMITTED)



Product Knowledge

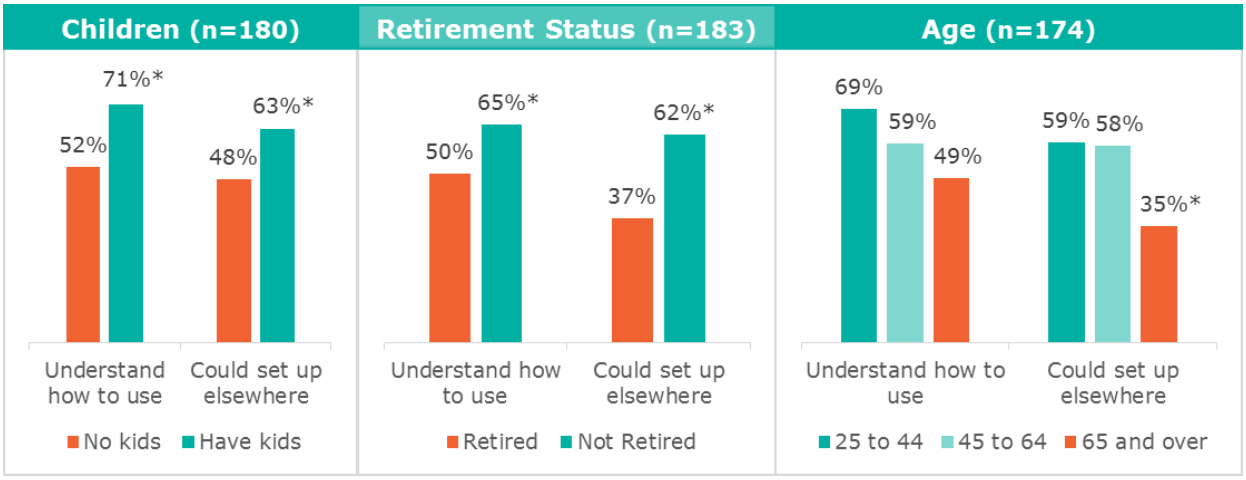
Respondents are fairly confident in their understanding of the Tier 2 APS and, to a lesser extent, their ability to set up the device elsewhere. As shown in Figure 11, sixty percent of respondents say they understand how to use the Tier 2 APS very well (rated a six or seven on a seven-point scale, with seven being very well and one being not at all) and only three percent say they do not understand how it works (rated a one or two). As further evidence of the respondents' understanding of the Tier 2 APS, 64 percent have shown others in their household how to use the device. In comparison, 55 percent of respondents are very confident they could set up the Tier 2 APS with another AV system and 15 percent are not confident they could set up the Tier 2 APS with another AV system (rated a one or two).

FIGURE 11. PRODUCT KNOWLEDGE (N=183)



As illustrated in Figure 12, product knowledge does vary by demographic factors. Households with kids and households that do not have a retired member rated their understanding of how to use the Tier 2 APS and ability to set up the device elsewhere significantly higher. Additionally, respondents 65 and older rated their understanding significantly lower than respondents 25 to 44 years old and rated their ability to set up the Tier 2 APS elsewhere significantly lower than respondents 25 to 64 years old.

FIGURE 12. PERCENT RATING THEIR UNDERSTANDING OF AND ABILITY TO SET UP POWER STRIP A SIX OR SEVEN



*Difference significant at p<.10

4.4 Usage Habits

Modifications

The survey assessed whether respondents made any changes to the Tier 2 APS since installation by asking if they have changed how devices are plugged in, added equipment or made any other changes to the Tier 2 APS. Almost one-fifth (19%) have changed how devices are plugged in, with 14 percent adding additional equipment and 6 percent making other changes.

When respondents did make changes to how the devices were plugged into the Tier 2 APS, they most frequently moved the TV (13 respondents, or 43%), Blue-ray or DVD (11 respondents, or 37%), or the DVR (10 respondents, or 32%). The most frequently cited reasons for these changes were because of interference with device operations and because a device or the Tier 2 APS was moved to a new location. IR-OS respondents that changed how the TV was plugged into the Tier 2 APS were also asked if the TV was moved to an "always on" outlet and all reported that it was not.

Game consoles (8 respondents, or 39%) were the most frequently added equipment and moving the Tier 2 APS to a new home or location was the most frequently cited other change people made to the device.

Conditions Prior to Tier 2 Advanced Power Strip

In order to understand baseline conditions prior to the installation of the Tier 2 APS, respondents were asked whether or not their television has built in energy saving features or if they unplugged their previous Tier 2 APS at night or when away from home for extended periods of time. There is a large degree of uncertainty around built-in energy saving features. Thirty-five percent were unsure if their television has built-in power saving features and 37 percent were aware that their television has built in power saving features. The remaining 28 percent said their television does not have built-in power saving features. Additionally, very

few respondents (10%) turned their old power strip off at night or while away from home for periods of time.

5 Differences in Household Characteristics and Responses by Manufacturer

This section of the report presents differences in household characteristics and customers between the two manufacturers. Differences highlighted are statistically significant at a 90 percent confidence interval.

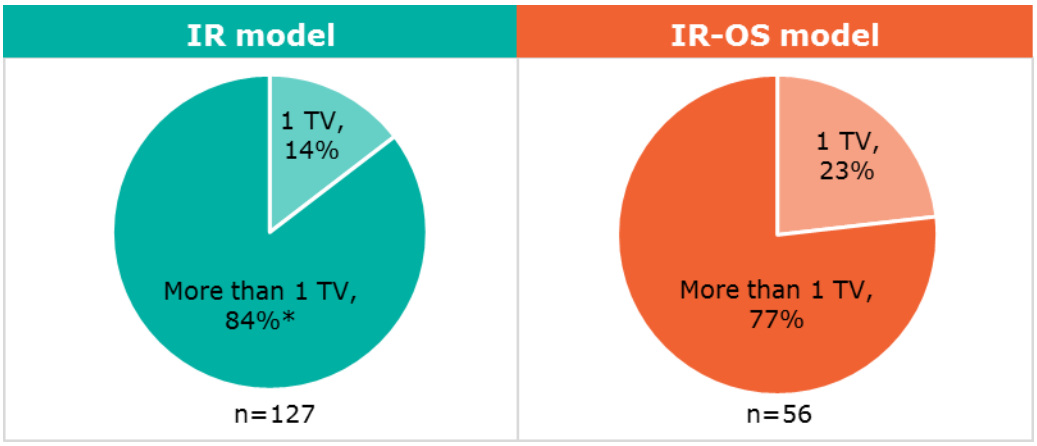
Although there was no difference in the recruitment strategy for the field trial, the study identified characteristic differences between households that received the IR model and IR-OS model Tier 2 APS devices. While it is unclear why this difference exists, given the differences in satisfaction and removal rate by various demographic groups, this information is presented for the reader's reference.

Additional demographic detail is provided in Appendix C. Additional detail at the manufacturer level is provided in Appendix D for the IR model Tier 2 APS and Appendix E for the IR-OS model Tier 2 APS.

5.1 Differences in Household Characteristics

While the majority of both groups of respondents have more than one television, significantly more IR model respondents have more than one television in their home (Figure 13). The overall mean number of televisions per household of 2.8 is consistent with findings of TV ownership surveys reported in Energy Consumption of Consumer Electronics in U.S. Homes in 2013[8]. A rate of 2.6 per household was reported from the 2013 CE usage Survey and 2.9 per household was reported from the CEA Market Research Report. Similar rates of both groups (about 85%) have cable or satellite service.

FIGURE 13. PERCENTAGE OF HOUSEHOLDS WITH MORE THAN ONE TELEVISION



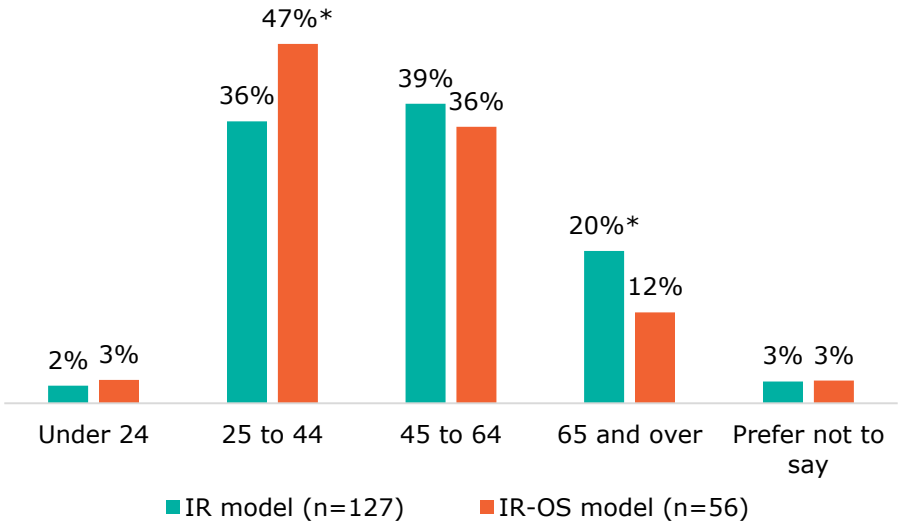
*Difference is significant at p<.10

[8] http://www.cta.tech/CorporateSite/media/environment/Energy-Consumption-of-Consumer-Electronics.pdf

Both groups of customers report similar numbers of people in their households; the average household size is 3.2 for IR model and 3.3 for IR-OS model. However, significantly more IR-OS model households report having children under the age of 17 in the household.

There are also differences in the retiree status and ages of the two groups of respondents. Forty-three percent of the IR model households have a retired member whereas only 21% of IR-OS model households do[9]. Additionally, as illustrated below in Figure 14, significantly more IR model respondents are 65 and over.

FIGURE 14. AGE OF RESPONDENTS

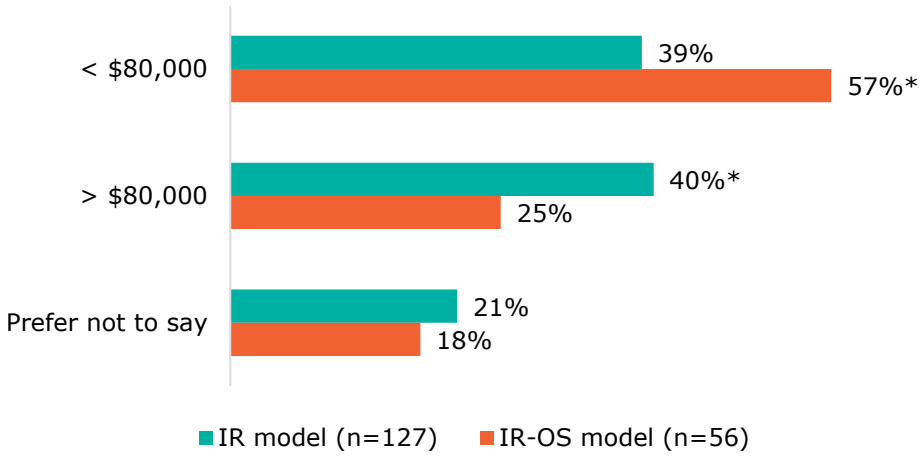


*Difference is significant at p<.10

Income is another area in which the two groups of respondents vary. It should be noted that overall, 20 percent of respondents opted not to share their household income levels.

[9] These are the weighted percentages, as a result, they are different than the unweighted percentages presented in Table 3.

FIGURE 15. HOUSEHOLD INCOME



*Difference is significant at p<.10

5.2 Differences in Response to Tier 2 Advanced Power Strips by Manufacturer

Persistence

Persistence rates were similar at 83 percent for IR model and 87 percent for IR-OS model. Though the IR model persistence rate is slightly lower, the difference is not statistically significant and could be a function of the IR model Tier 2 APS being in field longer at the time of survey than the IR-OS model Tier 2 APS. Customers gave different reasons for removing the Tier 2 APS. IR model respondents cited shutdowns (9 respondents or 43%) most frequently whereas IR-OS model respondents cited interference with other equipment (2 respondents or 25%) most frequently.

There was also a slight difference in baseline conditions. The percentage of IR-OS model respondents who turned off their previous power strip at night or when away from home is significantly higher than the corresponding percentage of IR model respondents (19% and 6%, respectively). However, this still represents a very small percentage of respondents in both groups.

There is no evidence to suggest that any differences reported above are attributed to device type.

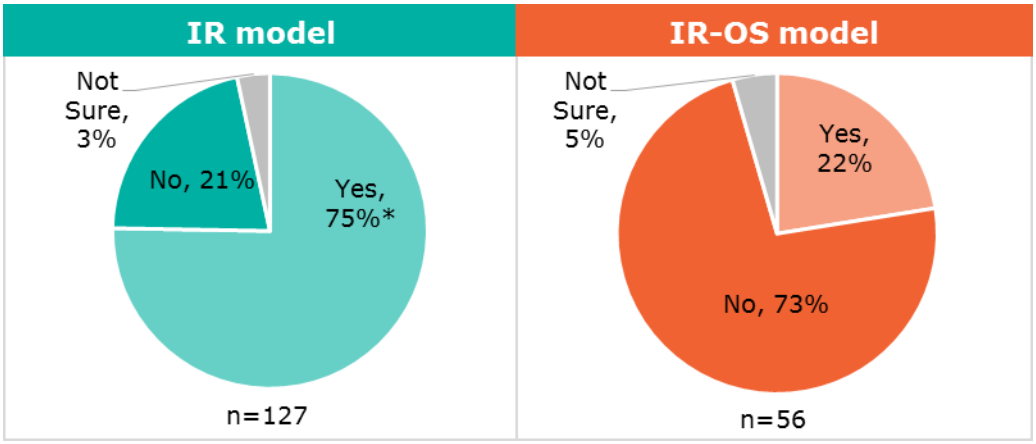
Device Shutdowns and Shutdown Timing

Three-quarters of IR model respondents had the Tier 2 APS turn off their TV while someone was watching it (Figure 16). Significantly fewer IR-OS model respondents reported the same (22%). There are a few possible explanations for this difference. One is that the IR model shutdown timer defaults to one hour whereas the IR-OS model shutdown timer defaults to one hour and fifteen minutes. The IR-OS model also allows for additional input to determine if devices are still in use. Another possible explanation is that the IR model devices were in

use longer than the IR-OS models at the time respondents were surveyed, giving more opportunity for the respondent to experience a shutdown.

Among respondents that have experienced a shutdown, the largest percentage (41%) of IR model respondents have experienced 6 or more shutdowns whereas 7 of the 13 (54%) IR-OS model respondents experienced 3 or fewer. However, this may again be explained by the fact that the IR model devices had been installed for a longer period of time before the respondents were surveyed.

FIGURE 16. OCCURRENCE OF DEVICE SHUTDOWNS



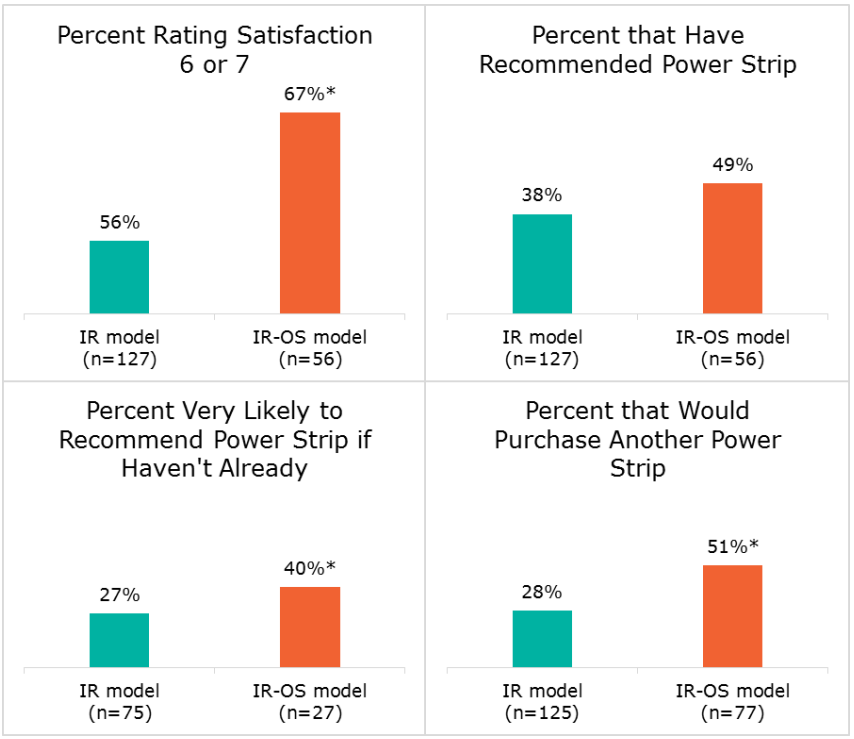
*Difference significant at p<.10

Significantly more IR model customers were aware that they could make adjustments to the shutdown timing, 84% compared to 29% of IR-OS model respondents. Almost half of the IR model respondents who knew they could adjust the settings did so, compared to only 1 of the IR-OS model respondents. These differences may be a result of the higher occurrences of shutdowns for IR model devices.

Satisfaction

As reported above in Section 4, device shutdowns have a large negative impact on customer satisfaction. As a result, with a much higher rate of shutdowns, the IR model Tier 2 APS received lower ratings on all measures of satisfaction. Figure 17 illustrates this difference in satisfaction.

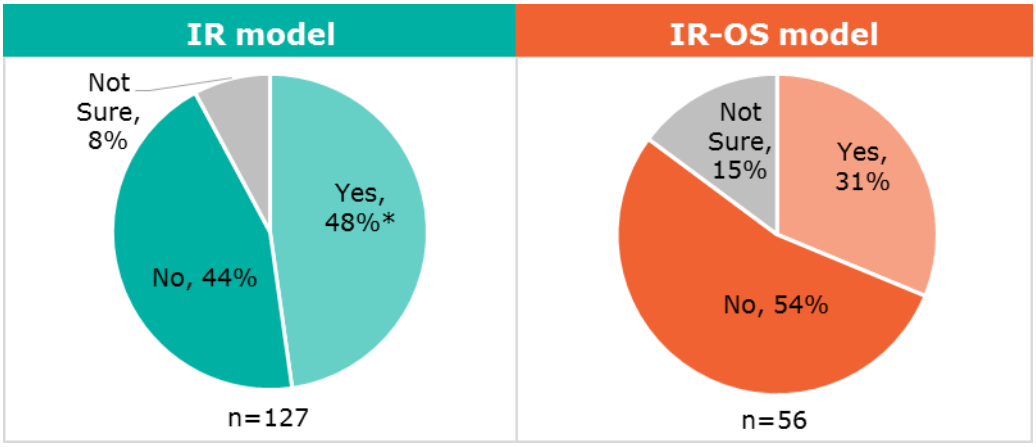
FIGURE 17. SATISFACTION MEASURES



*Difference significant at p<.10

Also likely a result of the high occurrence of device shutdowns, IR model respondents were significantly more likely to indicate there were product features or functionality they disliked. As shown in Figure 18, almost half (48%) of IR model respondents noted there were features they disliked compared to 31% of IR-OS model respondents. Not surprisingly, the device shutdowns were most frequently cited by IR model respondents. IR-OS model respondents most frequently cited problems turning it on as an area for dissatisfaction.

FIGURE 18. ARE THERE FEATURES OR FUNCTIONALITY OF THE TIER 2 APS THAT YOU DISLIKE?



*Difference significant at p<.10

6. Key Findings

Findings Related to Persistence, Satisfaction, and Product Knowledge

The Tier 2 advanced power strips have an 84% persistence rate. There are a number of factors that affect the persistence rate**.** Television shutdowns negatively affect the persistence, with those having a shutdown being more likely to remove the device. Survey respondents that experienced at least one shutdown had a 78% persistence rate compared to a 91% persistence rate among respondents that did not. Furthermore, the occurrence of television shutdowns was the most frequently cited reason for removing the Tier 2 APS.

Other drivers that that appear to affect persistence include: age or retiree status of respondent (fewer retired respondents still had the Tier 2 APS installed at the time of the survey) and time between installation and survey (persistence decreased as the length of time between installation and survey increased). The differences in persistence among these variables are not statistically significant and should be viewed as indicators only.

Seventy percent of respondents are satisfied with the Tier 2 advanced power strips; device shutdowns and respondent age appear to affect satisfaction. On a scale of one to seven, where seven is very satisfied, 70 percent of respondents indicated they were satisfied with the Tier 2 APS (rated a five through seven on a seven-point scale) and another 12 percent gave a neutral satisfaction rating of four, resulting in a mean satisfaction rating of 5.2. Having the Tier 2 APS turn off devices when not in use and saving energy are the product features respondents most frequently noted they like best. Furthermore, almost half (47%) reported that there are no features or functionality of the Tier 2 APS that they dislike.

Respondents that experienced having the Tier 2 APS turn off their television during viewing gave the Tier 2 APS significantly lower overall satisfaction ratings. These respondents were also significantly less likely to recommend the Tier 2 APS or say they would purchase another Tier 2 APS for use elsewhere in their home.

Respondents 65 and older rated their satisfaction with the Tier 2 APS lower than the younger respondents. Consequently they are less likely to have recommended or plan to recommend the product, are less likely to purchase another Tier 2 APS, and are more likely to state there are features or functionality they dislike.

Seventy percent of households said they recommended or are likely to recommend the Tier 2 advanced power strip to friends or family, 35% would purchase another for use elsewhere in their home. Forty-one percent of respondents said they have recommended the Tier 2 APS, and of those who have not yet recommended the Tier 2 APS, 48 percent said they are likely to recommend it. Thirty percent also remained undecided at the time of the survey about whether or not they would purchase another Tier 2 APS.

Additional Findings

Respondents have a good understanding of how the Tier 2 advanced power strip works. Sixty percent say they understand how to use the Tier 2 APS very well (rated a six or seven on a seven-point scale) and 55 percent are very confident (rated a six or seven on a seven-point scale) they could set up the Tier 2 APS somewhere else.

Households with children report higher product knowledge and are more likely to purchase another Tier 2 advanced power strip. These households rated their understanding of how the Tier 2 APS works and their confidence in their ability to set it up elsewhere significantly higher than households that do not have children living in them. A significantly higher percentage also said they would purchase another Tier 2 APS, 46 percent compared to 28 percent among households that do not have children.

Compared to respondents that have not experienced shutdowns, respondents that have experienced shutdowns are significantly more likely to know they can make adjustments to the shutdown settings. Seventy-eight percent of respondents that have had a shutdown knew they could adjust the settings compared to half of those that have not had a shutdown.

Respondents have difficulties turning on the devices plugged into the Tier 2 advanced power strip. This may indicate an opportunity for customer education during the direct install process**.** These difficulties were commonly mentioned as both a reason for unplugging the Tier 2 APS and as a feature respondents disliked. Specific difficulties respondents mentioned included having to push an additional button to turn devices on, that the television is slow to turn on and sometimes being uncertain if a device is on.

APPENDIX 4-A: IR AND IR-OS MODEL SURVEYS

IR APS survey

Goal: This survey evaluates customers' understanding and usage of the Tier 2 APS technology, as well as their satisfaction with the equipment. Its primary goal is to determine savings persistence for the Tier 2 APS.

Targets: 75 respondents with the IR model power strip and 75 respondents with the IR-OS model power strip. Phone surveys will be conducted for those who do not have email available and as a follow-up to achieve desired response if necessary.

Introduction

E-mail Text:

Dear [NAME],

Leede Research Group is conducting a survey on behalf of San Diego Gas & Electric of customers who have recently had an advanced power strip installed. We invite you to take a brief survey to share your experience. Your participation will give us invaluable feedback on the effectiveness of the program and the advanced power strip technology.

If you have any questions, please contact Leede at info@leede.com.

Please click here to access the survey. It will take about 10 minutes of your time and in appreciation of your participation we're offering a $10 payment for completed surveys. You'll receive a check in the mail 2-3 weeks after completing the survey.

Thank you,

Leede Research Group

[Screen break]

Phone Introduction:

Hello, my name is [INTERVIEWER NAME] with Leede Research Group calling on behalf of San Diego Gas & Electric. We are conducting a survey of customers who have recently had an advanced power strip installed. This is not a sales call, and responses will be used to inform San Diego Gas & Electric about your experience and to understand how advanced power strips are used. This interview will only take about 10 minutes of your time and in appreciation of your participation we're offering a $10 payment for completed surveys. You'll receive a check in the mail 2-3 weeks after completing the survey. The interview will be recorded for quality assurance purposes.

F1. Are you the person who is most familiar with the installation of the advanced power strip?

Yes

No

98. Not Sure **[PHONE ONLY; Ask if the person most familiar is available]**

[CONTINUE WITH THE APPROPRIATE CONTACT PERSON]

PHONE SCREENING QUESTIONS

I1. Are you currently talking to me on a regular landline phone or a cell phone?
1. (Landline phone)
2. (Cell Phone)
98. (Don't know)
99. (Refused)

[ASK IF I1 = 2, 98, 99]

I2. Are you currently driving a motorized vehicle?
1. (Yes) [Schedule call back]
2. (No)
98. (Don't know) [Schedule call back]
99. (Refused) [Schedule call back]

VERIFICATION

V1. Do you recall having an advanced power strip installed in your home one to three months ago?
1. Yes
2. No **[TERMINATE]**
98. Not Sure **[PHONE ONLY; Loop back to F1]**

V2. Is this power strip still plugged in?
1. Yes
2. No
98. Not Sure

[ASK IF V2 = 2]

V3. How long after the power strip was installed did you unplug it?
1. Less than 2 weeks
2. 2-4 weeks
3. More than a month
98. Not sure

[ASK IF V2 = 2]

V4. What are the main reasons you decided to stop using the device? [OPEN END]

Modifications

[ASK SECTION IF V2=1, else skip to next section]
These next questions are about how you have been using the power strip and any modifications you have needed to make.

M1. Have you made any changes to how your AV devices are plugged into the power strip since it was installed?
1. Yes
2. No
98. Not Sure

[ASK IF M1 = 1]
M2. Which plugs did you move? (check all that apply) **[MULTIPLE RESPONSE]**
1. TV
2. DVR
3. Set top box
4. Cable console
5. Blu-ray or DVD Player
6. Game console
7. Speakers
8. Amplifier
9. Receiver
10. Other. [Specify_____]

M3. Why did you move the plugs? **[OPEN END]**

M4. Have you added any new equipment to the power strip?
1. Yes
2. No
98. Not Sure

[ASK IF M4 = 1]
M5. Which equipment did you add to the power strip?
1. TV
2. DVR
3. Set top box
4. Cable console
5. Blu-ray or DVD Player
6. Game console
7. Speakers
8. Amplifier
9. Receiver
10. Other. [Specify_____]

M6. Have you made any other changes to the power strip since it was installed? (for example, changing location)
1. Yes
2. No
98. Not Sure

[ASK IF M6=1]
M7. What changes did you make? **[OPEN END]**

M8. Think back to before you received the advanced power strip. Did you turn off the power strip that your AV equipment used to be plugged into at night or when away from home for periods of time?
1. Yes
2. No
98. Not Sure

M9. Does your television have built-in power saving features?
1. Yes
2. No
98. Not Sure

FEATURES AND FUNCTIONALITY

S1. On a scale of 1 to 7, where 1 is not at all satisfied and 7 is very satisfied: How satisfied are you with the advanced power strip?

Not at all satisfied						Very satisfied
1	2	3	4	5	6	7

[ASK IF S1>3]
S2. What do you like most about the device? **[OPEN END]**

S3. Are there any features or functionality that you dislike?
1. Yes
2. No
98. Not Sure

[ASK IF S3=1]
S4. What functionality or features do you dislike? **[OPEN END]**

U1. Are you aware that the power strip shuts down your devices after a period of time?
1. Yes
2. No
98. Not Sure

U2. Has the power strip ever turned off your TV while you or someone else was watching TV or playing video games?
1. Yes
2. No
98. Not Sure

[ASK IF U2 = 1]

U2a. How many times has the power strip turned off your TV or game console while you or someone else was watching TV or playing video games?

1. Once
2. 2-3 times
3. 4-5 times
4. 6 or more times
98. Not Sure

[ASK IF U2 = 1]

U3. What did you (or the person present) do after the power strip turned the TV or game console off? **[OPEN END]**

U4. Were you aware you could adjust the shutdown time settings?

1. Yes
2. No
98. Not Sure

[ASK IF U4 = 1]

U5. Have you made adjustments to the shutdown time setting?

1. Yes
2. No
98. Not Sure

[ASK IF U5 = 1]

U6. What did you adjust the shutdown time to? [READ RESPONSE CATEGORIES]

1. 1-2 hours
2. 3-4 hours
3. 5-7 hours
4. 8 hours
98. Not Sure

U7. Has any aspect of the power strip interfered with watching TV, playing video games, or other audiovisual activities in any other way?

1. Yes
2. No
98. Not Sure

[ASK IF U7 = 1]

U5a. How did the power strip interfere with watching TV, playing video games, or other audiovisual activities? **[OPEN END]**

[ASK IF U7 = 1]

U6. What did you do as a result of this interference? **[OPEN END]**

U7. On a scale of 1 to 7, where 1 is not at all and 7 is very well: How well would you say you understand how to use the power strip?

Not at all						Very well
1	2	3	4	5	6	7

U8. On a scale of 1 to 7, where 1 is not at all confident and 7 is very confident: How confident are you that you could set up the power strip with another audiovisual system (for example, in another room or at a friend's house)?

Not at all						Very confident
1	2	3	4	5	6	7

Customer Service

C1. Did the installer who came to your home show you how the power strip works?
1. Yes
2. No
98. Not Sure

C2. Have you shown anyone else in your house how to use the power strip?
1. Yes
2. No
98. Not Applicable (no other household members)

C3. On a scale of 1 to 7, where 1 is not at all satisfied and 7 is very satisfied, how satisfied are you with the installation visit to your home?

Not at all satisfied						Very satisfied
1	2	3	4	5	6	7

RECOMMENDATIONS AND REPURCHASE

R1. Have you recommended the advanced power strip to friends or family?

1. Yes
2. No
98. Not Sure

[ASK IF R1 = 2, 98]

R2. On a scale of 1 to 7, where 1 is not at all likely and 7 is very likely, please indicate how likely you are to recommend this product to your friends and family?

Not at all likely						Very likely
1	2	3	4	5	6	7

R3. Would you purchase another advanced power strip device for use elsewhere in your home?

1. Yes
2. No
98. Not Sure

Household Demographics

D1. How many TVs are there in your home?
1. 1
2. 2
3. 3
4. 4
5. 5
6. 6
7. 7
8. 8 or more

D2. Do you have cable or satellite television?
1. Yes
2. No

D3. Including yourself, how many people live in your household full time?
1. 1
2. 2
3. 3
4. 4
5. 5
6. 6
7. 7
8. 8
9. 9
10. 10 or more
98. Prefer not to say

D4. How many children under the age of 17 live in your household?
1. 0
2. 1
3. 2
4. 3
5. 4
6. 5 or more
98. Prefer not to say

D6. Does any household member work from home?
1. Yes, full-time
2. Yes, part-time/occasionally
3. No
98. Prefer not to say

[ASK IF D6=1,2]

D7. Do you have a home office?
1. Yes
2. No
98. Not Sure

D7a. Is any member of your household retired?
1. Yes
2. No
98. Prefer not to say

D8. Which of the following best describes your educational background?
1. Less than high school
2. High school or GED
3. Some college
4. Technical College (2 year degree)
5. 4 Year college
6. Graduate degree
98. Prefer not to say

D9. What is your age?
1. 24 years or younger
2. 25 to 44 years
3. 45 to 64 years
4. 65 years or over
98. Prefer not to say

D10. Which of the following categories best represents your approximate annual household income from all sources in 2014, before taxes?
1. < $40,000
2. Between $40,000 and $60,000
3. Between $60,000 and $80,000
4. Between $80,000 and $120,000
5. Over $120,000
98. Prefer not to say

Thank You and Closing

The survey has been completed. Thank you for your feedback. Have a great day!

IR-OS APS survey

Goal: This survey evaluates customers' understanding and usage of the Tier 2 APS technology, as well as their satisfaction with the equipment. Its primary goal is to determine savings persistence for the Tier 2 APS.

Targets: 75 respondents with the IR model power strip and 75 respondents with the IR-OS model power strip. Phone surveys will be conducted for those who do not have email available and as a follow-up to achieve desired response if necessary.

New Questions: Questions M2a, M10, S2a, R4 and R5 were added to this version of the survey at the request of the client in order to further investigate certain areas.

Introduction

E-mail Text:

Dear [NAME],
Leede Research Group is conducting a survey on behalf of San Diego Gas & Electric of customers who have recently had an advanced power strip installed. We invite you to take a brief survey to share your experience. Your participation will give us invaluable feedback on the effectiveness of the program and the advanced power strip technology.
If you have any questions, please contact Leede at info@leede.com.
Please click here to access the survey. It will take about 10 minutes of your time and in appreciation of your participation we're offering a $20 payment for completed surveys. You'll receive a check in the mail 2-3 weeks after the study has been completed.
Thank you,
Leede Research Group
[Screen break]

Phone Introduction:

Hello, my name is [INTERVIEWER NAME] with Leede Research Group calling on behalf of San Diego Gas & Electric. We are conducting a survey of customers who have recently had an advanced power strip installed. This is not a sales call, and responses will be used to inform San Diego Gas & Electric about your experience and to understand how advanced power strips are used. This interview will only take about 10 minutes of your time and in appreciation of your participation we're offering a $20 payment for completed surveys. You'll receive a check in the mail 2-3 weeks after completing the survey. The interview will be recorded for quality assurance purposes.

F1. Are you the person who is most familiar with the installation of the advanced power strip?
1. Yes
2. No
98. Not Sure **[PHONE ONLY; Ask if the person most familiar is available]**

[CONTINUE WITH THE APPROPRIATE CONTACT PERSON]

PHONE SCREENING QUESTIONS

I1. Are you currently talking to me on a regular landline phone or a cell phone?
1. (Landline phone)
2. (Cell Phone)
98. (Don't know)
99. (Refused)

[ASK IF I1 = 2, 98, 99]
I2. Are you currently driving a motorized vehicle?
1. (Yes) [Schedule call back]
2. (No)
98. (Don't know) [Schedule call back]
99. (Refused) [Schedule call back]

VERIFICATION

V1. Do you recall having an advanced power strip installed in your home one to three months ago?
3. Yes
4. No **[TERMINATE]**
98. Not Sure **[PHONE ONLY; Loop back to F1]**

V2. Is this power strip still plugged in?
3. Yes
4. No
98. Not Sure

[ASK IF V2 = 2]
V3. How long after the power strip was installed did you unplug it?
4. Less than 2 weeks
5. 2-4 weeks
6. More than a month
99. Not sure

[ASK IF V2 = 2]
V4. What are the main reasons you decided to stop using the device? **[OPEN END]**

Modifications

[ASK SECTION IF V2=1, else skip to next section]

These next questions are about how you have been using the power strip and any modifications you have needed to make.

M1. Have you made any changes to how your AV devices are plugged into the power strip since it was installed?
3. Yes
4. No
98. Not Sure

[ASK IF M1 = 1]
M2. Which plugs did you move? (check all that apply) **[MULTIPLE RESPONSE]**
11. TV
12. DVR
13. Set top box
14. Cable console
15. Blu-ray or DVD Player
16. Game console
17. Speakers
18. Amplifier
19. Receiver
20. Other. [Specify_____]

[ASK IF M2=1]
M2a. Did you move the television to the wall or an "Always On" outlet?
3. Yes
4. No
99. Not Sure

[ASK IF M1 = 1]
M3. Why did you move the plugs? **[OPEN END]**

M4. Have you added any new equipment to the power strip?
1. Yes
2. No
98. Not Sure

[ASK IF M4 = 1]
M5. Which equipment did you add to the power strip?
11. TV
12. DVR
13. Set top box
14. Cable console
15. Blu-ray or DVD Player
16. Game console
17. Speakers
18. Amplifier
19. Receiver
20. Other. [Specify_____]

M6. Have you made any other changes to the power strip since it was installed? (for example, changing location)
3. Yes
4. No
98. Not Sure

[ASK IF M6=1]
M7. What changes did you make? **[OPEN END]**

M8. Think back to before you received the advanced power strip. Did you turn off the power strip that your AV equipment used to be plugged into at night or when away from home for periods of time?

3. Yes
4. No
98. Not Sure

M9. Does your television have built-in power saving features?

3. Yes
4. No
98. Not Sure

[ASK IF M9=1]
M10. Did you use the power saving feature on your television prior to receiving the advanced power strip?

FEATURES AND FUNCTIONALITY

S1. On a scale of 1 to 7, where 1 is not at all satisfied and 7 is very satisfied: How satisfied are you with the advanced power strip?

Not at all satisfied						Very satisfied
1	2	3	4	5	6	7

[ASK IF S1>3]
S2. What do you like most about the device? **[Open End]**

[ASK IF S1>3]
S2a. On a scale of 1 to 7, where 1 is not at all important and 7 is very important, How important are each of the following in your satisfaction with the advanced power strip?

1. Surge protection
2. Protecting my electronic equipment
3. Safety
4. Power is turned off when devices are not in use
5. Saving energy
6. Saving money
7. Easy to use

S3. Are there any features or functionality that you dislike?

3. Yes
4. No
98. Not Sure

[ASK IF S3=1]
S4. What functionality or features do you dislike? **[OPEN END]**

U1. Are you aware that the power strip shuts down your devices after a period of time?
3. Yes
4. No
99. Not Sure

U2. Has the power strip ever turned off your TV while you or someone else was watching TV or playing video games?
3. Yes
4. No
99. Not Sure

[ASK IF U2 = 1]
U2a. How many times has the power strip turned off your TV or game console while you or someone else was watching TV or playing video games?
5. Once
6. 2-3 times
7. 4-5 times
8. 6 or more times
99. Not Sure

[ASK IF U2 = 1]
U3. What did you (or the person present) do after the power strip turned the TV or game console off? **[OPEN END]**

U4. Were you aware you could adjust the shutdown time settings?

3. Yes
4. No
99. Not Sure

[ASK IF U4 = 1]
U5. Have you made adjustments to the shutdown time setting?
3. Yes
4. No
99. Not Sure

[ASK IF U5 = 1]
U6. What did you adjust the shutdown time to? [READ RESPONSE CATEGORIES]
5. 1-2 hours
6. 3-4 hours
7. 5-7 hours
8. 8 hours
99. Not Sure

U7. Besides shutting down the TV or game console, has any other aspect of the power strip interfered with watching TV, playing video games, or other audiovisual activities in any other way?
3. Yes
4. No
99. Not Sure

[ASK IF U7 = 1]
U5a. Besides shutting down the TV, how did the power strip interfere with watching TV, playing video games, or other audiovisual activities? **[OPEN END]**

[ASK IF U7 = 1]
U6a. What did you do as a result of this interference? **[OPEN END]**

U7a. On a scale of 1 to 7, where 1 is not at all and 7 is very well: How well would you say you understand how to use the power strip?

Not at all						Very well
1	2	3	4	5	6	7

U8. On a scale of 1 to 7, where 1 is not at all confident and 7 is very confident: How confident are you that you could set up the power strip with another audiovisual system (for example, in another room or at a friend's house)?

Not at all						Very confident
1	2	3	4	5	6	7

Customer Service

C1. Did the installer who came to your home show you how the power strip works?
3. Yes
4. No
99. Not Sure

C2. Have you shown anyone else in your house how to use the power strip?
3. Yes
4. No
98. Not Applicable (no other household members)

C3. On a scale of 1 to 7, where 1 is not at all satisfied and 7 is very satisfied, how satisfied are you with the installation visit to your home?

Not at all satisfied						Very satisfied
1	2	3	4	5	6	7

RECOMMENDATIONS AND REPURCHASE

R1. Have you recommended the advanced power strip to friends or family?

1. Yes
2. No
98. Not Sure

[ASK IF R1 = 2, 98]

R2. On a scale of 1 to 7, where 1 is not at all likely and 7 is very likely, please indicate how likely you are to recommend this product to your friends and family?

Not at all likely						Very likely
1	2	3	4	5	6	7

R3. Would you purchase another advanced power strip device for use elsewhere in your home?

1. Yes
2. No
98. Not Sure

[ASK IF R3 = 2, 98]

R4. Why wouldn't you purchase another advanced power strip for your home? **[OPEN END]**

[ASK IF R3 = 1]

R5. Where in your home would you use the additional advanced power strip?

1. Bedroom
2. Children's room
3. Secondary media room (Den, recreation room)
4. Other [SPECIFY_____]
98. Not Sure

Household Demographics

D1. How many TVs are there in your home?

9. 1
10. 2
11. 3
12. 4
13. 5
14. 6
15. 7
16. 8 or more

D2. Do you have cable or satellite television?

3. Yes
4. No

D3. Including yourself, how many people live in your household full time?
1. 1
2. 2
3. 3
4. 4
5. 5
6. 6
7. 7
8. 8
9. 9
10. 10 or more
98. Prefer not to say

D4. How many children under the age of 17 live in your household?
1. 0
2. 1
3. 2
4. 3
5. 4
6. 5 or more
98. Prefer not to say

D6. Does any household member work from home?
4. Yes, full-time
5. Yes, part-time/occasionally
6. No
98. Prefer not to say

[ASK IF D6=1,2]

D7. Do you have a home office?
1. Yes
2. No
98. Not Sure

D7a. Is any member of your household retired?
1. Yes
2. No
98. Prefer not to say

D8. Which of the following best describes your educational background?
7. Less than high school
8. High school or GED
9. Some college
10. Technical College (2 year degree)
11. 4 Year college
12. Graduate degree
98. Prefer not to say

D9. What is your age?
1. 24 years or younger
2. 25 to 44 years
3. 45 to 64 years
4. 65 years or over
98. Prefer not to say

D10. Which of the following categories best represents your approximate annual household income from all sources in 2014, before taxes?
6. < $40,000
7. Between $40,000 and $60,000
8. Between $60,000 and $80,000
9. Between $80,000 and $120,000
10. Over $120,000
98. Prefer not to say

Thank You and Closing

The survey has been completed. Thank you for your feedback. Have a great day!

APPENDIX 4-B: WEIGHTED HOUSEHOLD CHARACTERISTICS

TABLE 5. NUMBER OF TELEVISIONS IN THE HOME

	Overall		IR model		IR-OS model	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
1	33	18%	20	16%	13	23%
2	46	25%	36	29%	9	16%
3	47	25%	30	24%	17	30%
4	39	21%	26	21%	13	22%
5	16	9%	11	9%	5	9%
6	3	2%	3	2%	0	0%

TABLE 6. NUMBER OF HOMES WITH CABLE OR SATELLITE TELEVISION

	Overall		IR model		IR-OS model	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Yes	153	84%	104	82%	49	88%
No	30	16%	23	18%	7	12%

TABLE 7. NUMBER OF PEOPLE IN THE HOUSEHOLD

	Overall		IR model		IR-OS model	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
1	18	10%	12	10%	6	10%
2	63	35%	46	36%	17	31%
3	27	15%	20	16%	7	13%
4	35	19%	24	19%	11	20%
5	27	15%	17	13%	10	18%
6	9	5%	5	4%	4	8%
7	2	1%	2	2%	0	0%
Prefer not to say	1	0%	1	1%	0	0%

TABLE 8. NUMBER OF CHILDREN UNDER 17 IN THE HOUSEHOLD

	Overall		IR model		IR-OS model	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
0	102	56%	78	61%	24	43%
1	24	13%	14	11%	9	17%
2	37	20%	21	16%	16	28%
3	14	8%	10	8%	4	8%
4	3	2%	1	1%	3	5%
Prefer not to say	4	2%	4	3%	0	0%

TABLE 9. DOES ANYONE WORK FROM HOME?

	Overall		IR model		IR-OS model	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Yes, full-time	35	19%	24	19%	11	19%
Yes, part-time/occasionally	38	21%	30	24%	8	15%
No	102	56%	66	52%	36	64%
Prefer not to say	7	4%	6	5%	1	2%

TABLE10. NUMBER OF HOMES WITH A HOME OFFICE

	Overall		IR model		IR-OS model	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Yes	51	70%	39	71%	13	65%
No	22	30%	16	29%	7	35%

TABLE 11. IS A MEMBER OF THE HOUSEHOLD RETIRED?

	Overall		IR model		IR-OS model	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Yes	52	28%	39	30%	13	23%
No	131	72%	88	70%	43	77%

TABLE 12. EDUCATION LEVEL

	Overall		IR model		IR-OS model	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
High school or GED	17	9%	11	9%	6	11%
Some college	46	25%	26	21%	19	34%
Technical College	11	6%	7	6%	4	7%
4 Year college	56	31%	39	31%	17	30%
Graduate degree	48	26%	39	30%	9	16%
Prefer not to say	5	3%	4	3%	1	2%

TABLE 13. AGE OF SURVEY RESPONDENTS

	Overall		IR model		IR-OS model	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Under 18	1	0%	0	0%	1	2%
18 to 24	4	2%	3	2%	1	2%
25 to 44	72	40%	46	36%	26	47%
45 to 64	69	38%	49	39%	20	36%
65 and over	32	17%	25	20%	7	12%
Prefer not to say	5	3%	4	3%	2	3%

TABLE 14. HOUSEHOLD INCOME

	Overall		IR model		IR-OS model	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
< 40,000	20	11%	13	10%	7	12%
Between 40 and 60,000	37	20%	22	17%	15	27%
Between 60 and 80,000	24	13%	14	11%	10	18%
Between 80 and 120,000	38	21%	29	22%	9	16%
Over 120,000	27	15%	22	17%	5	9%
Prefer not to say	37	20%	27	21%	10	18%

APPENDIX 4-C: IR MODEL FINDINGS

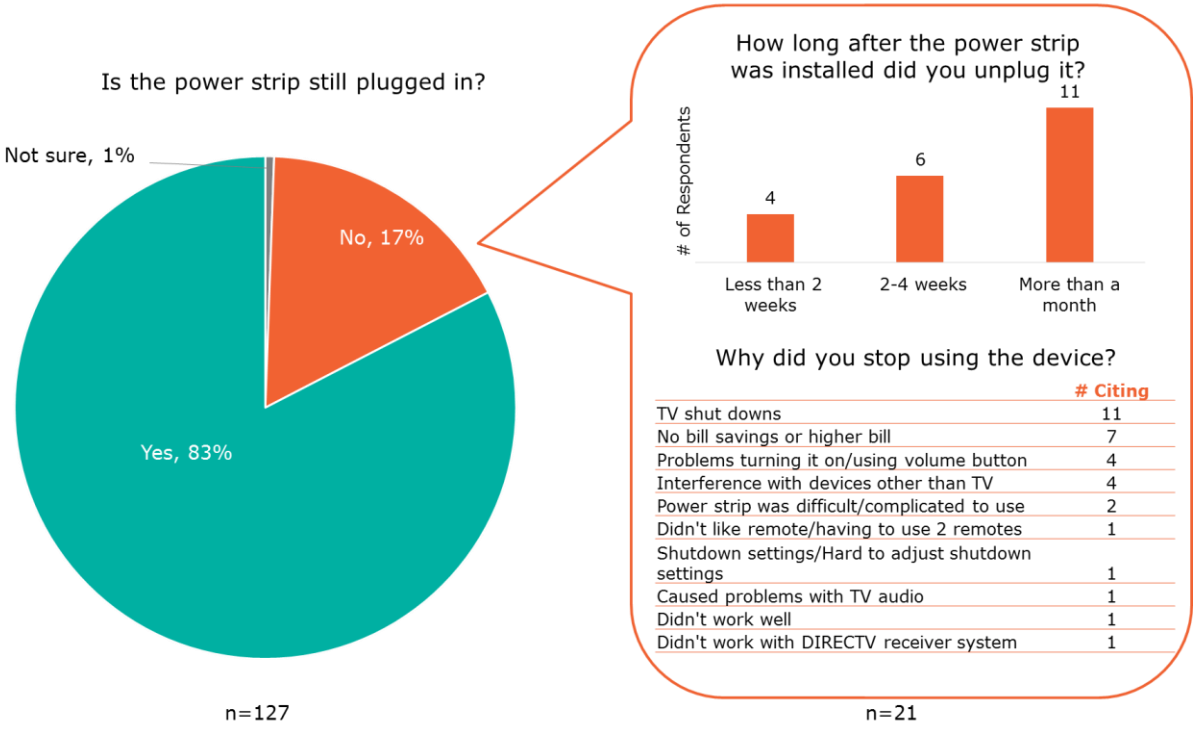
This section of the report presents the key study findings for the IR model Tier 2 APS and consists of four subsections: (1) Persistence; (2) Satisfaction; (3) Features and Functionality; (4) Usage Habits.

C.1 Persistence

Persistence Rate

At the time of the survey, 83% of the IR model Tier 2 APS devices were still installed. Of those that were removed, the largest number, 11 (53%), were removed after more than a month after installation. The most frequently cited reason for removing the Tier 2 APS among IR model respondents was the incidence of television shutdowns.

FIGURE 19. IR MODEL PERSISTENCE RATE



Why did you stop using the device?

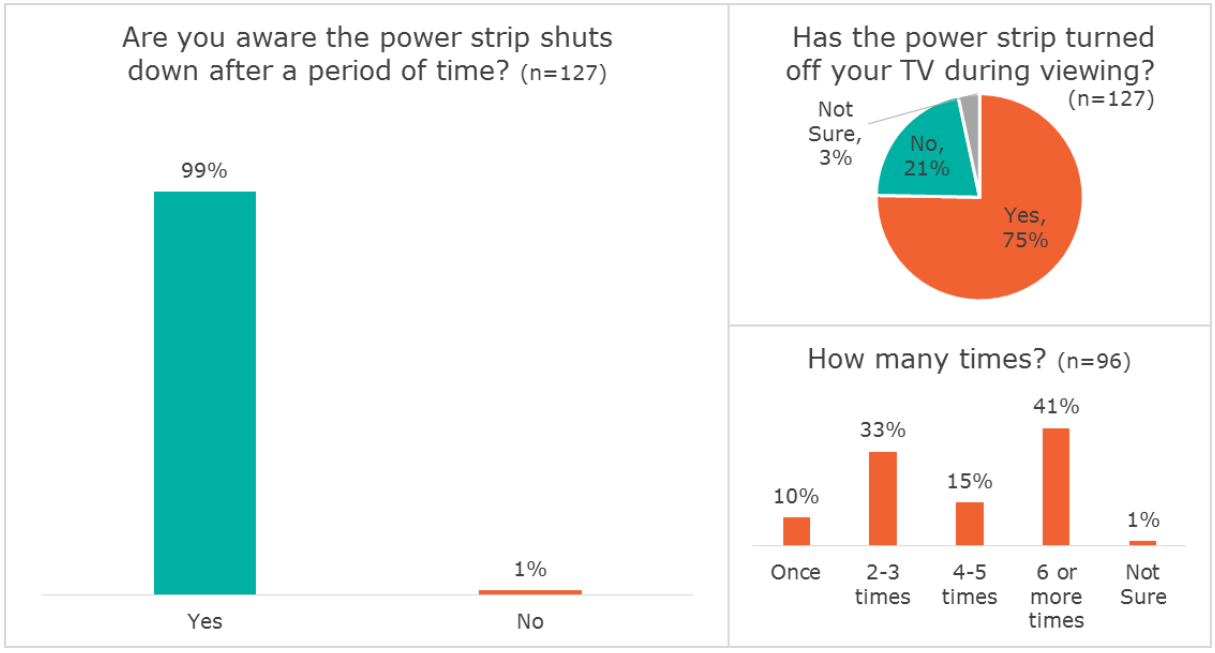
	# Citing
TV shut downs	11
No bill savings or higher bill	7
Problems turning it on/using volume button	4
Interference with devices other than TV	4
Power strip was difficult/complicated to use	2
Didn't like remote/having to use 2 remotes	1
Shutdown settings/Hard to adjust shutdown settings	1
Caused problems with TV audio	1
Didn't work well	1
Didn't work with DIRECTV receiver system	1

Device Shutdowns

The IR model Tier 2 APS appears to shut down while respondents are watching TV frequently. As shown in Figure 20, nearly all (99%) respondents were aware that the IR model Tier 2 APS shuts down after a period time and most, 75%, have experienced this while viewing television. Furthermore, 90% of those who have experienced a shutdown have had more than one, with 41% experiencing 6 or more shutdowns. Eighty-eight percent of the respondents that experienced shutdowns simply turned the TV back on, although 20% of those noted that they became angry or frustrated while doing so. Further investigation revealed that shutdowns are

not occurring at higher rates for a particular customer group. There was no difference in the incidence of shutdowns by the age, number of kids at home or retiree status of the respondents.

FIGURE 20. IR MODEL SHUTDOWNS



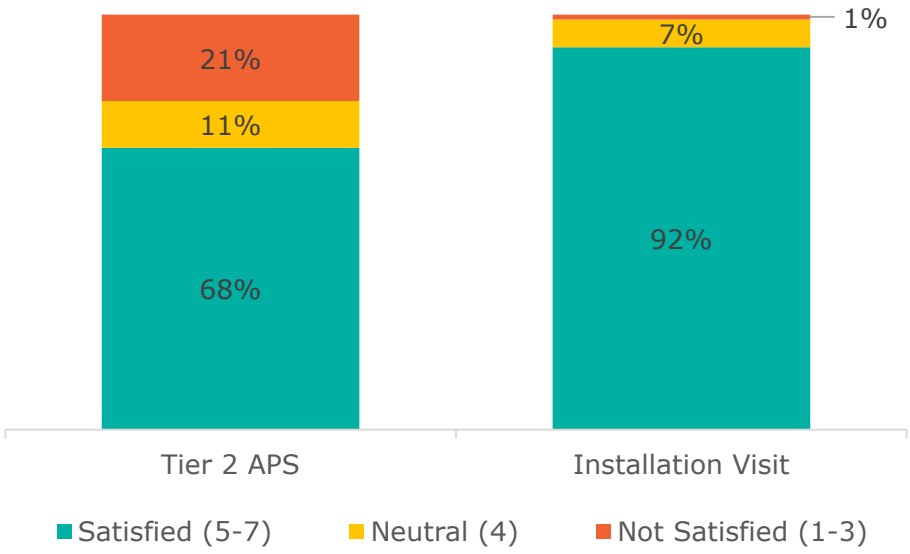
Most respondents (84%) are aware that they can adjust the shutdown time settings on the Tier 2 APS and almost half (44%) who were aware they could adjust the settings did. Adjustments to 3-4 hours (44%) and 8 hours (24%) were most common.

Twelve respondents indicated that the Tier 2 APS interfered with their audiovisual activities in some manner other than shutting down. They cited a variety of different problems, but problems recording (2) was the only one mentioned by more than one respondent. Four of the respondents removed the Tier 2 APS as a result of these issues.

C.2 Satisfaction

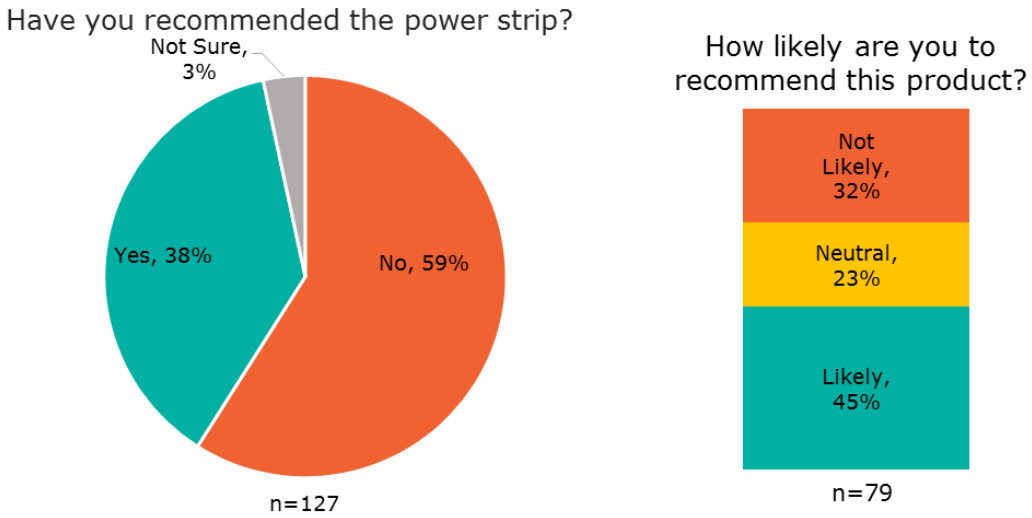
Customers were asked to rate their satisfaction with the Tier 2 APS itself as well as the installation visit on a seven-point scale where one was not at all satisfied and seven was very satisfied. The mean satisfaction rating for the Tier 2 APS was 5.1 and the mean satisfaction rating for the installation visit was 6.5. As illustrated in Figure 21, 68% of respondents indicated they were satisfied (rated a five through seven) with the Tier 2 APS and 92% were satisfied with the installation visit, with 93% of the respondents recalling that the installer showed them how to use the Tier 2 APS. While only one respondent was not satisfied with the installation visit, 21% of respondents indicated they were not satisfied (rated a one through three) with the IR model Tier 2 APS.

FIGURE 21. SATISFACTION WITH THE IR MODEL TIER 2 ADVANCED POWER STRIP AND INSTALLATION VISIT (N=127)



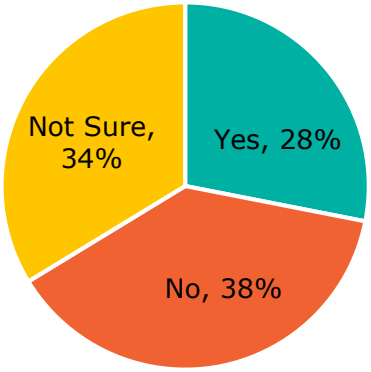
Customers were also asked if they have, or would, recommend the Tier 2 APS to friends or family in order to further assess their satisfaction with the product. Thirty-eight percent of the respondents have already recommended the IR model Tier 2 APS. Of those that haven't already recommended the product, 45% stated they are likely (rated a five through seven on a seven-point scale, with seven being very likely) to recommend the product to friends or family. Figure 22 provides more details on the likeliness of respondents to recommend the Tier 2 APS.

FIGURE 22. RECOMMENDATION OF THE IR MODEL TIER 2 ADVANCED POWER STRIP



When asked if they would purchase another Tier 2 APS for use elsewhere in their home, the largest percentage of respondents, 38%, said they would not purchase another Tier 2 APS to use elsewhere (Figure 23).

FIGURE 23. WOULD YOU PURCHASE ANOTHER POWER STRIP FOR ELSEWHERE IN YOUR HOME? (N=127)

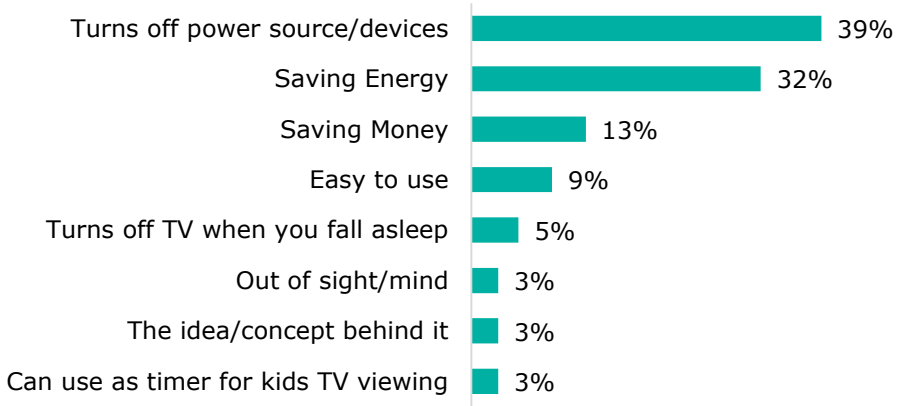


C.3 Features and Functionality

Product Likes and Dislikes

Customers that rated their overall satisfaction with the Tier 2 APS a four or higher on a seven-point scale, with seven being very satisfied, were asked what functionality or features they like best about the device (Figure 24). The fact that the Tier 2 APS turns off the power to devices was mentioned by 39% of the respondents followed by 32% who specifically stated that they liked saving energy and 13% who specifically stated that they liked saving money. Because multiple responses were permitted there is some overlap with respondents mentioning more than one of the top reasons. It is also interesting to note that some respondents saw more unexpected benefits such as using the Tier 2 APS to turn the TV off when you fall asleep or as a timer for kids' television viewing.

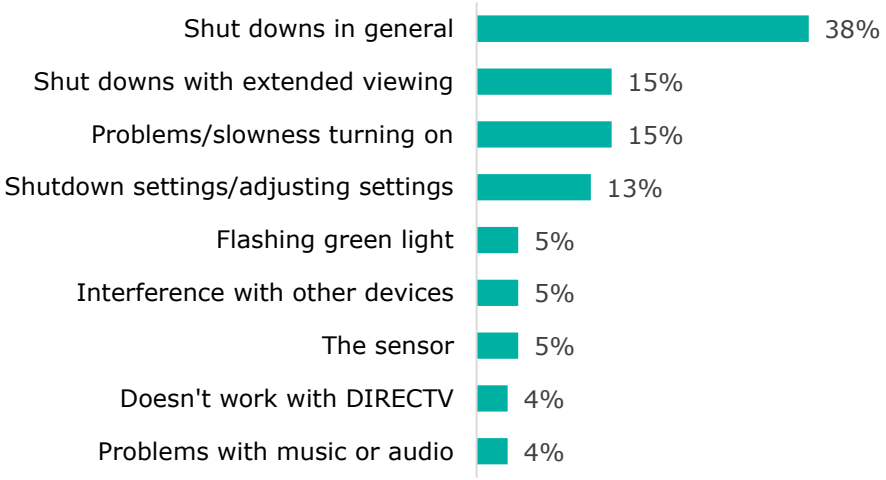
FIGURE 24. MOST FREQUENTLY MENTIONED FEATURES RESPONDENTS *LIKE* ABOUT THE IR MODEL TIER 2 ADVANCED POWER STRIP (N=96, MULTIPLE RESPONSES PERMITTED)



All respondents, including those that removed the Tier 2 APS, were asked if there were any features or functionality that they didn't like (Figure 25). Just under half (48%), stated that there were features of the product they disliked. Television shutdowns were by far the biggest

drawback with 38% of respondents stating they disliked the shutdowns and another 15% specifically stating the shutdowns with extended viewing such as when watching movies, recorded TV or sporting events. This was followed by difficulties (dislike of having to use the volume button to turn on TV) or slowness when turning on the television.

FIGURE 25. MOST FREQUENTLY MENTIONED FEATURES RESPONDENTS D*ISLIKE* ABOUT THE IR MODEL TIER 2 ADVANCED POWER STRIP (N=61, MULTIPLE RESPONSES PERMITTED)



Product Knowledge

Respondents are fairly confident in their understanding of the Tier 2 APS and to a lesser extent, their ability to set up the Tier 2 APS elsewhere. Eighty-one percent of respondents say they understand how to use the Tier 2 APS well (rated a five through seven on a seven-point scale, with seven being very well and one being not at all) and only seven percent say they do not understand how to use it (rated a one through three). In comparison, 71 percent of respondents are confident (rated a five through seven on a seven-point scale, with seven being very confident and one being not at all confident) they could set up the Tier 2 APS with another AV system and 17% are not confident (rated a one through three) they could set up the Tier 2 APS with another AV system. As further evidence of the respondents' understanding of the Tier 2 APS, 65% have shown others in their household how to use the devices.

C.4 Usage Habits

Modifications

Few respondents who still have the Tier 2 APS installed have made any changes to it since installation. About 20% have changed how devices are plugged into the Tier 2 APS, 13% have added additional equipment and 6% have made other changes.

When respondents did make changes to how the devices were plugged into the Tier 2 APS, they most frequently changed the TV or Blue-ray or DVD, each mentioned by nine respondents (42%), or the DVR which was mentioned by eight respondents (37%). The most frequently cited reason for these changes was because of interference with device operations.

Game consoles were the most frequently added equipment and moving the Tier 2 APS to a new home or location was the most frequently cited other change people made to the Tier 2 APS.

Conditions Prior to Tier 2 Advanced Power Strip

With respect to energy-saving behaviors prior to the installation of the Tier 2 APS, very few respondents (6%) turned their old power strip off at night or while away from home for periods of time. Additionally, only 39% were aware that their television has built in power saving features. Another 33% were not sure if their television has built-in power saving features.

APPENDIX 4-D: IR-OS MODEL FINDINGS

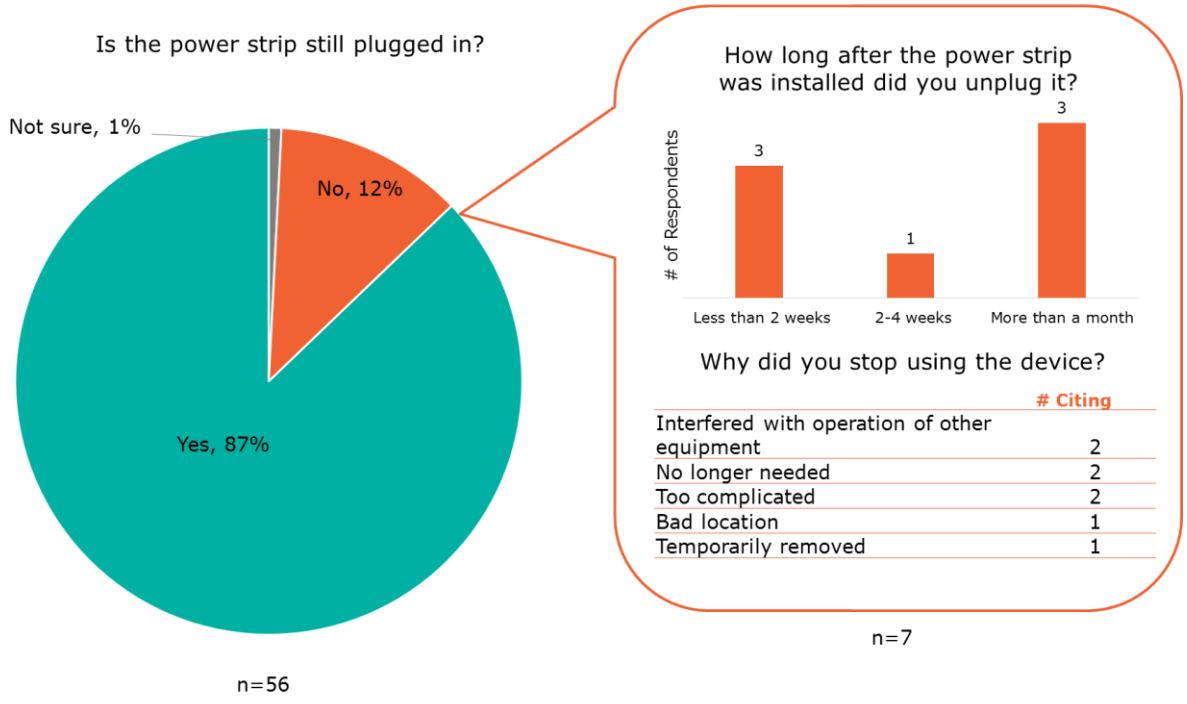
This section of the report presents the key study findings for the IR-OS model Tier 2 APS and consists of four subsections: (1) Persistence; (2) Satisfaction; (3) Features and Functionality; (4) Usage Habits.

D.1 Persistence

Persistence Rate

As depicted in Figure 26, 87% of the IR-OS model Tier 2 APS devices were still installed at the time of the survey. Of the seven devices that were no longer installed, three were removed in less than two weeks and three were removed after more than one month. Interference with the operation of other equipment, that the device was no longer needed or that it was too complicated were each noted by two of the respondents that removed the device.

FIGURE 26. IR-OS MODEL PERSISTENCE RATE

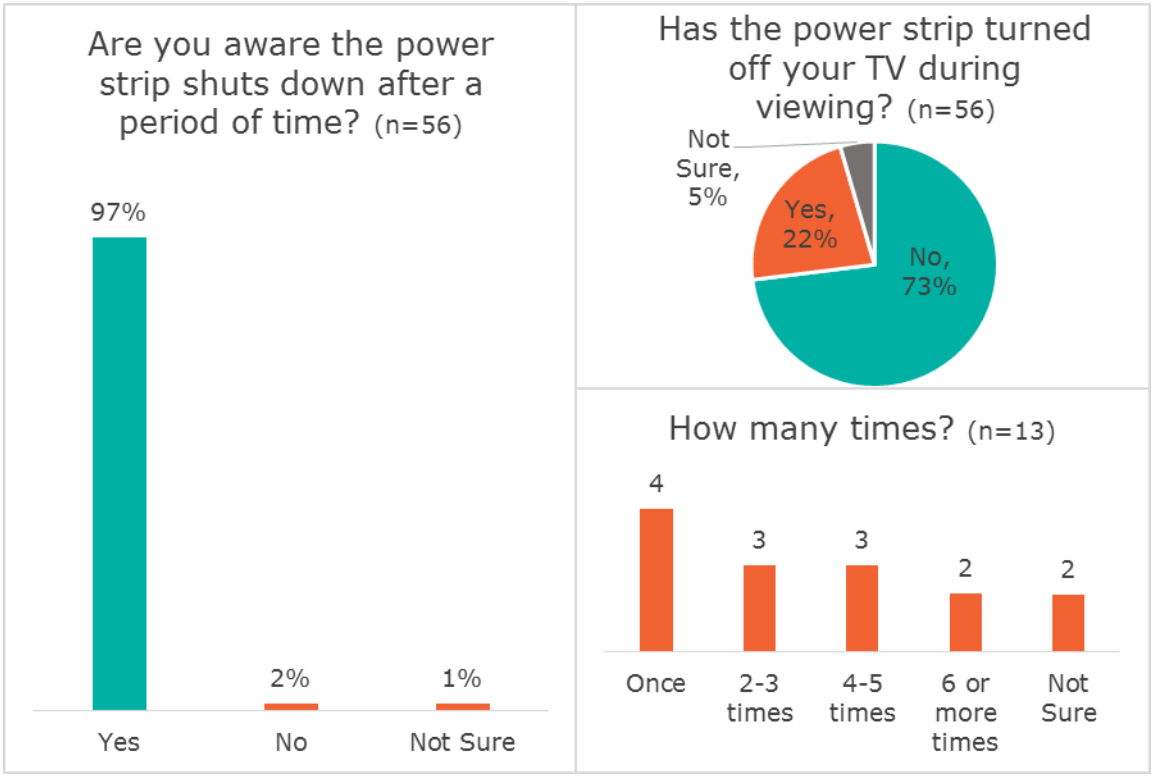


Device Shutdowns

Device shutdowns have not been a major complaint of IR-OS model respondents. Almost all (97%) respondents are aware the device will shut down after a period of time but only 22% have had this happen while watching TV. For those who have experienced TV shutdowns, about half (7 respondents) have experienced three or fewer shutdowns. Additional detail regarding TV shutdowns is provided below in Figure 27. Most respondents (eight of the thirteen) who have experienced shutdowns simply turned the TV back on when this happened

and none noted that they were angry while doing so. Shutdowns with the IR-OS model Tier 2 APS occurred at higher rates in households with children under 17 (29%) than in those without children (14%).

FIGURE 27. IR-OS MODEL TIER 2 ADVANCED POWER STRIP SHUTDOWNS



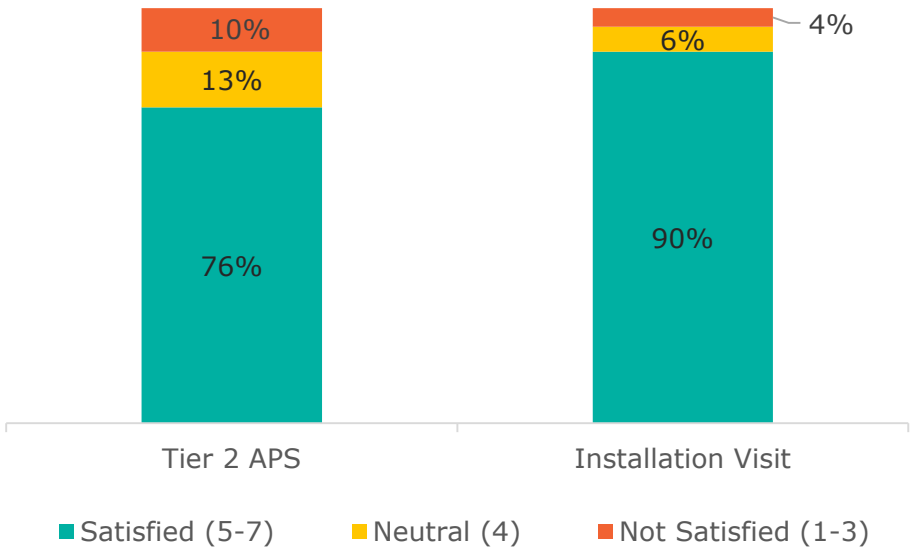
Few IR-OS model respondents (25%) were aware that they can adjust the shutdown time settings on the Tier 2 APS and only one person has actually made adjustments to the shutdown time.

Two respondents indicated that the Tier 2 APS interfered with their audiovisual activities in some manner other than shutting down. The interference cited included shutting down a receiver and the amount of time it takes for the TV to turn on.

D.2 Satisfaction

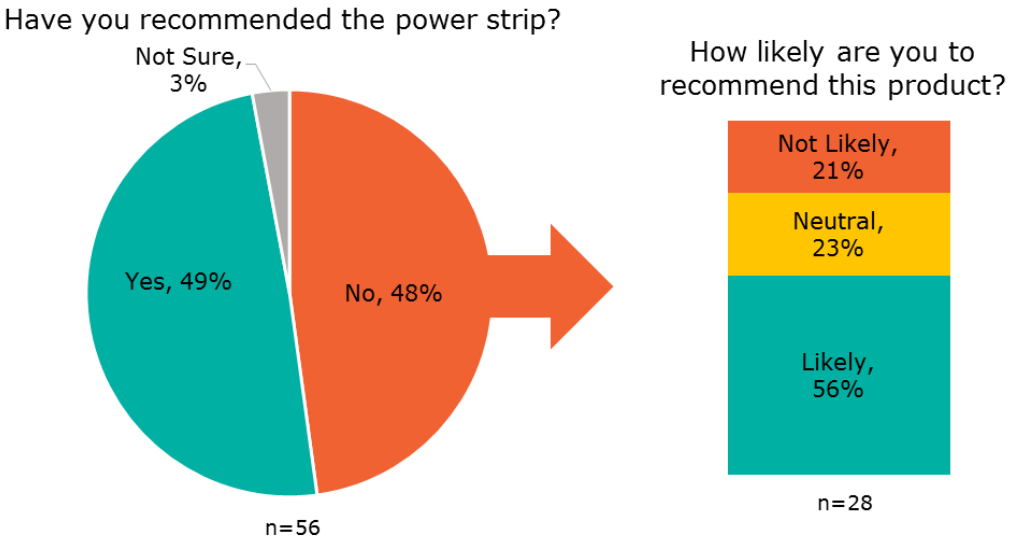
Respondents had a high rate of satisfaction with both the IR-OS model Tier 2 APS and the installation visit. The Tier 2 APS had a mean satisfaction rating of 5.6 on a seven-point scale with seven being very satisfied and the installation visit had a mean rating of 6.2. Furthermore, 76% indicated they were satisfied (rated a five through seven) with the Tier 2 APS and 90% indicated they were satisfied (rated a five through seven) with the installation visit. Very few respondents indicated they were not satisfied with the Tier 2 APS or the installation visit. Further detail is shown below in Figure 28.

FIGURE 28. OVERALL SATISFACTION WITH THE IR-OS MODEL TIER 2 ADVANCED POWER STRIP AND INSTALLATION VISIT (N=56)



In order to further assess satisfaction with the Tier 2 APS, respondents were also asked if they have, or would, recommend the Tier 2 APS to friends or family. As illustrated in Figure 29, nearly half (49%), of the respondents have already recommended the Tier 2 APS to friends or family. Of those who have not yet recommended, 56% of respondents are likely (rated a five through seven on a seven-point scale with seven being very likely) to recommend the product.

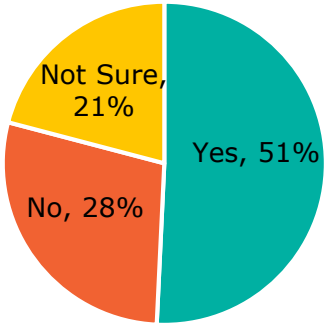
FIGURE 29. RECOMMENDATION OF THE IR-OS MODEL TIER 2 ADVANCED POWER STRIP



Just over half (51%) of the IR-OS model respondents stated they would purchase another Tier 2 APS for use elsewhere in their home (Figure 30). The most common locations

respondents would use another Tier 2 APS are the bedroom (53%) and secondary media room (38%).

FIGURE 30. WOULD YOU PURCHASE ANOTHER TIER 2 ADVANCED POWER STRIP FOR ELSEWHERE IN YOUR HOME? (N=56)



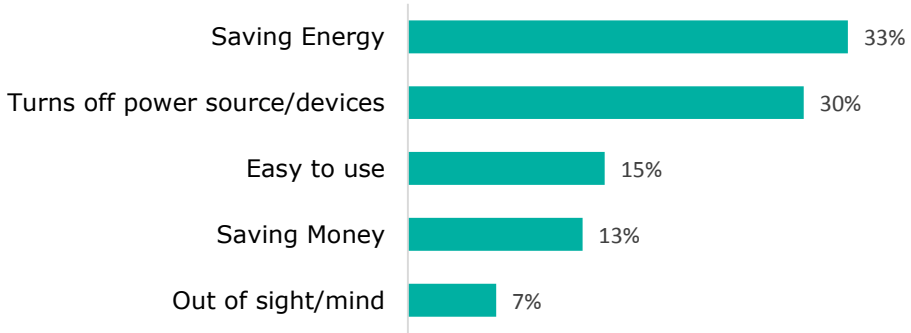
In order to gain a better understanding of why respondents would not purchase another Tier 2 APS for their home, IR-OS model respondents who stated they would not purchase another Tier 2 APS were also asked why not. The most frequently cited reason was because another Tier 2 APS is not needed (40%), followed by cost (27%). The remaining respondents cited a variety of reasons such as uncertainty about the advantages, functionality or energy bill savings, devices being too complicated or producing too much light, lack of interest or the ability to turn off devices oneself.

D.3 Features and Functionality

Product Likes and Dislikes

Respondents who rated their overall satisfaction with the IR-OS model device higher than a three on a seven-point scale were asked what they like most about the device. The most frequently cited responses are shown below in Figure 31. As shown, saving energy and having power turned off are the features IR-OS model respondents like most.

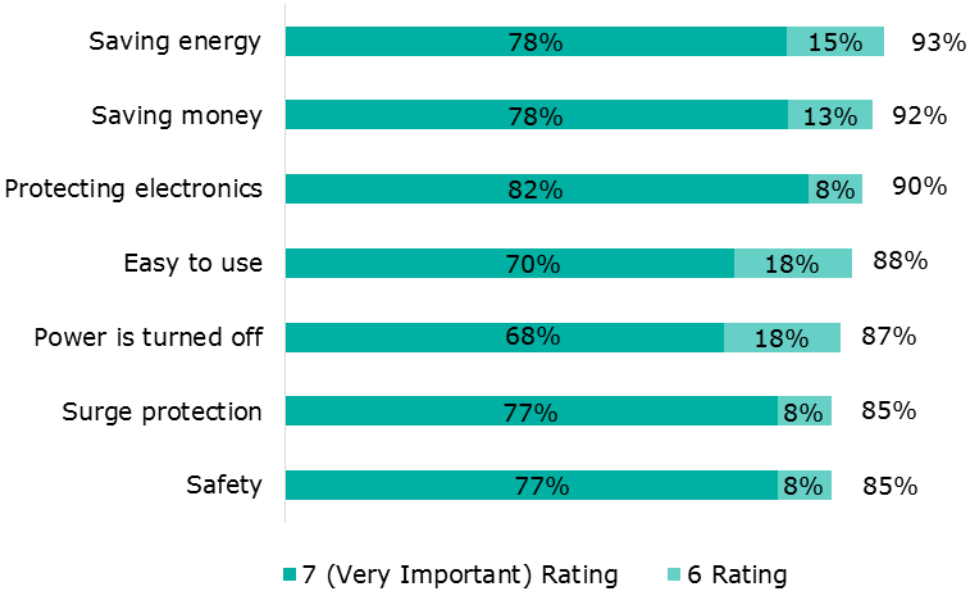
FIGURE 31. MOST FREQUENTLY MENTIONED FEATURES RESPONDENTS *LIKE* ABOUT THE IR-OS MODEL TIER 2 ADVANCED POWER STRIP (N=50)



These respondents were also asked to rate the importance of several product features (listed in Figure 32) on a seven-point scale, with seven being very important, in their satisfaction

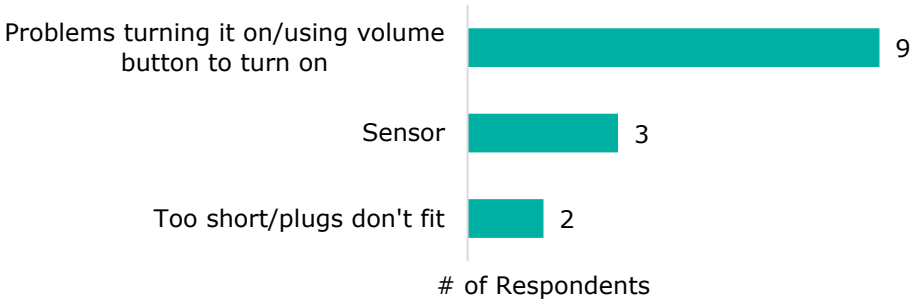
with the Tier 2 APS. When the percentage of respondents that rated each factor a six or seven is combined, there is very little difference in the rankings with saving energy rated as being very important by 93% and saving money rated as being very important by 92% of respondents.

FIGURE 32. IMPORTANCE OF FEATURES IN SATISFACTION WITH THE IR-OS MODEL POWER STRIP (N=50)



All respondents were asked if there are any features or functionality of the Tier 2 APS they dislike. Thirty-one percent of the IR-OS model reported that there was something they disliked about the product. As shown below in Figure 33, this was most often difficulties turning the device or television on which was cited by nine respondents (55%).

FIGURE 33. MOST FREQUENTLY MENTIONED FEATURES RESPONDENTS *DISLIKE* ABOUT THE IR-OS MODEL TIER 2 ADVANCED POWER STRIP (N=16)



Product Knowledge

Overall, respondents appear to understand the Tier 2 APS fairly well. Even though all but one respondent reported that the installer showed them how the Tier 2 APS works, 76 percent of

respondents say they understand how to use the IR-OS model Tier 2 APS (rated a five through seven on a seven-point scale, with seven being very well and one being not at all). Ten percent do not understand (rated a one through three) how to use the Tier 2 APS. Similarly, 73% of respondents are confident (rated a five through seven on a seven-point scale, with seven being very confident and one being not at all confident) they could set up the Tier 2 APS with another AV system while 13% were not confident (rated a one through three) they could set up the Tier 2 APS with another AV system. As further evidence of the respondents' understanding of the Tier 2 APS, 60% have shown others in their household how to use the devices.

D.4 Usage Habits

Modifications

Very few respondents who still have the Tier 2 APS installed have made any changes to it since installation. About 17% have changed how devices are plugged into the Tier 2 APS, 17% have added additional equipment and 7% have made other changes.

When respondents did make changes to how the devices were plugged into the Tier 2 APS, they most frequently changed the TV (3 respondents) or Blue-ray or DVD (2 respondents). None of the respondents that moved the TV moved it to an "Always on" outlet.

Game consoles were the most frequently added equipment, mentioned by four respondents, and moving the Tier 2 APS to a new home or location was the most frequently cited (3 respondents) other change people made to the Tier 2 APS.

Conditions Prior to Tier 2 Advanced Power Strip

Respondents were also asked about their energy-saving habits related to audiovisual equipment prior to the installation of the Tier 2 APS. Nineteen percent of respondents were turning off their Tier 2 APS at night or when away from home for extended periods of time. Respondents were largely unsure about their television's built-in power saving features, with 38% stating they weren't sure if their TV has built-in power saving features. Thirty-five percent of respondents stated their TV does have power saving features, however, only 5 of those respondents (30%) used the features.

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