

Energy Trust of Oregon

# Pilot Study of Tier 1 Advanced Power Strips in Multifamily

March 23, 2018

# Acknowledgements

This report was prepared by Justin Hovland and Tracy Scott of Lockheed Martin, and Erika Kociolek of Energy Trust of Oregon, with support and input from Kate Scott and Paul Sklar of Energy Trust of Oregon.

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# 1 Summary

Lockheed Martin (LM) conducted a pilot study to determine the savings from Tier 1 advanced power strips (APS) using a direct distribution model. Half of pilot participants received a standard power strip, and half received a Tier 1 APS. All power strips were provided with an energy meter attached to capture energy usage and elapsed time, which the LM team collected after a two-week period. The configuration of equipment plugged into the strips was also recorded and participants responded to a survey to gain information on customer satisfaction and anticipated persistence.

After normalizing the test group to the control group and adjusting for non-installs and HVAC interaction, the average savings was calculated to be 77 kWh. Approximately a year after the end of study surveys were conducted, LM followed up with customers to assess whether or not the power strips were still installed. Of those respondents that reported installing their power strip as of the end of study survey, 19% said the power strip was not installed a year or more later.

This pilot was conducted with a blend of market rate and affordable housing apartments. However, the measure is planned to be implemented as an in-unit leave behind as a part of the direct-install savings track of Energy Trust of Oregon's Multifamily program, which also serves assisted living, campus living, and condominiums. Also, although this pilot study was conducted by delivering one power strip per participant, the intent is to deliver one APS for each active television located by field staff. The program anticipates an average install rate of about 1.5 APS per dwelling unit based on data from the Residential Building Stock Assessment, or RBSA (NEEA, 2013).

# MEMO

**Date:** March 23, 2018  
**To:** Energy Trust Board of Directors  
**From:** Erika Kociolek, Evaluation Project Manager  
Mike Bailey, Planning Manager  
Kate Scott, Commercial Program Manager  
**Subject:** Staff Response to Advanced Power Strip (Tier I) Pilot Evaluation

Energy Trust undertook a pilot to assess the savings from advanced power strips in the multifamily sector. The first phase of this pilot focused on tier I (load sensing) power strips. Advanced power strips save energy by sensing when the current from equipment (typically a television) plugged into a “control outlet” drops below a pre-set level, which then turns off devices plugged into “switched outlets.”

To assess energy savings from advanced power strips, the Multifamily program provided advanced power strips and control power strips to a mix of 125 market-rate and affordable housing units. The program recorded the number and types of devices plugged into the power strips, and metered the energy use of the power strips over a two-week period. The program also conducted participant surveys to assess customer satisfaction and determine the number of participants that did not install their power strip.

Results from the metering and end of study surveys suggested savings of approximately 76 kWh per year. This savings estimate accounts for the approximately 11.7% of participants who did not install their power strip. Customers reported being highly satisfied, providing the advanced power strip an average rating of 4.2 out of 5.

If survey information is used to supplement the meter data to identify which participants did not install the power strip, the non-install rate would be 15.4%. The difference in the estimated savings is not significant.

Given these results, the program has moved forward with distributing power strips to qualified multifamily tenants at no cost.

Approximately a year after the end of study surveys were conducted, the program followed up with customers to assess whether or not the power strips were still installed. Of those respondents that reported installing their power strip as of the end of study survey, 19% said the power strip was not installed a year or more later.

The program and Planning have incorporated this information into the measure approval document for tier 1 power strips, resulting in savings of 61 kWh.

## 2 Introduction

### 2.1 APS Technologies

Advanced power strips (APS) help reduce electric consumption by disconnecting power from devices when they are not in use. Electronics such as TVs, DVD players, speakers, etc. still draw a small amount of current even when turned off – this is commonly referred to as standby load, vampire load, or phantom load. Until recently, the only way to eliminate these loads was to unplug the equipment, however, this is rarely done. Advanced power strips offer a way to eliminate standby loads without unplugging equipment.

There are two primary types of APS that have emerged on the consumer market: Tier 1 and Tier 2.

Tier 1 APS utilize load-sensing technology and track the current being drawn through a particular outlet, called the control outlet. In a residential application, it is most common to make the television the control device. Other devices are plugged into a bank of switched outlets which are energized when a high current is detected in the control outlet, indicating that the TV is on. When the device plugged into the control outlet is turned off by the consumer, the current through the control outlet drops below a predetermined threshold and switched outlets are then disconnected from the power source. Most APS also come with some “always on” outlets to accommodate devices that require continuous power, such as internet routers.

Tier 2 APS typically have a load sensing control outlet as well, but also have an external sensor such as an infrared (IR) sensor and/or motion sensor located near the TV. This enables the strips to sense when a consumer has stopped watching the television, through lack of use of the remote for a pre-set amount of time and/or lack of motion in near proximity to the television. The APS will then automatically turn off the television. When the control device is turned off, the rest of the outlets will be de-energized as in Tier 1 operation. The user must first energize the power strip by pushing a button on their television or accessory remote control that will send an IR signal which the IR sensor will detect (the television or accessory cannot detect the signal yet since they are effectively unplugged). The power strip may also be energized by pressing a button located on the sensor. Devices may then be turned on and used as normal. Because of these additional features, it is commonly thought that Tier 2 APS enable greater savings than Tier 1 technology.

The current retail cost of a typical Tier 1 APS is about \$30, whereas the cost of a typical Tier 2 APS is about \$80. Due to the high cost of the Tier 2 equipment, LM has focused first on measure development activities on the Tier 1 equipment. However, Energy Trust intends to add a second phase to this pilot, which will test Tier 2 APS as well.

### 2.2 Measure History

In September 2014, Tier 1 advanced power strips were approved by Energy Trust for use in commercial office settings. Lockheed Martin (LM) recommended that a measure be created specifically for distribution through the Multifamily direct-install service.

LM developed a bottom-up analysis of savings anticipated from Tier 1 APS in late September 2014, which estimated the savings to be up to 124 kWh. However, the bottom-up analysis was not able to answer several questions critical to estimating savings, including the non-install rate and whether tenants would use the control function properly. It was decided that a pilot should be conducted to confirm the energy savings.

## 2.3 Report Structure

This report has six sections. Sections 1 and 2 are the executive summary and background sections, respectively. Section 3 summarizes the design of the APS pilot. Section 4 summarizes the methodology used to estimate energy savings from APS, Section 5 summarizes the analyses of the energy use data gathered through the pilot, and Section 6 summarizes the results of surveys conducted with participants and information collected about the types of devices plugged into the power strips.

## 3 Pilot Design

The pilot was designed to answer the following research questions:

1. What are the kWh savings for APS connected to media centers in multifamily housing?
2. How will tenants configure the APS (that is, will they use the control function properly)?
3. How many tenants will install and continue to use the APS if it is delivered to them as a “leave-behind”?
4. What is the customer satisfaction with the product?

It was initially discussed that a pre/post-style test should be implemented with time-series data-logging equipment. However, this was ruled out because program staff would need to install these data loggers, which would no longer make APS (in this study) a self-installed measure, which would compromise the ability to answer one of the key research questions. Also, in the interest of time, it was decided that control and APS groups would be treated simultaneously instead of using a pre/post approach. The final pilot design included 120 participants (60 control and 60 APS) and 10 properties.

Of particular interest was determining whether customers would use APS with audio equipment in the control outlet, rather than televisions. Using audio equipment in the control outlet is not the intended use of the equipment, and would presumably result in a different level of savings than APS with TVs in the control outlet. There were zero instances of audio equipment as the control, although there were several instances where other non-TV devices were being used as the control (see Section 4.1 for more information).

Only the general type of device was recorded - i.e., TV, DVD player, speakers, etc. Make and model information was not recorded since that would have significantly increased the on-site time required as well as the post-processing time required to gather information on all of the specific models of equipment.

There were also concerns as to whether customers would use controlled outlets gaming systems with hard drives and if being powered down suddenly would harm them. Such systems were found to be plugged into the controlled outlets during the study, and no participants reported any damage, however the study period was short and this remains an open question until long-term data is made available.

### 3.1 Equipment

LM used Kill A Watt® EZ meters to collect the electric usage data, as they are simple for customers to install. These record total kWh and elapsed time, retain data when unplugged, and could be provided to the tenants already plugged in to their power strips.

The APS that were used were TrickleStar 181SS-US-7XX/3. LM searched for a regular power strip that resembled the TrickleStar as closely as possible and settled on the Belkin BE107000-04-CM. These power strips are shown as they were delivered, plugged into the Kill A Watt® EZ meter, in Figure 1.



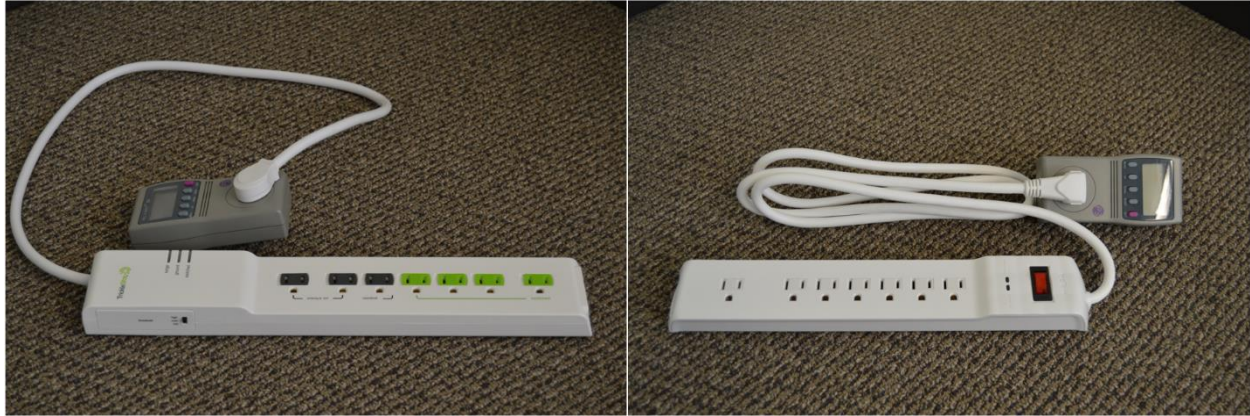


Figure 1. APS (left) and regular strips (right) used in the study

### 3.2 Recruitment & Metering

LM business development staff reached out to property managers who have previously participated in Energy Trust programs. Tenants were recruited to sign-up to participate, with the understanding that the pilot was designed to collect energy usage at the power strip and equipment configuration, and were offered either movie tickets or gift cards to participate. Sign-up rates were lower than anticipated per property, and ultimately ten different properties were recruited to reach the desired participation level. While this lengthened the period of the pilot, it also had the effect of diversifying the study population.

Table 1 shows the market sector and size of each participating property, as well as the number of participants in each sample and how many from each resulted in valid data used in the analysis (that is, were not subject to any of the attrition rules discussed in Section 4.1). It also shows the dates the power strips were dropped off at each property, and when the logging equipment was picked up. All properties that participated in the pilot are in the Portland Metro area.

Table 1. Properties and sample sizes

Property	Sector	Drop-Off Date	Pickup Date	Units at Property	Control		APS		% Participation
					Total	Valid	Total	Valid	
1	Market	3/24/15	4/9/15	202	8	7	8	7	7%
2	Market	3/26/15	4/14/15	191	5	4	6	4	5%
3	Market	4/17/15	5/4/15	506	9	6	8	7	3%
4	Market	4/13/15	4/29/15	127	6	6	7	6	9%
5	Market	4/21/15	5/12/15	294	3	3	6	5	3%
6	Market	5/11/15	6/2/15	200	6	6	4	3	5%
7	Market	5/11/15	5/27/15	228	5	4	4	3	4%
8	Affordable	7/7/15	7/23/15	105	11	7	10	6	16%
9	Affordable	7/7/15	7/23/15	180	3	2	5	5	4%
10	Affordable	7/8/15	7/24/15	100	7	2	4	2	9%
Totals				2,133	63	47	62	48	5%

To recruit participants, LM first reached out to the property manager and gained permission to conduct the study at their building. Tenant sign-up forms were then delivered to property management to be distributed to the tenants. The forms used for the property managers and tenants can be found in Appendix A.

After about one week, LM collected the participation forms and notified tenants whether they would be included in the study (some were screened out; for example, one property was also participating in an Energy Trust convective wall heater pilot so tenants in that study were excluded from this one). Tenants were randomly assigned to be in the control and APS groups.

After the participants were recruited, LM scheduled the drop-off and delivered a power strip, Kill A Watt® meter, and instructions to each tenant. Drop-off and pick-up dates are recorded in Table 1. All materials were delivered in-person by LM staff, or if the tenant was not home, the materials were left in a conspicuous location. Materials included a power strip plugged into an energy meter, a setup guidelines sheet, and an instruction card stating not to unplug the strip from the meter. All of these materials can be found in Appendix A.

After a two-week period, LM conducted the pick-up visit in which the energy meters were collected, the configuration of the power strip (what was plugged into it) was recorded, and the tenants were given a brief survey (end of study survey). The data collection templates and survey instruments can be found in Appendix B.

Participants were offered a reward on the completion of the end of study survey. The first participants were offered two movie tickets and the uptake was low. This was changed to a \$25 Visa gift card to increase participation, which did not have much impact because this reward required the tenant to complete a W-9. Participants recruited in the final buildings were offered four movie tickets, which increased participation and filled the remaining sample slots.

Over a year after the end of study survey, LM staff completed phone surveys with study participants (persistence survey). The survey instruments can be found in Appendix B.

Approximately two thirds of the participants were market rate tenants. The other third recruited were affordable housing tenants. This slightly over-represents the affordable sector since it accounts for about 19% of the northwest building stock, according to the multifamily Residential Building Stock Assessment (NEEA, 2013).

## 4 Energy Savings Analysis Methodology

The data available for the energy savings analysis were:

- Total kWh
- Elapsed time
- Equipment categories of plugged-in devices (i.e. configurations)
- Self-reported TV usage times

There was some variation in the overall distribution of plugged-in devices between the control and APS groups. As a result, several methods of normalizing the APS group to the control group were developed. Each method is presented below, along with the raw usage data. All savings numbers are also adjusted for non-install cases and HVAC interaction (which roughly accounts for the displacement of space heating loads).

The annual energy usage for each participant was extrapolated from the recorded usage during the period of the study using the following equation:

$$\text{Annual kWh} = \frac{\text{kWh} * 8760}{\text{Elapsed Time (Hrs)}} \quad (\text{Eq. 1})$$

### 4.1 Attrition Rules

A series of attrition rules were applied to eliminate invalid data. Table 2 describes each rule and shows how many participants from each market sector met that rule. This data comes from the field observations and data collected by LM staff. The rules are all mutually exclusive; participants meeting one of them was not counted as meeting any others.

Table 2. Attrition rules

Rule		Number of Participants				
		Control		APS		Totals
		Market	Affordable	Market	Affordable	
		42	21	43	19	<b>125</b>
1. Did not have TV	<i>dropped</i>	1	3	0	1	5
	<i>remaining</i>	<b>41</b>	<b>18</b>	<b>43</b>	<b>18</b>	<b>120</b>
2. Zero kWh reading and no device data	<i>dropped</i>	2	1	2	0	5
	<i>remaining</i>	<b>39</b>	<b>17</b>	<b>41</b>	<b>18</b>	<b>115</b>
3. Weather-dependent devices (e.g. AC units)	<i>dropped</i>	0	2	1	3	6
	<i>remaining</i>	<b>39</b>	<b>15</b>	<b>40</b>	<b>15</b>	<b>109</b>
4. Strip used in non-AV application	<i>dropped</i>	1	1	0	1	3
	<i>remaining</i>	<b>38</b>	<b>14</b>	<b>40</b>	<b>14</b>	<b>106</b>
5. Zero kWh reading with device data	<i>dropped</i>	1	1	3	1	6
	<i>remaining</i>	<b>37</b>	<b>13</b>	<b>37</b>	<b>13</b>	<b>100</b>
6. Usage data but no device data	<i>dropped</i>	1	2	2	0	5
	<i>remaining</i>	<b>36</b>	<b>11</b>	<b>35</b>	<b>13</b>	<b>95</b>

Below, we discuss the attrition rules that are summarized in Table 2:

1. Five study participants were found to not have a television so their data and participation were completely dropped from the study<sup>1</sup>, leaving a sample size of 120 participants comprised of 59 in the control group and 61 in the APS group.
2. Five participants did not use the equipment after drop-off, often due to physical limitations, which was evident when there was no kWh data recorded and the power strip was not connected when LM staff conducted the pick-up.
3. In six cases, weather-sensitive equipment, such as an AC unit, was plugged into the power strip, making the kWh data unreliable since this seasonality could not be reliably accounted for when extrapolating the usage over the entire year.
4. In three cases, the power strip was used in a non-AV application, such as in a kitchen where no television or associated equipment was located.
  - o Cases falling into #2-4 were excluded from the savings analysis and considered “non-installs”, since they include cases where the power strip was not used at all as well as cases where it was used in a way that would not achieve energy savings.
5. In six cases there was no kWh reading due to the Kill A Watt® meter being disconnected or improperly used, however the power strip was used and device data was recorded.
6. In five cases there was no device data available, primarily due to participants unplugging all of the devices from the power strips before LM staff arrived for pick-up, however it was clear that the power strip was used since there was kWh usage data recorded.
  - o Cases falling into #5-6 were excluded from the savings analysis, but are still counted as having installed their power strip and kept in the pool of participants from which the non-install rate was calculated.

The non-install rate overall is 14 (the number of non-install cases) divided by 120, or 11.7%.

The non-install rates were 7% (6 out of 84) for market rate properties and 22% (8 out of 36) for affordable properties; combining these and normalizing such that the affordable properties represent 19% of the sample per the RBSA (NEEA, 2013), the overall non-install rate was found to be 10%.

Overall, there were 14 non-install cases and another 11 participants with invalid data, making a total of 25 that could not be included in the savings analysis. The remaining 95 were used for the savings analysis – 47 in the control group and 48 in the APS group. The full sample of 120 qualifying participants (this excludes the five participants without TVs) completed the survey and all of these participants are included in the survey results.

## 4.2 Normalization

Since the number of devices plugged into the power strips and the hours of use of TVs differed among participants, LM attempted to account for these differences by normalizing. In all, LM made three separate, independent adjustments to the data. In each case, the APS group usage was adjusted based on the value difference of a given normalization metric according to the following equation:

$$\text{Adjusted APS Group Usage} = \text{APS Group Usage} * (\text{Ratio}) \quad (\text{Eq. 2})$$

$$\text{where Ratio} = 1 + \frac{\text{Control Value} - \text{APS Value}}{\text{APS Value}}$$

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<sup>1</sup> Owning a television was listed as a requirement on the participation agreement, however, LM staff did not specifically verify this during drop-offs.

The idea of applying further filters to the data was also explored. For example, participants with high hours of use or few plugged-in devices might be filtered out. However, no trend could be established while exploring the use of these kinds of filters, and some filters resulted in reduced savings while others resulted in increased savings (though it is notable that there were no permutations identified that resulted in low or negative savings). Because of these observations, no filters were applied to the data; all three of the normalization methods were applied to the entire data set of 95 participants. The three normalization methods are: device count, connected wattage, and bottom-up. We describe each one in turn, below.

#### Device Count Normalization

This method looks at the average number of plugged-in devices in each group. The savings for the APS group is adjusted based on the ratio of plugged-in devices between the two groups. This is the simplest of the three methods.

#### Connected Wattage Normalization

This method utilizes external data on the average wattage of each plugged-in device category. A major source of this data is from measurements made available by the Lawrence Berkeley National Laboratory (LBNL, 2015). When LBNL data was not available, other sources were referenced and recorded in the analysis spreadsheet. For this method, the estimated connected wattage was calculated for each group and the savings for the APS group was adjusted based on the ratio of connected wattage between the APS group and the control group. This method, while still fairly simple, may be more accurate than the device count methodology since it also accounts for the potential impact of each connected device on energy usage.

#### Bottom-Up Normalization

A theoretical energy usage for each group was determined by performing a bottom-up calculation of expected energy usage based on the wattage and usage pattern of all connected equipment. This type of methodology has been used in RTF analyses to determine advanced power strip savings in similar applications (RTF, 2013). Wattage data for each connected device was defined for three states: on, ready and off (LBNL, 2015). Average hours of use were assumed based on data from the RBSA (NEEA, 2013) and the RTF (RTF, 2013), and adjusted for each participant based on their self-reported hours of television use. This method was included because it expands on the connected wattage method by accounting for the standby power in the off state as well as how long each device is in this state. This adds considerable complexity but also makes it a potentially more accurate methodology.

# 5 Energy Savings Results

For each participant, the raw annual energy usage was obtained using Equation 1. The average raw usage for the control and APS groups are presented in Table 3. The affordable and market rate housing types have been separated and all total values have been calculated using the RBSA ratio of 19% affordable, which corrects for the slight over-representation of the affordable housing type in the study sample.

It can be seen from these values that the total raw apparent savings was 144 kWh, though this value is reduced in all cases when normalized, and again when adjusted for non-install cases and HVAC interaction.

Table 3. Raw annual kWh results, by group and housing type

	Control		APS		Raw Average Annual kWh Difference (Control – APS)
	Annual Average kWh	Standard Deviation	Annual Average kWh	Standard Deviation	
<b>Affordable</b>	525	362	362	269	163
<b>Market</b>	538	319	398	213	139
<b>Total</b>	535	324	392	225	144

The distribution of the raw annual average energy usage in each group is shown in Figure 2, and it is apparent that there are fewer high-use cases and more low-use cases in the APS group, supporting the lower average energy usage values found for the APS group.

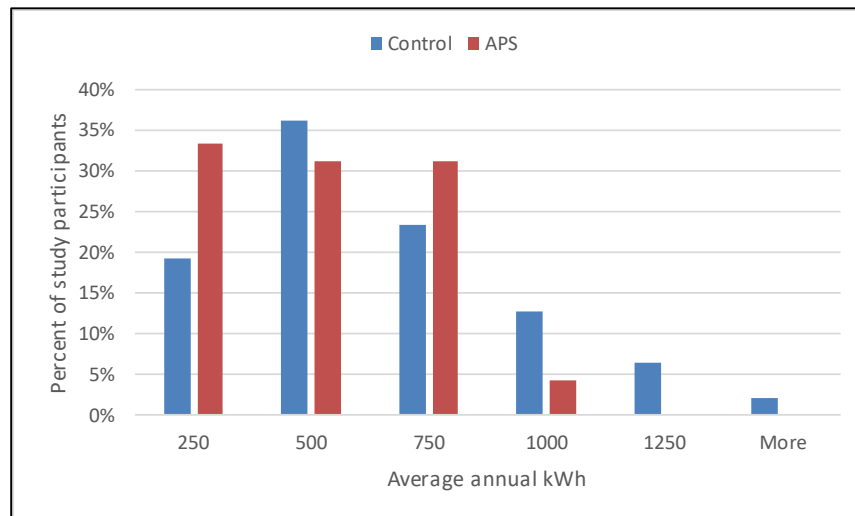


Figure 2. Distributions of energy usage

We now summarize the three different ways we normalized. Note that these normalizations are not layered, but are three independent methods of normalizing the raw data.

## 5.1 Device Count Normalization

Table 4 shows the average number of devices for each group and housing type, as well as the ratio used in Equation 2. For example, the normalization ratio for the total sample accounting for the average number of devices is 1.11, which means the adjusted APS group usage is 11% higher than the raw APS group usage.

These ratios are applied in Table 5, showing how the APS kWh usage was adjusted from its original value. The savings is then calculated as the difference between the control kWh usage and the device-normalized APS kWh usage, yielding the device-normalized kWh savings. Finally, the device-normalized savings are adjusted by subtracting the percentage of non-installs and then the HVAC interaction percentage. As mentioned in Section 4.1, the non-install percentage was 22% for the affordable housing type, 7% for the market rate housing type, and 10% overall. The HVAC interaction percentage that was subtracted was 15% in all cases.

*Table 4. Number of devices, by group and housing type*

	Control		APS		Ratio*
	Avg. # of Devices	Standard Deviation	Avg. # of Devices	Standard Deviation	
<b>Affordable</b>	4.36	1.57	3.54	1.61	1.23
<b>Market</b>	4.92	1.18	4.54	1.46	1.08
<b>Total</b>	4.81	1.26	4.32	1.54	1.11

\*Note:  $Ratio = 1 + \frac{Control\ Value - APS\ Value}{APS\ Value}$

*Table 5. Device count normalization results*

	Control kWh	APS kWh	Ratio	Device-Normalized APS kWh	Device-Normalized kWh Savings	Device-Normalized Adjusted kWh Savings
<b>Affordable</b>	525	362	1.23	447	79	52
<b>Market</b>	538	398	1.08	431	107	84
<b>Total</b>	535	392	1.11	436	100	76

## 5.2 Connected Wattage Normalization

Table 6 shows the average connected wattage for each group and housing type, as well as the derived normalization ratios. Table 7 shows the normalization ratios applied and the resulting savings values, which are then reduced by the non-install and HVAC interaction factors to result in the normalized adjusted kWh savings.



Table 6. Connected wattage, by group and housing type

	Control		APS		Ratio*
	Avg. Connected Watts	Standard Deviation	Avg. Connected Watts	Standard Deviation	
<b>Affordable</b>	187	43	182	56	1.03
<b>Market</b>	241	100	215	96	1.12
<b>Total</b>	231	94	207	89	1.11

\*Note:  $Ratio = 1 + \frac{Control\ Value - APS\ Value}{APS\ Value}$

Table 7. Connected wattage normalization results

	Control kWh	APS kWh	Ratio	Connected Watt-Normalized APS kWh	Connected Watt-Normalized kWh Savings	Connected Watt-Normalized Adjusted kWh Savings
<b>Affordable</b>	525	362	1.03	373	152	100
<b>Market</b>	538	398	1.12	448	90	71
<b>Total</b>	535	392	1.11	436	100	76

### 5.3 Bottom-up Normalization

Table 8 shows the average estimated kWh (using bottom-up analysis) for each group and housing type, as well as the derived normalization ratios. Table 9 shows the normalization ratios applied and the resulting savings values, which are then reduced by the non-install and HVAC interaction factors to result in the normalized adjusted kWh savings.

Table 8. Bottom-up kWh estimates, by group and housing type

	Control		APS		Ratio*
	Avg. Bottom-up kWh	Standard Deviation	Avg. Bottom-up kWh	Standard Deviation	
<b>Affordable</b>	665	427	529	434	1.26
<b>Market</b>	486	167	453	258	1.07
<b>Total</b>	520	241	470	301	1.11

\*Note:  $Ratio = 1 + \frac{Control\ Value - APS\ Value}{APS\ Value}$

Table 9. Bottom-up normalization results

	Control kWh	APS kWh	Ratio	Bottom-Up-Normalized APS kWh	Bottom-Up-Normalized kWh Savings	Bottom-Up-Normalized Adjusted kWh Savings
<b>Affordable</b>	525	362	1.26	455	70	46
<b>Market</b>	538	398	1.07	428	110	87
<b>Total</b>	535	392	1.11	434	102	78

## 5.4 Results Summary

Table 10 presents the final average annual kWh savings values for each normalization method used, as well as the average of all three. While the values vary significantly by method and housing type, the totals are all very similar regardless of the normalization method used. The average total savings value, after normalization and adjusting for non-install cases and HVAC interaction, was 77 kWh.

Table 10. Summary of kWh savings from each normalization method

	Device-Normalized Adjusted kWh Savings	Connected Watt-Normalized Adjusted kWh Savings	Bottom-Up-Normalized Adjusted kWh Savings	Average Normalized Adjusted kWh Savings
<b>Affordable</b>	52	100	46	66
<b>Market</b>	84	71	87	81
<b>Total</b>	76	76	78	77

# 6 Survey Results & Equipment Profile

This section summarizes results from two surveys completed with study participants (one at the end of the study, and one more than a year after the end of the study) and from information collected by program staff about the equipment plugged into the power strips during the study period.

## 6.1 End of Metering Period Survey Responses

At the end of the two-week metering portion of the study, program staff retrieved the meters and surveyed participants (if they were home). Surveys were completed by phone, mail or e-mail if they were not home.<sup>2</sup> The goals of this end of study survey were to:

- determine average hours of use of TVs
- learn whether or not APS group participants installed their APS
  - if it was not installed, why
- whether or not installation instructions were used, and if so, whether or not they were helpful
- assess customer satisfaction with APS

All of the 125 participants completed a survey at the end of the study period and received a participation incentive<sup>3</sup>.

The following are the responses from the surveys for both the control and APS groups. Some questions pertain to the APS group only. Responses to open-ended questions are given as tables with one response per row. The survey instruments used can be found in Appendix B.

Across both groups, respondents indicated that they use their TV an average of 5.8 hours per day (Table 11).

Table 11. How many hours per day do you use your television?

Group (n)	Number of Hours
APS (61)	5.8
Control (59)	5.9

Fifty-four out of 61 (89%) APS participants reported installing the APS (Table 12).

Table 12. Did you install your provided power strip?

Group (n)	Yes	No	Maybe
APS (61)	89%	11%	0%
Control (59)	95%	5%	0%

Per field staff data collection, 14 participants (7 control and 7 APS) did not install their provided strip, as shown in Table 13, below.

Table 13. Summary of non-installs from field data collection

<sup>2</sup> 51% completed the survey in person, 22% by email, 21% by phone, and 6% by mail (this was less common since paper surveys were only left behind for participants who needed to fill out a W-9 form and mail it back).

<sup>3</sup> The extra five participants who did not have televisions also received the participation incentive, however their surveys were not included in the results summarized in this report.

Source	Reason for non-install	APS	Control	Total
Field data collection	Zero kWh reading and no device data	3	2	5
	Weather-dependent devices (e.g., AC units)	2	4	6
	Strip used in non-AV application	2	1	3
Total		7	7	14

Table 14, below, shows the number of respondents in the APS group that were either identified as non-install based on the survey, field data collection, both, or neither. Cells highlighted in grey indicate non-installs. Of the 7 APS group participants determined to be “non-installs” based on the field data collection, two indicated that they did not install their APS via the survey. There were an additional five APS participants that indicated that they did not install their APS. This means that there are a total of 12 APS non-installs: 5 from field data collection only, 2 based on both field data collection and the survey, and 5 from the survey only.

*Table 14. Summary of non-installs from survey and/or field data collection, for APS group*

APS (n=61)	Not identified as non-install in field data collection	Zero kWh reading and no device data	Weather-dependent devices (e.g., AC units)	Strip used in non-AV application
Not identified as non-install in survey	49	0	4	1
Response to question, “did you install your provided power strip?”	5	1	0	0
<b>Total</b>	54	2	4	1

Table 15, below, shows the number of respondents in the control group that were either identified as non-install based on the survey, field data collection, both, or neither. Cells highlighted in grey indicate non-installs. Of the 7 control group participants determined to be “non-installs” based on the field data collection, two indicated that they did not install their power strip via the survey. There was an additional participant that indicated they did not install their power strip. This means that there are a total of 8 control non-installs: 5 from field data collection only, 2 based on both field data collection and the survey, and 1 from the survey only.

*Table 15. Summary of non-installs from survey and/or field data collection, for control group*

Control (n=59)	Not identified as non-install in field data collection	Zero kWh reading and no device data	Weather-dependent devices (e.g., AC units)	Strip used in non-AV application
Not identified as non-install in survey	51	1	2	2
Response to question, “did you install your provided power strip?”	1	2	0	0
<b>Total</b>	52	3	2	2

In total, this means that the number of non-installs increases from 14 to 20, increasing the non-install rate from 11.7% to 16.7%.

Table 16, below, shows the number of respondents in market rate properties that were either identified as non-install based on the survey, field data collection, both, or neither. Cells highlighted in grey indicate non-installs. Of the 6 participants determined to be “non-installs” based on the field data collection, four indicated that they did not install their power strip via the survey. There were an additional 5 participants that indicated they did not install their power strip in the survey. This means that there are a total of 11 non-installs: 2 from field data collection only, 4 based on both field data collection and the survey, and 5 from the survey only.

Table 16. Summary of non-installs from survey and/or field data collection, for market rate

Market Rate (n=84)	Not identified as non-install in field data collection	Zero kWh reading and no device data	Weather-dependent devices (e.g., AC units)	Strip used in non-AV application
Not identified as non-install in survey	73	0	1	1
Response to question, “did you install your provided power strip?”	5	4	0	0
<b>Total</b>	<b>78</b>	<b>4</b>	<b>1</b>	<b>1</b>

Table 17, below, shows the number of respondents in affordable properties that were either identified as non-install based on the survey, field data collection, both, or neither. Cells highlighted in grey indicate non-installs. Of the 8 participants determined to be “non-installs” based on the field data collection, none indicated that they did not install their power strip via the survey. There was an additional participant that indicated they did not install their power strip in the survey. This means that there are a total of 9 non-installs: 8 from field data collection only, zero based on both field data collection and the survey, and 1 from the survey only.

Table 17. Summary of non-installs from survey and/or field data collection, for affordable

Affordable (n=36)	Not identified as non-install in field data collection	Zero kWh reading and no device data	Weather-dependent devices (e.g., AC units)	Strip used in non-AV application
Not identified as non-install in survey	27	1	5	2
Response to question, “did you install your provided power strip?”	1	0	0	0
<b>Total</b>	<b>28</b>	<b>1</b>	<b>5</b>	<b>2</b>

In total, this means that the number of non-installs, normalized such that the affordable properties represent 19% of the sample per the RBSA (NEEA, 2013) increases the non-install rate from 10% to 15.4%.

Two of the 7 APS group respondents and 2 of the 3 control group respondents who indicated they did not install their power strip provided information about why they did not (Table 18).

Table 18. [If no] Why? (n = 4)

1	Control	Foot surgery
2	APS	didn't work with our setup

3	Control	Install by You.
4	APS	b/c instructions weren't clear

As shown in Tables 19 and 20, 88% of the participants in the APS group reported using the provided instructions, and 80% indicated that the instructions were helpful. A common comment regarding the instructions was that they were confusing because of the multiple control options presented (TV vs. audio control). As a result the program intends to remove the audio control portion of the instructions, which will make the instructions easier to follow and also align better with how participants have been observed to use the APS.

Table 19. Did you use the instructions provided? (APS only)

Group (n)	Yes	No	Maybe
APS (57)	88%	10%	2%

Table 20. Did you find them helpful? (APS only)

Group (n)	Yes	No	Maybe
APS (51)	80%	18%	2%

When asked to describe why the instructions provided were not helpful, 7 of the 10 respondents that indicated the instructions were not helpful provided feedback (Table 21). Most (5 of 7) said the instructions were confusing.

Table 21. [If no] Why? (n = 7)

1	Confusing, inconvenient
2	confusing
3	We had to call for help as the TV wouldn't work
4	Confusing
5	confusing
6	could be improved
7	just unclear

Most (84%) of the APS respondents indicated the power strip is being used as originally installed (Table 22).

Table 22. Is the power strip still being used as originally installed? (APS only)

Group (n)	Yes	No	Maybe
APS (56)	84%	16%	0%

Of the nine respondents that reported not using the p as originally installed, three provided feedback (see Table 23).

Table 23. [If no] Why? (n = 3)

1	replugged in unplugged
2	says not enough plugs
3	changed around few configurations

As shown in Tables 24 and 25, survey responses indicate that across both the APS and control groups, 35% of participants have audio systems and 68% of these participants use their audio system independently from their television. However, the LM team noted that independent audio systems are typically located at a separate wall outlet from the TV. There were zero instances of audio systems being used in the control outlet, however, as noted above, there were several instances where other non-TV devices were being used as the control (see Section 4.1 for more information).

Table 24. Does your media equipment center include an audio system?

Group (n)	Yes	No	Maybe
APS (59)	31%	69%	0%
Control (57)	40%	60%	0%

Table 25. Do you use it independently from your television?

Group (n)	Yes	No	Maybe
APS (59)	15%	69%	15%
Control (57)	33%	47%	20%

Table 26. [If yes] How often do you use audio only? (n = 27)

1	Control	0.5
2	Control	1
3	APS	0 to 1
4	Control	1 to 2
5	Control	2
6	APS	less than 1 hour
7	Control	4 to 5
8	Control	3
9	Control	24
10	Control	6
11	Control	6
12	Control	6
13	Control	0.5
14	Control	2 hours
15	APS	1 hr per week
16	APS	30 min max
17	Control	2 hrs per week
18	Control	10 hrs/week
19	Control	1
20	APS	4
21	Control	2
22	APS	0
23	APS	1
24	Control	2
25	Control	less than 1 hour
26	APS	30 min max
27	APS	1 to 2 per week

As shown in Table 27, 95% of APS and control group respondents reported that they do not typically unplug or turn off their media center power strips.

Table 27. Do you typically unplug or turn off your media center power strip?

Group (n)	Yes	No	Maybe
APS (58)	3%	95%	2%
Control (58)	5%	95%	0%

Eighty-five percent of APS group respondents reported that if the APS was not part of a study and without a follow-up survey, they still would have installed it (Table 28).

Table 28. If this advanced power strip was not part of a study and without a follow-up survey, would you still have installed it? (APS only)

Group (n)	Yes	No	Maybe
APS (59)	85%	10%	5%

Most (88%) of APS group respondents indicated that they would continue to use the APS (Table 29).

Table 29. Will you continue using the advanced power strip? (APS only)

Group (n)	Yes	No	Maybe
APS (60)	88%	10%	2%

Of the six that said they would not continue to use the APS, 1 provided feedback (Table 30).

Table 30. [If no] Why? (n = 1)

1	it's useless
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As shown in Table 31 below, 78% of APS respondents were satisfied; the average overall satisfaction was 4.2 out of 5.

Table 31. How satisfied are you with the advanced power strip? (APS only)

Group (n)	Average Satisfaction Rating	Percent Satisfied
APS (58)	4.2 out of 5	78%

As shown in Table 32 below, comments were generally positive, though a common complaint was that the strip does not fit larger AC adapter plugs very well. Respondents indicated that it would be helpful if the outlets were spaced out more or rotated 90° in order to accommodate AC adapters.

Table 32. General comments (n = 31)

1	APS	It ensures my Xbox and ps4 and other vampire electronics don't drain unnecessary energy. It's a smart tool.
2	APS	Thank you for the opportunity to try an energy saving device that I wasn't familiar with!
3	Belkin	strip never plugged in
4	APS	Useless!
5	APS	I enjoy the features the strip offers and the green light it employs when used.



6	APS	Not big enough, not enough plug ins.
7	Belkin	No Comments
8	APS	I didn't know one [this technology] existed before that [the study]. I think it's a great idea. I had been concerned that our DVR never turns off (it records programs) and was wasting power.
9	APS	Only issue was some of my plugs didn't fit into the spaces where I would have liked.
10	APS	Our internet and tv are hooked up the same and didn't benefit our set up.
11	Belkin	We did notice power bill was lower
12	Belkin	Leave device plugged in all day
13	APS	Don't plan on replacing strip
14	Belkin	I have another TV in my bedroom that I watch. I recently started a new job and haven't been watching the living room tv as much or just watching tv overall as much as I have been working 9-13 hour days (I work out of my home)
15	APS	Power bill decreased, they would like to have more smart strips
16	Belkin	What is difference between power strips?
17	APS	I wish it would have had a few more areas for plug ins
18	APS	Wish easier to use as audio only
19	APS	Wishes outlets were rotated 90 degrees to accommodate larger power bricks
20	APS	Will continue use if saving money.
21	Belkin	Left it alone, but will start turning off
22	APS	I like the idea of finding tangible ways I can save energy. Living in an apartment I am dependent on the appliances they provide (which may or may not be energy efficient), so it's nice to know there are items like this I can install to help save energy and lower my monthly bill.
23	APS	I like knowing that even the little bit of energy that I'm saving counts. I may move it from my TV to my computer area, since turning on and off the cable is annoying as it has to load all of the channels and takes about 5 minutes just to watch a show. Or I may have to move the cable plug to an always on plug.
24	Belkin	<p>(About SPS) I am sad to say your power strip is not working for me. I plugged in the TV, DVD player, Stereo tuner and CD player. The TV and DVD player worked fine. I could not play music. I read the instructions carefully, but had no success. So, I hooked my "entertainment center" back to my old power strip and everything is working fine.</p> <p>I am using your energy-saving strip to power a summer fan and that seems like a waste of potential savings. I am not willing to try the power-saving strip with my computer. Too much hassle. I regret that this has not worked for me because I was so excited about the possibilities. It seems that if you were doing market research, a power strip would be provided that was user friendly. Thanks anyway.</p>
25	APS	Needs better instructions for always - on or control swithc
26	APS	I hope study successful, we want to elimatte power
27	APS	The concept makes perfect sense and I hope to see my energy usage decrease.
28	APS	Which kind of device goes where in power strip
29	APS	Great participating
30	APS	Turning off devices when TV was on
31	APS	I like the way it works. When powering down or up the TV and accessories (light strip) there is one power button to push.

The non-install rate used in the savings analysis was based on the combined observations of participants who did not use their power strip as well as those who did not use the strip in an application that would result in savings (attrition rules #2-4). Before adjusting to account for the RBSA affordable housing percentage, the non-install rate calculated from this methodology was 11.7%, becoming 10% after adjusting for the RBSA sector split as described in Section 4.1.

Taking into account the survey results and before adjusting to account for the RBSA affordable housing percentage, the non-install rate calculated from this methodology was 16.7% (20 divided by 120), becoming 15.4% after adjusting for the RBSA sector split as described in Section 4.1.

## 6.2 Persistence Survey Responses

At the end of the metering portion of the study, program staff left behind advanced power strips for control group participants. Between 8/19/2016 and 9/6/2016, over a year after the fielding period for the end of study surveys (4/29/2015 and 8/13/2015), the program reached out to study participants to survey via phone in order to:

- gather information from APS group participants about measure persistence, including whether APS are still installed and operable
  - if APS have been removed, when they were removed and why
- learn whether or not control group participants installed their APS
  - if was installed, when installation occurred and whether it is operating correctly
  - if it was not installed, why
- assess customer satisfaction with APS and determine if satisfaction levels changed over time

The program did not attempt to survey 7 participants in the APS group because they all reported not installing the APS in the end of study survey. The program did attempt to survey the five APS group participants considered to be “non-installs” based solely on field data collection. The program also attempted to survey all control group participants. In total, 54 APS and 59 control participants were eligible to be surveyed.

Twenty-six APS participants and 31 control participants completed this persistence survey. One control response was not able to be matched to participation lists, so we exclude them from analysis, leaving a total of 26 APS participants and 30 control participants that completed this persistence survey. This represents a 48% response rate for APS participants, a 51% response rate for control participants, and a 50% response rate overall. The control group respondents were heavily weighted toward market rate (77%) as were the APS group respondents (73%).

The following are the responses from the surveys for both the control and APS groups. Some questions pertain to the APS or control group only, and are marked as such. Responses to open-ended questions are given as tables with one response per row. The survey instruments used can be found in Appendix B.

81% of APS respondents reported that they are still using their smart power strip (Table 33). Note that of those 21 respondents that are still using their power strips, 3 were categorized as “non-installs” based solely on field data collection. If those are excluded, the percent that indicated they are still using their smart power strip is 78% (n=18) compared to 22% (n=5) that are not still using their smart power strip.

Of the 21 respondents that are still using their power strips, 16 are market rate and 5 are affordable. Of the 18 respondents that are still using their power strips (21 minus the 3 categorized as “non-

installs" based solely on field data collection), 15 are market rate and 3 are affordable. Of the 5 respondents that are not still using their power strips, 3 are market rate and 2 are affordable. Adjusting for the RBSA sector split as described in Section 4.1, the non-install rate one year after the fielding period is 18% (this utilizes the numbers that exclude those respondents categorized as "non-installs" based solely on field data collection).

*Table 33. Are you still using your smart power strip? (APS only)*

Response (n=26)	Percent
Yes	81%
No	19%

All five of the respondents that reported not using the smart power strip provided feedback (Table 34) and indicated when they stopped using the smart power strip (Table 35).

*Table 34. [If no] Why aren't you using it? (n = 5)*

1	Moved; didn't work right; not sure how to resetup
2	once off, the items wouldnt turn on; messing up the DVR; shows wouldnt record
3	we moved locations,
4	Moved and did not hook it up again
5	Had a smaller one. Took too much space

*Table 35. [If no] Approximately when did you stop using it? (n = 5)*

1	moved in march
2	about a year
3	last October
4	Did not want to answer
5	2 months ago

Just under a third of APS respondents indicated that they changed what is plugged into their smart power strip (Table 36). Six of the 8 respondents that indicated they did change the items plugged into their smart power strip provided feedback about the specific changes made (Table 37).

*Table 36. Have you changed what's plugged into it? (APS only)*

Response (n=21)	Percent
Yes	29%
No	71%

*Table 37. [If yes] What did you change and what were the reasons for the change? (n = 6)*

1	switched to printer and fan, fan is used for summer and printer is next to fan
2	Kept TV as control
3	wii game system and sound bar; moved and added items
4	PS4 into always on, put TV in control, and router in always on.
5	Plugged in TV and DVD player and home charger
6	Added laptop and back massager

As shown in Table 38, 81% of control respondents said they installed the new smart power strip.

*Table 38. During our last visit in the summer of last year, our team left a smart power strip in your apartment. Did you install the new smart power strip? (control only)*

Response (n=30)	Percent
Yes	80%
No	17%
Other	3%

The single "other" response was, "Did install power strip but did not function properly."

All five respondents that reported they did not install the new smart power strip provided feedback (Table 39).

*Table 39. [If no] Why haven't you installed your smart power strip? (n = 5)*

Response	Number
No time or forgot	-
Didn't know how to	2
Location is hard to reach	-
Other	3

Other responses included: misplaced the power strip (1), gave it away to family member (1), and moved and put the power strip in storage (1).

The majority (84%) of control group respondents indicated that they installed their power strip the same day or within 30 days after they received the power strip (Table 40).

*Table 40. Approximately when did you install the smart power strip? (control only)*

Response (n=24)	Percent
The same day or within 30 days after	83%
Other	17%

Other responses included: does not remember (2), three weeks ago (1), and next month (1).

To gather information about whether or not study participants are using the power strips correctly, two questions were asked: if the TV is plugged into the "control" outlet, and if the items plugged into the "switched" outlets turn off when the TV is switched off. As shown in Table 41, most (76%) of APS group respondents reported that their TV was plugged into the "control" outlet, compared to only 46% of the control group respondents. And as shown in Table 42, most (62%) of APS group respondents reported that the items plugged into "switched" outlets turn off when the TV is switched off, compared to 42% of the control group respondents.

*Table 41. What's currently plugged into the "control" outlet? The control outlet is labeled "control" on your smart power strip and is located between the "always on" and "switched" outlets.*

Group (n)	TV	Other
APS (21)	76%	24%
Control (24)	46%	54%

Other responses for the APS group included: don't know (2), printer/fan (1), home theater receiver (1), and computer (1). Other responses for the control group included: don't know (3), another power strip (2), nothing (2), lamp (1), dehumidifier (1), battery chargers (1), docking station for laptop (1), surround sound system (1), and air conditioner (1).

*Table 42. Do the items plugged into your "switched" outlets turn off when you switch off your TV?*

Group (n)	Yes	No
APS (21)	62%	38%
Control (24)	42%	58%

All of the APS group respondents and 88% of the control group respondents plan to continue to use their smart power strip (Table 43). One control group respondent said they do not, because the device does not work (Table 44).

Table 43. Do you plan to continue to use your smart power strip?

Group (n)	Yes	No	Other
APS (21)	100%	-	-
Control (24)	88%	4%	8%

Other responses included: not sure (1) and "moved into house" (1).

Table 44. [If no] Why not? (n = 1)

1	Does not work
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As shown in Table 45, 83% of APS group respondents were satisfied with their power strip, providing an average satisfaction rating of 4.6 out of 5; 60% control group respondents were slightly less satisfied, providing an average satisfaction rating of 4.0 out of 5. Many control group respondents (27%) were neutral. Excluding non-installs, 91% of APS group respondents and 71% of control group respondents reported being satisfied with the APS.

Table 45. How satisfied are you with the smart power strip?

Group (n)	Average Satisfaction Rating	Percent Satisfied
APS (26)	4.6 out of 5	83%
Control (30)	4.0 out of 5	60%

When asked if they would have purchased a smart power strip on their own, most (58%) APS and most (68%) control group respondents said they would not have purchased one on their own (Table 46).

Table 46. If Energy Trust had not provided you with a smart power strip, would you have purchased one on your own?

Group (n)	Yes	No	Other
APS (26)	27%	58%	15%
Control (30)	30%	67%	3%

Other responses for the APS group included: not sure (1), depends on price (1), "if available at Best Buy and an associate there to explain it" (1), and "I was using others but others better" (1).

Other responses for the control group included: not sure (1).

Interestingly, when asked to consider the retail cost of power strips in their decision, more (70%, 2 percentage points more) of the control group respondents said they would not have purchased one on their own, but far fewer (38%, twenty percentage points less) of the APS group respondents said they would have purchased one on their own (Table 47). This difference is especially surprising when we consider that the majority of both groups of respondents are from market rate properties.

Table 47. Smart power strips cost approximately \$30. With this in mind, if Energy Trust had not provided you with a smart power strip, would you have purchased one on your own?

Group (n)	Yes	No	Other
APS (26)	58%	38%	4%

Control (30)	30%	70%	-
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Other responses included: not sure (1) and "moved into house" (1).

Average household size was about the same for both APS and control group respondents: just under two (Table 48).

Table 48. How many people reside in your home including yourself?

Group (n)	Average Household Size
APS (26)	1.7
Control (30)	2

Thirteen APS and 16 control group respondents provided feedback, which can be found in Table 49.

Table 49. General comments (n = 29)

1	APS	No, I am very satisfied.
2	APS	No, I appreciate participating in the program.
3	APS	good program
4	APS	very happy with device
5	APS	sound bar does not turn on/off automatically - reason for "4" on satisfaction
6	APS	No, pleased to participate, happy with the ETO team that explained technology, they were pleasant. Glad to see these types of items are available
7	APS	No, happy with it
8	APS	no; need to learn to use well and would use in future
9	APS	disappointed; great idea but doesnt work with the DVR system.
10	APS	Switched outlets don't work properly.
11	APS	no, thank you for giving me the free APS!
12	APS	Loved the program. Thought it was pretty cool.
13	APS	Loves that the product has multiple outlets
14	Control	Power strip regulates flow of power and kept removing power from wireless router.
15	Control	Would've liked some instruction on how to setup the power strip correctly.
16	Control	Would purchase if cost was around \$15. Unit works very well and more education should be provided to the public.
17	Control	Most people have cable modems and routers that are used 24 hours a day and people are not using TV as often making this unit less practical.
18	Control	No additional comments. Customer has not seen any energy savings.
19	Control	The green part that covers for dust is very good. Would have been helpful to have instructions to help the user setup the power strip.
20	Control	Power strip works good.
21	Control	Instructions were not very helpful and clear.
22	Control	Unit is not sensitive enough. Have to plug a unit that draws more power to get the other outlets to work.
23	Control	Some of the outlets would not work.
24	Control	Difficult to use. Some outlets do not work.
25	Control	Great product. Works well and saves money
26	Control	No comments. Very high quality power strip
27	Control	No instructions were provided. Made it difficult to use and understand how the unit worked
28	Control	no, didnt understand how to use the power strip.

29	Control	Instructions were not clear. Was not able to use the power strip. Liked the concept but unable to make it work.
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Note: Comments other than “no” and “no comments” are listed in the table above.

### 6.2.1 Key Takeaways from Survey Results

The two surveys of study participants provided useful information about installation rates, measure persistence, measure performance, and customer satisfaction. Key takeaways from these two surveys are below.

- Through the end of the study survey, 89% of APS participants reported that they installed the APS. When surveyed more than a year later, 81% of APS group respondents (which excludes those that said they did not install the APS at the end of the study) are still using their APS. Note that neither of these percentages are adjusted for the RBSA split (which is described in more detail in Section 4.1).
  - Reasons for not using the APS included moving (and not knowing how to re-install), space (wanting a power strip with a smaller footprint), and issues getting the APS to work with electronic devices (DVRs were mentioned specifically).
  - Respondents that reported not using their APS gave diverse answers as to when they stopped using the APS (see table 30).
- When adjusted for the RBSA split, the percent of APS participants that installed the APS (through both the end of study survey and/or the field data collection) was 84.6% and the percent of APS group respondents (excluding any non-installs) that are still using their APS more than a year later is 82%.
- 81% of control group participants reported that they installed the APS received at the end of the study. Note that this percentage is not adjusted for the RBSA split (which is described in more detail in Section 4.1).
  - Reasons for not installing the APS included: the device did not work, that the APS was not available (because it was misplaced, because it was in storage, or because it had been given away), and not knowing how to install the APS.
- Two questions were asked to help assess whether or not respondents are operating the APS correctly: if the TV is plugged into the “control” outlet, and if the items plugged into the “switched” outlets turn off when the TV is switched off.
  - Responses were fairly different among APS and control group respondents
    - 76% of APS group respondents reported that their TV was plugged into the control outlet, compared to only 46% of the control group respondents.
    - 62% of APS group respondents reported that the items plugged into “switched” outlets turn off when the TV is switched off, compared to 42% of the control group respondents.
- At the end of the study, 83% of APS participants reported that they were satisfied. More than a year later, 91% of APS group respondents (which excludes any non-installs) reported being satisfied with the APS. Control group respondents were slightly less satisfied; only 60% reported being satisfied with the APS. Many control group respondents (27%) were neutral.
  - Looking only at control group respondents that said they installed the APS, satisfaction is slightly higher (71%).
- Regarding whether study participants would have purchased a power strip on their own, most (58%) APS and most (67%) control group respondents said they would not have purchased one on their own.

- o Interestingly, when asked to consider the retail cost of power strips in their decision, more (70%, 3 percentage points more) of the control group respondents said they would not have purchased one on their own, but far fewer (38%, twenty percentage points less) of the APS group respondents said they would have purchased one on their own. This difference is especially surprising when we consider that the majority of both groups of respondents are from market rate properties.

### 6.3 Equipment Profile

Table 50 lists the frequency with which each type of equipment was observed to be plugged into the power strip for each group. Overall it is observed that the most frequent equipment types are cable boxes, modems/routers, DVD players, and speakers. Game consoles are also common and were found to be a mix of PS3, PS4, Xbox 360, Xbox One, and the Nintendo Wii. Next most common are streaming devices (such as the Apple TV), audio receivers, and subwoofers. There were also a fair number of non-AV items such as lamps, computers, clocks, fans, and phone chargers that were typically plugged into an always-on outlet.

Table 50. Equipment type counts

Equipment	Control (n = 47)	% Occurrence	APS (n = 48)	% Occurrence
TV	47	100%	48	100%
DVR / Cable Box	25	53%	21	44%
Modem / Router	19	40%	25	52%
DVD Player	18	38%	21	44%
Speakers	14	30%	13	27%
Streaming device	7	15%	15	31%
Wii	8	17%	8	17%
Stereo / Receiver	9	19%	6	13%
Lamp	8	17%	6	13%
Subwoofer	8	17%	4	8%
Xbox 360	8	17%	4	8%
Laptop	6	13%	4	8%
PS4	4	9%	4	8%
Clock	6	13%	2	4%
Fan	5	11%	3	6%
VCR	5	11%	2	4%
Phone	6	13%	1	2%
Phone Charger	6	13%	1	2%
PS3	4	9%	2	4%
CD Player	4	9%	2	4%
Xbox One	2	4%	3	6%
Converter box	1	2%	3	6%
Printer	1	2%	1	2%
Desktop	1	2%	1	2%
PS2	0	0%	1	2%



Antenna	0	0%	1	2%
Monitor	1	2%	0	0%
Refrigerator	1	2%	0	0%
Headphone Stand	0	0%	1	2%
Other	1	2%	2	4%

## 7 References

LBNL. (2015). <http://standby.lbl.gov/summary-table.html>.

NEEA. (2013). *Residential Building Stock Assessment: Multifamily Characteristics and Energy Use*. Northwest Energy Efficiency Alliance.

RTF. (2013, September 5). *Residential: Advanced Power Strips*. Retrieved from <http://rtf.nwcouncil.org/measures/measure.asp?id=150>.

## Appendix A - Forms and Collateral

- Property participation agreement
- Tenant participation letter
- Tenant participation agreement
- APS installation guidelines
- Energy meter instruction cards

Form 305SPS  
**Participation Agreement – Smart Power Strip Study**  
**Existing Multifamily**



To be completed by Participant

*Lockheed Martin Services, Inc. is a Program Management Contractor for Energy Trust.*

Program Use Only	
Project ID	FastTrack ID

Submit this form to participate in the Smart Power Strip Study.

**Smart Power Strip Study Terms and Conditions of Participation**

Energy Trust is conducting a 2 week study to examine the energy efficiency results of smart power strips used in tenant dwelling units (the Study). Energy Trust will work with Participant named below to enroll up to 120 tenant dwelling units at the multifamily property site listed to participate in the Study. Participant agrees to:

- Assist Energy Trust with delivering a Study letter announcement and tenant sign-up form to its multifamily property residents at the site;
- Help facilitate the sign-up of a maximum of 120 qualified tenant dwelling units to participate in the Study by collecting Program-provided Tenant Sign Up Forms from its tenants at its leasing office;
- Refer any questions about the Study to Energy Trust at .877.510.2130;
- Comply with all laws and stipulations in tenant leases regarding notification and access to participating tenant dwelling units;
- Provide those tenants confirmed by Energy Trust for Study participation with 24 hours advance notice of entry and make the property manager available to accompany an Energy Trust representative and provide entry to each participating dwelling unit during two different events: 1) to deliver a power strip and Kill A Watt® Power Monitor, and 2) to return on a pre-determined day roughly two weeks later to read the Kill A Watt monitor's energy usage data, pick up the monitor, and document the types of equipment that are plugged into the power strip.

**Property Owner Information (the Participant)**

Legal Business Name			
Contact Name	Company (if applicable)		
Mailing Address	City	State	Zip
Primary Phone <input type="checkbox"/> Work <input type="checkbox"/> Cell	Email		

**Building Representative (Property Manager, HOA Representative, etc.) Provide if different than above**

Company Name			
Contact Name	Title		
Address	City	State	Zip
Email	Primary Phone <input type="checkbox"/> Work <input type="checkbox"/> Cell	Fax	

Return completed form to:  
**Existing Multifamily**  
 620 SW Fifth Avenue, #400 • Portland, Oregon 97204  
 1.877.510.2130 • Fax 503.243.1154  
 multifamily@energytrust.org

Form 305SPS  
**Participation Agreement – Smart Power Strip Study**  
**Existing Multifamily**



To be completed by Participant

*Lockheed Martin Services, Inc. is a Program Management Contractor for Energy Trust.*

Property Information			
Property Name			
Address		County	
City		State	Zip
Electric Utility	<input type="checkbox"/> PGE <input type="checkbox"/> Pacific Power	<input type="checkbox"/> Other	Gas Utility <input type="checkbox"/> NW Natural <input type="checkbox"/> Cascade
			<input type="checkbox"/> None <input type="checkbox"/> Other

Additional Terms and Conditions
<p><b>Access and Evaluation.</b> Participant agrees to provide access to the site property identified herein and represents that it has or will obtain any and all necessary consents. Participant further agrees to provide Energy Trust and its authorized representatives with reasonable assistance and access to the property to perform any verification or evaluation efforts needed.</p> <p><b>No Endorsement.</b> While this Smart Power Strip Study (Study) is limited to certain types of products, Energy Trust does not endorse any particular manufacturer, contractor or product in promoting the Program. Manufacturers, contractors, products or systems not included in the study are not implied to be unsuitable or defective in any way.</p> <p><b>Disclaimer/No Liability.</b> Participant understands that, while Energy Trust may provide this funding, neither Energy Trust nor the PMC are installing the equipment used for the Study, and neither Energy Trust nor the PMC are responsible in any way for proper performance of any equipment provided for the Study. Neither Energy Trust nor its PMC make any warranties whether express or implied with respect to any equipment provided in connection with the Study, including but not limited to any warranty of merchantability or fitness for a particular purpose. Participant assumes the risk of any loss or damage(s) that Participant may suffer in connection with the Study, equipment or installation. In no event will Energy Trust or its PMC be liable, pursuant to this agreement, to Participant or any third party for any damages, whether characterized as general, special, direct, indirect, punitive, consequential or otherwise. Energy Trust does not guarantee any particular energy savings results by its approval of this application, or by any other of their respective actions. This provision shall survive participation in the study and this agreement shall be exclusively governed by and construed in accordance with the laws of the State of Oregon, without regard to any conflicts of laws rules thereof.</p> <p><b>Information Release.</b> Participant agrees that Energy Trust may include the following information in reports or other documentation submitted to the Energy Trust's Board of Directors, the Oregon Public Utility Commission (OPUC), Oregon Department of Energy, Oregon Department of Housing and Community Services, or the Oregon Legislature: Participant's name, Energy Trust services, and any resulting energy savings (kWh).</p>

Signature		
By signing below, you represent and warrant that (i) the Participant has read, understands and agrees to the terms and conditions of this agreement, and (ii) you have the authority to sign this agreement on behalf of the Participant.		
Authorized Representative Name and Title (printed)	Signature	Date

Return completed form to:  
**Existing Multifamily**  
 620 SW Fifth Avenue, #400 • Portland, Oregon 97204  
 1.877.510.2130 • Fax 503.243.1154  
 multifamily@energytrust.org



421 SW Oak Street, Suite 300  
Portland, OR 97204

866.368.7878  
503.546.6862 fax  
energytrust.org

Participate and receive:

- 4 FREE Regal Cinemas Movie Tickets
- FREE energy efficient power strip (\$30 value)
- Knowing you are making a difference to help improve energy-efficiency

To participate, fill out the Sign-Up Form and return it to [REDACTED] at the front desk by **5:00 PM on June 30, 2015**.

Dear Resident,

Energy Trust of Oregon is conducting a study with 120 residents on the energy-savings benefits of smart power strips connected to media equipment in apartments like yours. Using a smart power strip for media equipment can help reduce power costs by up to 20 percent for equipment like televisions, DVR systems and video game consoles.

If you are interested in being a part of this study, please **fill out the Sign-Up Form** and return it to the leasing office by **5:00 PM on June 30, 2015**.

The study lasts two weeks long. **If you are chosen to participate you'll receive a smart power strip (a \$30 value), and at the end of the study after you complete a short survey you'll receive 4 free Regal Cinemas movie tickets (a \$25 value). The power strip is yours to keep.**

Energy Trust will select 120 residents (one per apartment) to participate. Energy Trust will send each selected participant an email letting you know that you're a part of the study and how you will receive your equipment. If you are not selected to participate you will receive an email letting you know, as well.

If you have any questions about this study, please contact [REDACTED] field engineer, at [REDACTED] or email [REDACTED]. Thank you for taking the time to learn about the smart power strip energy-savings study.

Sincerely,

**Tracy Scott**  
Program Manager  
Multifamily Program Management Contractor  
Energy Trust of Oregon

Serving customers of Portland General Electric, Pacific Power, NW Natural and Cascade Natural Gas.

**Form 305SPST**  
**Smart Power Strip Sign-Up Form**  
To be completed by Participant



Energy Trust of Oregon is working with [REDACTED] to conduct a brief study on the energy-savings benefits of smart power strips. Study participants will be randomly divided into two groups, with some receiving a standard power strip and others receiving a smart power strip. A Kill A Watt® EZ Monitor will collect data about how much energy the strip is consuming. All Study participants will receive:

- One smart power strip (a \$30 value) at the beginning of the Study or at the end of the Study.
- 4 Regal Cinemas Movie Tickets upon completion of a short survey after the Study, Sent to the mailing address you indicate if you complete the survey by phone

**Eligibility and Requirements to Participate:** If you are interested in participating, you must meet the following requirements:

- At least one person (18+) in my household is available to participate during the two-week study period (anticipated to be during July).
- My household has a television.
- I am willing to install and use the power strip and Kill A Watt EZ Monitor for my media equipment according to the provided installation instructions.
- If selected to participate, I will install the power strip and Kill A Watt EZ Monitor according to instructions within 24 hours of receipt and will use them during the study according to the instructions. I will allow an Energy Trust representative to access my apartment two times (accompanied by my property manager), first to leave the power strip and Kill A Watt EZ Monitor, and then to document power strip configurations and remove the Kill A Watt EZ Monitor. I understand that I will receive at least 24 hour advance notice from my property manager before each entry.
- If selected to participate, I will take a short survey at the end of the Study when the Kill A Watt EZ Monitor is removed if I am present, or afterwards during a phone call.
- I understand that selection for Study participation will be at Energy Trust's sole discretion and I may or may not be selected. I acknowledge that Energy Trust and its representatives are not responsible in any way for proper performance of any equipment provided, and do not guarantee any energy savings results. I agree that I am responsible for proper installation of the equipment and assume the risk of any loss or damage(s) that may occur in connection with its acceptance, installation or use of any provided equipment. I understand that I should contact the manufacturer if I have any questions regarding the equipment performance or warranties.

**YES, I would like to be considered for participation in the Study. By signing below, I certify that I am 18 years or older, and I have read, understand and agree to the study participation requirements listed above. (All fields required)**

Participant Name	Apartment Address
Email Address	Phone



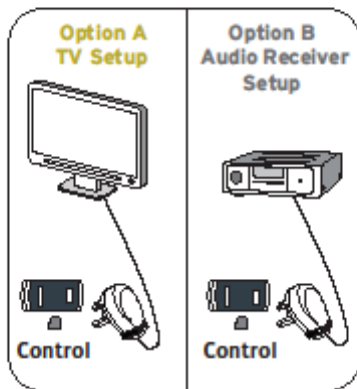
# TV OR AUDIO RECEIVER SETUP GUIDELINES FOR SMART POWER STRIPS

**UPGRADING YOUR CONVENTIONAL POWER STRIP TO A SMART POWER STRIP CAN HELP SAVE ENERGY AND REDUCE COSTS**

Energy Trust of Oregon provides no cost high-performance smart power strips to help reduce energy consumption and save on energy bills. If your entertainment system is not connected to a smart power strip it may be wasting energy even when the equipment is not on. We have included helpful guidelines for connecting the smart power strip to peripheral equipment that can help to provide you with maximum energy savings.

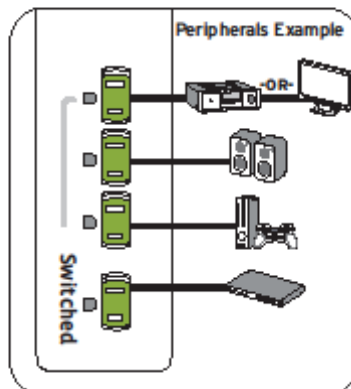
**Which device do you use the most: TV or Audio Receiver?**

- Step 1: If you use your TV more than your audio receiver, follow **Option A TV Setup**. - OR - If you use your audio receiver more than your TV, follow **Option B Audio Receiver Setup**.
- Step 2: Identify your peripheral devices.
- Steps 3-5: Complete setup.



**STEP 1**

Plug the TV or audio receiver into the "Control" outlet.



**STEP 2**

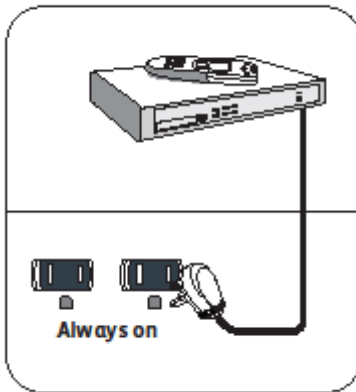
Plug peripherals into the "Switched" outlets. Peripherals can be an audio receiver or TV, and an amp, subwoofer, game console or DVD player.

**BENEFITS OF SMART POWER STRIPS FOR MULTIFAMILY PROPERTIES:**

- Reduces phantom energy waste up to 10 percent annually.
- Saves up to \$15 in annual energy bills.
- The power to some devices can be automatically controlled based on whether the primary device is on or off.
- Fireproof surge protection.

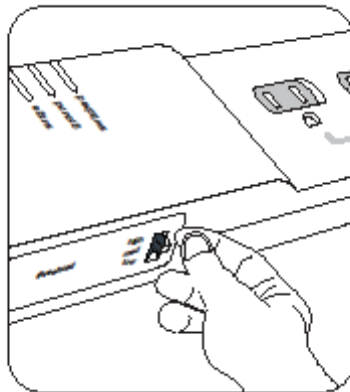






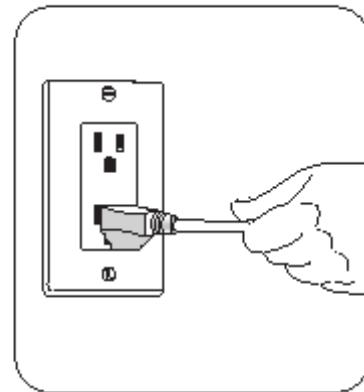
**STEP 3**

Plug cable box, DVR or any other device that doesn't require control such as a lamp in the "Always On" outlet.



**STEP 4**

Adjust switching threshold - typically on "high" for TVs.



**STEP 5**

Plug in power strip to a grounded receptacle.

For more information refer to page 4 "How It Works" at <http://www.tricklestar.com/us/Resources/INS%2018055-US-7XX.pdf>.

Contact the manufacturer for details regarding equipment performance or warranties. Energy Trust and its representatives shall not be responsible in any way for proper performance of any equipment provided, and do not guarantee any energy savings results. Recipient is responsible for proper installation of equipment and assumes the risk of any loss or damage(s) that it may suffer in connection with its acceptance, installation or use of any provided equipment.



Take control of your energy costs.

For product questions or technical support please contact TrickleStar at **1.888.700.1098** or visit **www.tricklestar.com**.

**Energy Trust of Oregon** 421 SW Oak St., Suite 300, Portland, OR 97204 1.877.510.2130 503.243.1154 fax **energytrust.org**

Energy Trust of Oregon is an independent nonprofit organization dedicated to helping utility customers benefit from saving energy and tapping renewable resources. Our services, cash incentives and energy solutions have helped participating customers of Portland General Electric, Pacific Power, NW Natural and Cascade Natural Gas save on energy costs. Our work helps keep energy costs as low as possible, creates jobs and builds a sustainable energy future. Printed on paper that contains 100% post-consumer waste. 12/14

# SMART POWER STRIP SETUP INSTRUCTIONS WITH METER DEVICE

You have received a new smart power strip plugged into a Kill A Watt® EZ meter. Please keep the power strip plugged into the meter.

Use this to replace your media center power strip. Simply plug the meter into your wall outlet, then follow the "Setup Guidelines for Smart Power Strips" instructions sheet provided.



# POWER STRIP SETUP INSTRUCTIONS WITH METER DEVICE

You have received a new power strip plugged into a Kill A Watt® EZ meter. Please keep the power strip plugged into the meter.

Use this to replace your media center power strip. Simply plug the meter into your wall outlet, then plug your media center devices into the power strip.



## Appendix B - Data Collection Forms

- Data collection sheet for APS group
- Data collection sheet for control group
- APS group end of study survey
- Control group end of study survey
- APS group persistence survey
- Control group persistence survey

# Data Collection Sheet for APS Group

## General Information

<b>Data collection date</b>	
<b>Participant survey date</b>	
<b>Participant address</b>	
<b>Leave behind date</b>	
<b>Elapsed Time</b>	
<b>Threshold setting</b>	
<b>kWh used</b>	
<b>Number of TVs in unit</b>	

## APS Configuration

Device Plug	TV	Speakers	DVD Player	DVR/ Cable Box	Stereo/ Receiver	Game Console	Other (Specify)
Always On 1							
Always On 2							
Control							
Switched 1							
Switched 2							
Switched 3							
Switched 4							

# Data Collection Sheet for Control Group

## General Information

<b>Data collection date</b>	
<b>Participant survey date</b>	
<b>Participant address</b>	
<b>Leave behind date</b>	
<b>Elapsed Time</b>	
<b>kWh used</b>	
<b>Number of TVs in unit</b>	

## Power Strip Configuration

Device Plug	TV	Speakers	DVD Player	DVR/ Cable Box	Stereo/ Receiver	Game Console	Other (Specify)
1							
2							
3							
4							
5							
6							
7							

# APS Group End of Study Survey

Participant Number:

Survey Date: \_\_\_\_\_ Survey Type: a. In person b. Over the phone

1. How many hours per day do you use your television?
2. Did you install your Advanced Power Strip?
  - a. If no, why not?
3. What date did you install your Advanced Power Strip?
4. Did you use the instructions provided?
  - a. If yes, did you find them helpful?
  - b. If no, why?
5. Is it still being used as originally installed?
  - a. If no, how is it now being used?
6. Does your media equipment center include an audio system?  
  
If yes,
  - a. Do you use it independently from your television?
  - b. How many hours per day do you use the audio only?
7. Do you typically unplug or turn off your media center power strip?
8. If this Advanced Power Strip was not part of a study and without a follow-up survey, would you still have installed it?
9. On a scale of 1-5, how satisfied are you with the Advanced Power Strip? (1 being not satisfied at all, 5 being very satisfied.)
10. Will you continue using the Advanced Power Strip?
  - a. If no, why not?

Please share any additional comments:

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# Control End of Study Survey

Participant Number:

Survey Date:

Survey Type:    a. In person    b. Over the phone

1. How many hours per day do you use your television?
2. Did you install your provided power strip?
  - a. If no, why not?
3. What date did you install your provided power strip?
4. Does your media equipment center include an audio system?  
If yes,
  - a. Do you use it independently from your television?
  - b. How many hours per day do you use the audio only?
5. Do you typically unplug or turn off your media center power strip?

Please share any additional comments:

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## Persistence Survey Introduction

Hello may I speak with [Mr./Ms. Customer],

This is \_\_\_\_\_. I'm calling from Energy Trust of Oregon. How are you today? I am following up with you regarding the smart power strip study that you participated in last year, and I had a few brief questions regarding the power strip you received. My questions should take no more than five minutes.

(Proceed to appropriate questionnaire based on customer group type)

# APS Group Persistence Survey

Property:

Unit:

Survey Date:

1. Are you still using your smart power strip?

Yes → 4

No → 2

2. Why aren't you using it?

3. Approximately when did you stop using it? → 10

4. Have you changed what's plugged into it?

Yes → 5

No → 6

5. What did you change and what were the reasons for the change?

6. What's currently plugged into the "control" outlet? The control outlet is labeled "control" on your smart power strip and is located between the "always on" and "switched" outlets.

TV

Other (Please specify)

7. Do the items plugged into your "switched" outlets turn off when you switch off your TV?

Yes

No -> (If no, probe for details, and record in the box below)

8. Do you plan to continue to use your smart power strip?

Yes → 10

No → 9

Other (please specify) → 10

9. Why not?

10. On a scale of 1-5, where 1 is not at all satisfied, and 5 is very satisfied, how satisfied are you with the smart power strip?

- 1 (Not at all satisfied)
- 2
- 3
- 4
- 5 (Very satisfied)

11. If Energy Trust had not provided you with a smart power strip, would you have purchased one on your own?

- Yes
- No
- Other (please specify)

12. Smart power strips cost approximately \$30. With this in mind, if Energy Trust had not provided you with a smart power strip, would you have purchased one on your own?

- Yes
- No
- Other (please specify)

13. How many people reside in your home including yourself?

14. Do you have any additional feedback or comments you'd like to share?

Those are all the questions I have. Thank you for your time and feedback today!

# Control Group Persistence Survey

Property:

Unit:

Survey Date:

1. During our last visit in the summer of last year, our team left a smart power strip in your apartment. Did you install the new smart power strip?

- Yes → 2
- No → 3
- Other (please specify) → 8

2. Approximately when did you install the smart power strip? → 4

- The same day or within 30 days after
- Other (please specify)

3. Why haven't you installed your smart power strip? → 8

(DO NOT READ OPTIONS BELOW TO CUSTOMER)

- No time or forgot
- Didn't know how to
- Location is hard to reach
- Other (please specify)

4. What's currently plugged into the "control" outlet? The control outlet is labeled "control" on your smart power strip and is located between the "always on" and "switched" outlets.

TV

Other (Please specify)

5. Do the items plugged into your "switched" outlets turn off when you switch off your TV?

Yes

No -> (If no, probe for details, and record in the box below)

6. Do you plan to continue to use your smart power strip?

Yes → 8

No → 7

Other (please specify) → 8

7. Why not?

8. On a scale of 1-5, where 1 is not at all satisfied, and 5 is very satisfied, how satisfied are you with the smart power strip?

- 1 (Not at all satisfied)
- 2
- 3
- 4
- 5 (Very satisfied)

9. If Energy Trust had not provided you with a smart power strip, would you have purchased one on your own?

- Yes
- No
- Other (please specify)

10. Smart power strips cost approximately \$30. With this in mind, if Energy Trust had not provided you with a smart power strip, would you have purchased one on your own?

- Yes
- No
- Other (please specify)

11. How many people reside in your home including yourself?



12. Do you have any additional feedback or comments you'd like to share?

Those are all the questions I have. Thank you for your time and feedback today!