TrickleStar USA
6026 Kalamazoo Ave
STE 232
Kentwood MI 49508

Secretary Rosemary Chiavetta
Pennsylvania Public Utilities Commission
Commonwealth Keystone Building
400 North Street, 2nd Floor North
P.O. Box 3265
Harrisburg, PA. 17105-3265

April 14, 2015

Re: Docket No. M-2015-2469311, 2016 TRM Annual Update Tentative Order

TrickleStar USA, a manufacturer of energy monitoring devices and Advanced Power Strips suitable for both residential and commercial applications, wishes to thank the Commission for continuing your support for Tier 1 "Smart Strip Plug Outlets" and for adding Tier 2 "Smart Strip Plug Outlets" to the Proposed 2016 Technical Reference Manual (TRM). The industry-standard terminology used to describe these devices is "Advanced Power Strip" (APS). Tier 2 APS deliver additional functionality beyond that of a Tier 1 APS unit, as Tier 2 APS manages both standby and active power consumption. The addition of Tier 2 APS to your Proposed 2016 TRM will help save Pennsylvania residents energy and money.

We believe that the language used in the 2016 TRM should describe a Tier 2 APS unit in general terms as to allow all manufacturers equal access to utility programs that use the 2016 TRM as a guide or resource. We also believe that the 2016 TRM should reference all available sources of information from which the guidance in the 2016 TRM is based upon. For this second point, we suggest that the Commission direct the authors of the 2016 TRM to review and incorporate information contained in the following three sources into the 2016 TRM section addressing Smart Strip Plug Outlets:

1. Tier 2 Advanced PowerStrip Testing Report California Plug Load Research Center, 28 Feb 2014 (Attachment A)
2. Environmental Claim Verification letter TrickleStar Tier 2 APS UL Environment, Inc., 07 Jan 2015 (Attachment B)
3. Advanced Power Strip Common Terminology NEEP APS Working Group, June 2014 (Attachment C)

With respect to our first point, we have a concern with the language used to describe "Tier 2 Smart Strips." The existing language does not describe Tier 2 Smart Strips in general terms which includes Tier 2 Smart Strip products from all manufacturers. In fact, the existing language describes a single Tier 2 Smart Strip product made by a single manufacturer. Therefore, we propose the following language be changed to reflect a more general, category level definition of Tier 2 Smart Strip.

> **Existing language:** "Tier 2 smart strips operate without a master control socket and instead sense power of all devices connected to the controlled sockets. When one or more devices are switched off from the controlled outlets the Tier 2 smart strip will remove power from all connected devices. These smart strips also sense the user's absence or inactivity and after a period of user absence or inactivity they will shut off all items plugged into the power-saver sockets."
>
> **Proposed language:** "Tier 2 advanced power strips (APS) deliver additional functionality beyond that of a Tier 1 APS unit, as Tier 2 APS manages both standby and active power consumption. The Tier 2 APS manages standby power consumption by turning off devices from a control event; this could be a TV or

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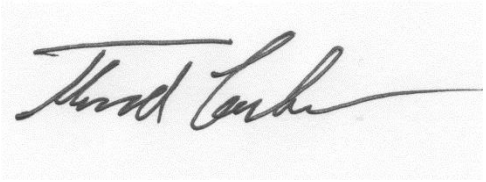
other item powering off, which then powers off the controlled outlets to save energy. Active power consumption is managed by the Tier 2 APS unit by monitoring a user's engagement or presence in a room by either or both infrared remote signals sensing or motion sensing. If after a period of user absence or inactivity, The Tier 2 APS unit will shut off all items plugged into the controlled outlets, thus saving energy."

With respect to the eligibility section of the 2016 TRM's section on Smart Plug Outlets (Advanced Power Strips), we request that the language be changed to specifically state that commercial applications are also appropriate for Smart Plug Outlets. The National Renewable Energy Laboratory (NREL) did two studies in 2014 for the use of Smart Plug Outlets in commercial spaces. Those studies are the following:

1. Reducing Office Plug Loads through Simple and Inexpensive Advanced Power Strips. This report is available online at http://www.nrel.gov/docs/fy13osti/57730.pdf
2. Reducing Plug Loads in Office Spaces. This report is available online at http://www.nrel.gov/docs/fy14osti/60382.pdf

Thank you for addressing our concerns and suggestions. Again, we commend the Commission for the addition of Tier 2 Smart Plug Outlets to your portfolio of energy saving measures.

Sincerely,



Thad Carlson
Director, Market Development
TrickleStar USA
Thad.Carlson@tricklestar.com | www.tricklestar.com

Attachment A

Tier 2 Advanced PowerStrip Testing Report

California Plug Load Research Center

28 Feb 2014

Tier 2 Advanced PowerStrip Testing Report

California Plug Load Research Center

February 28, 2014

4100 Calit2 Building

UC Irvine

Irvine, CA 92697-2800

Office: 949.824.9073

www.calplug.org

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This publication provides informative material of a professional nature. This information is intended to be as accurate as possible at the time of publication, but CalPlug assumes no responsibility for any losses or damages that might result because of reliance on this material.

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Glossary

- **Active Mode**: The media device is turned on with primary functions ;
  - **User Engaged:** The user is actively engaged with the appliance (pressing buttons on the remote control);
  - **User Absent:** The user is not engaged with the appliance (Users are not actively interacting with the device, such as pressing buttons on a remote control);
- **Standby Mode:** The appliance is waiting to be switched to Active Mode with no primary functions;
- **Off Mode:** The appliance is turned off but remains plugged into the outlet;
- **P_Appliance X_Mode Y**: The power consumption of the appliance X in mode Y.

Chapter 1: Executive Summary

1.1 Background

Standby power/load is wasted electrical energy consumed while appliances are switched off (to standby or off mode) but are still plugged in. These appliances range from televisions, home entertainment systems, personal computers and peripherals, to space heaters, room air-conditioners and coffee pots – all of which continue to draw power even when they are turned off or not in use.

Entertainment electronics make up 60% of all plug load consumption by home electronics while home office electronics make up 31% of all plug load consumption by home electronics (California 2008).

The plug loads for household electronics in the United States account for almost 20% of all residential energy and that percentage is anticipated to increase as households purchase more electronics (California 2008).

Advanced power strips are energy-saving devices where one outlet controls the power supplied to other outlets on the same strip. Advanced power strips can automatically eliminate these wasted loads of electronic peripheral devices that are not needed (DVD player, computer printer, scanner, etc.) when an electronic control device (television or personal computer) is in standby or off mode.

1.2 CalPlug Research

The California Plug Load Research Center (CalPlug) was established to improve energy efficiency in the use and design of appliances and consumer electronic devices. CalPlug focuses on energy efficiency solutions, efficiency evaluations of consumer electronics, standards development, education and public outreach, and user behavior studies.

Calplug conducted research to test Tier 2 Advanced Power Strip (APS) energy savings in both bench-top and simulated environments.

CalPlug conducted an independent study to determine the effectiveness of TrickleStar's APS+ (Tier 2 APS+) in managing household energy use in the home entertainment section. CalPlug conducted the following two tests:

- SIM Lab Living Room Test – Tested the energy savings from the four most common home entertainment configurations room attached to a Tier 2 APS+ in an average American household living room.
- SIM Lab User Behavior Test – Tested usage patterns including the user engaged hours and absent hours.

1.3 Methodology

CalPlug utilized the data collected in the independent SIM lab tests and secondary research to support the assumptions and determine the overall power consumption and potential energy savings of the Tier 2 APS+ in the home entertainment section. The Tier 1 APS energy savings calculated by the NYSERDA 2011 study is compared with our results.

The main differentiation of TrickleStar's Tier 2 APS+, relative to Tier 1 APS, lies in effectively capturing User Absent Hours. When compared to the Tier 1 APS, the Tier 2 APS+ provides additional savings by automatically turning off the TV during User Absent Hours with the infrared (IR) sensor. User Absent Hours are defined as the time that the user is not actively engaged with the devices. On average, the TV is turned off earlier with Tier 2 APS+, thus turning off the peripherals earlier to generate extra savings with the assumption that the peripherals are usually left on by absent users. The total energy savings of Tier 2 APS+ is simply described in this formula:

$\boldsymbol{E\_Tier\ 2\_Total}(\boldsymbol{WHr}) = \boldsymbol{E\_Tier\ 2\_Extra} + \boldsymbol{E\_Tier\ 1}$, the additional saving is generated by the IR Sensor of the Tier 2 APS+.

To our best knowledge, there have not been research reports specifically on user engagement hours while watching TV on a regular basis. To supply preliminary data on user engagement hours, CalPlug's investigated secondary sources for user absence, including simultaneous consumption of media while watching TV.

1.4 Results

This document reports the test results and calculations of potential energy savings for TrickleStar's Tier 2 APS+. The annual energy savings is determined at 323 KWH.

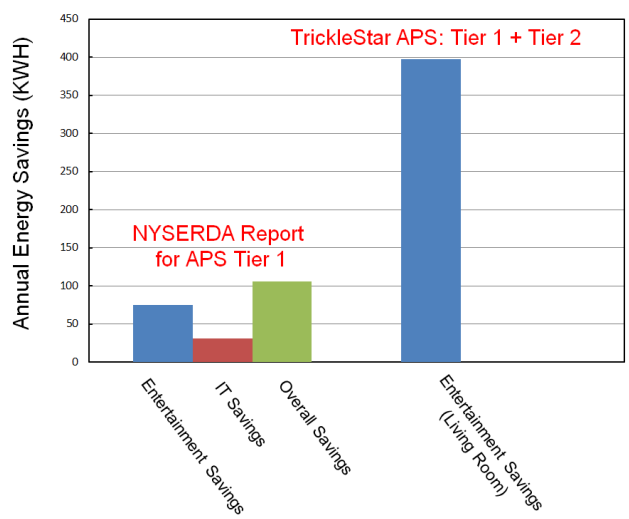


Figure 1.1: Comparison of annual energy savings of APS Tier 1 and Tier 2.

Chapter 2: Methodology

The main differentiation of Tier 2 APS+, relative to Tier 1 APS, lies in effectively capturing user absent hours. The total savings of Tier 2 APS+ should be simply described as following formulas:

$$\boldsymbol{E\_Tier\ 2\_Total(WHr) = E\_Tier\ 2\_Extra\ +\ E\_Tier\ 1}$$

2.1 Advanced Power Strip (APS)

There are a range of APS products available on the market, which has built-in intelligence to save energy. Within the APS category there are two tiers of product:

2.1.1 Tier 1 APS

Utilizes current sensing and a simple master / slave configuration to sense when a TV is switched on and to then switch peripherals on, and to sense when the TV is switched off and to switch the peripherals off.

Outlets – a total of 7 outlets: 1 control / master, 2 always-on and 4 slave.

The savings for this measure are typically 100 kWh per year (NYSERDA 2011) [1].

2.1.2 Tier 2 APS+

A more sophisticated product that utilizes multiple control / sensing technologies to control a TV and the peripherals usually present in a home entertainment center. It utilizes current sensing and a simple master/ slave configuration to sense when a TV is switched on and off and then switch peripherals on and off. Tier 2 APS+ also utilizes IR sensing with a countdown timer to detect user presence / absence and then switches off a TV and peripherals when no IR activity is detected in a pre-programmed amount of time.

Outlets – a total of 7 outlets: 2 always-on and 5 slave.

The savings for this measure are estimated at 300-400 kWh per year represent an outstanding opportunity for large scale energy savings (RTF 2012).

2.2 Energy Savings Methodology for Tier 1 APS

2.2.1 Assumptions

According to APS Tier 1 calculation of the annual savings, which is based on "NYSERDA APS Research Report" and the document of "TrickleStar Calculator: Energy Savings Calculation for APS", it has the following assumptions:

1. The peripherals are left either at active mode or standby mode for the rest of the day after their active usage hours. For example, the user forgets to completely turn off or unplug the peripherals after using them.
2. The user will press the button to turn off the TV (Master) after its average ON time.

Thus the savings with Tier 1 APS can be generated because the APS switches off the peripherals (Slave) when the TV (Master) is switched off by the user. Annual Entertainment savings, IT savings, and overall savings are 75.1KWH, 31.0KWH, and 106.1KWH respectively. (NYSERDA 2011) [1].

2.2.2 Equations for Tier 1 APS Energy Savings (NYSERDA Report)

The equations to determine the change in kilowatt hours per year by using a Tier 1 APS in the home are shown and explained below. For a typical household, the differences between the amount of time a product in the master outlet and products in the controlled outlets are turned off is based on the national average values. To calculate an estimated savings, the savings in standby mode is calculated and the time the peripheral is in standby mode is subtracted from the time that the master product is in either standby or off mode. Any remaining time that the peripheral is in off mode is then determined and the savings while in off mode is calculated. The savings from standby and off modes is then added together to determine a total savings. When plugged into a Tier 1 APS, the power consumption of products plugged into controlled outlets will be shut off and draw zero watts. The resulting equation to determine the kWh savings for a typical household or for any given household using the calculation is

$$\frac{\Delta kWh_e}{Year} = \sum_m \left(SDW_{e,m} \times \frac{SDHrs_{e,m}}{Day} \times \frac{kW_e}{1000W_e} \times \frac{365\ Days}{Year} \right)$$

$where$:
$e\ =\ type\ of\ home\ electronic\ equipment$
$m\ =\ shutdown\ mode\ (standby\ or\ off)$
$SDWe,m\ =\ shutdown\ watts, the\ watts\ drawn\ by\ e\ in\ shutdown\ mode\ m$
$SDHrse,m\ =\ number\ of\ hours\ e\ is\ in\ shutdown\ mode\ m\ with\ respect\ to\ the\ number\ of\ hours\ the\ product\ in\ the\ master\ control\ is\ in\ shutdown\ mode$

If the product in the master control outlet is in standby and turned off for a lesser number of hours during the day than the products in the controlled outlets, then the potential energy savings in kWh for each electronic device can be determined with the equation

$$\frac{\Delta kWh_e}{Year} = \sum_m (SDW_{e,m} \times \frac{SDHrs_{i,m}}{Day} \times \frac{kW_e}{1000W_e} \times \frac{365\ Days}{Year})$$

$where$:
$e = type\ of\ home\ electronic\ equipment$
$i = type\ of\ home\ electronic\ equipment\ in\ the\ master\ control\ outlet$
$m = shutdown\ mode\ (standby\ or\ off)$
$SDWe, m = shutdown\ watts, the\ watts\ drawn\ by\ e\ in\ shutdown\ mode\ m$
$SDHrsi, m = number\ of\ hours\ i\ is\ in\ shutdown\ mode\ m; = 24 - number\ of\ operating\ hrs$

Table 2.1: Estimated Power Consumption and Savings from using a Tier 1 APS, Typical Household (NYSERDA 2011) [1].

Total Annual Entertainment Energy Consumption per Household (kWh)	602.8
Total Annual IT Energy Consumption per Household (kWh)	197.9
Total Annual Entertainment Change in Consumption with APS (Energy Savings in kWh)	75.1
Total Annual IT Change in Consumption with APS (Energy Savings in kWh)	31.0
Total Annual Change in Consumption with APS (Energy Savings in kWh)	106.1
Total Dollar Savings per Household over the Average Life of the APS	$78.81

2.2.3 TrickleStar Existing Calculator for Energy Savings Calculation of APS

1. Collect the on P_{on} and standby power $P_{standby}$ values for each of the devices that are going to be controlled (switched on and off) by the APS. Do not include the device that is sensed by the APS and used to turn on and off the other devices.

2. For each of these devices, determine the percent of time in normal operation when not being used when the device is left switched on or left on standby, $T_{on\%}$.

3. For the whole set of devices, how many hours on a typical weekday are the devices used and how many hours on a typical weekend are the devices used. For example, this would be the number of hours of active computer use, or active television watching. These then are H_{week_day} and $H_{weekend\_day}$.

4. Then the energy saved for each device is calculated per year as follows:

$$E_{saved\_year\_Wh} = \left(\left(P_{on} \times \frac{T_{on\%}}{100}\right) + \left(P_{standby} \times \left(\frac{1 - T_{on\%}}{100}\right)\right)\right) \times \frac{\left(\left(24\ Hr - H_{week\_day}\right) \times 5 + \left(24\ Hr - H_{weekend\_day}\right) \times 2\right)}{7} \times 365.25$$

5. This can be described as follows: Calculate the average power when not used. Then, take this and apply it to the number of unused hours per weekday and the unused hours per weekend day. Multiply the weekday usage by 5 and the weekend usage by 2 to get a weekly usage. Divide this by seven to get a daily usage and then multiply by 365.25 to get an annual figure.

2.3 Energy Savings Methodology for Tier 2 APS (TrickleStar's Tier 2 APS+)

2.3.1 Tier 2 APS+ Energy Savings

Since the Tier 2 APS+ product has an additional feature of a shutting down mechanism with the aid of the IR sensor, the specific user behavior (user actively presses the remote control button) is detected to determine the user engaged hours instead of appliance "ON" hours. On average, the TV is turned off before it reaches its average "ON" hours, thus all the peripherals are switched off accordingly to generate extra savings.

The main differentiation of Tier 2 APS+, relative to Tier 1 APS, lies in effectively capturing user absent hours. The savings are exclusively drawn from user absent hours. The total savings of Tier 2 APS+ should be simply described as the following formula:

$\boldsymbol{E\_Tier\ 2\_Total(WHr) = E\_Tier\ 2\_Extra\ +\ E\_Tier\ 1}$ (Additional Saving generated by IR Sensor of Tier 2 APS+)

Here **E_Tier 1** is what NYSERDA have previously tested and reported, and **E_Tier 2** is what CalPlug is characterizing in our labs.

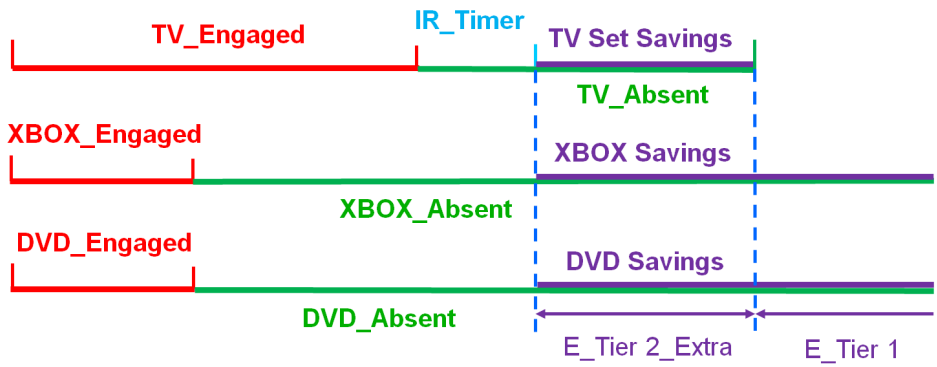
Table 2.2: Investigation of different modes for energy savings of APS Tier 1 and 2

Energy Savings	Tier 2 APS+		Tier 1 APS	
Appliance Modes	Active Mode (ON)		Standby Mode	Off Mode
	User Engaged Mode	User Absent Mode		
NYSERDA	No	No	Yes	Yes
CalPlug	Yes	Yes	Yes	Yes

- **Active Mode:** The media device is turned on and either in User Engaged Mode or Absent Mode ;
  - **User Engaged:** The appliance is turned on and the user is actively engaged with the appliance (pressing buttons on the remote control);
  - **User Absent:** The appliance is turned on and the user is not engaged with the appliance (Users are not actively interacting with the device, such as pressing buttons on a remote control);
- **Standby Mode:** The appliance is waiting to be switched to Active Mode;
- **Off Mode:** The appliance is turned off but remains plugged into the outlet.

2.3.2 Equations for Tier 2 APS+ Energy Savings

The average engaged/absent hours from our primary/secondary research are employed in the formulas below.



$$
\begin{aligned}
E\_Tier\ 2\_Total(WHr) &= E\_Tier\ 2\_Extra\ +\ E\_Tier\ 1 \\
&= P_{TV\_Absent}(W) \times \left(T_{TV\_Absent} - T_{IR\_Timer}\right)(Hr/Day)\ \times (365.25)(Days) \\
&+ P_{XBOX\_Absent}(W) \\
&\times \left(T_{XBOX\_Engaged} + T_{XBOX\_Absent} - T_{TV\_Engaged} - T_{IR\_Timer}\right)(Hr/Day) \\
&\times (365.25) + P_{DVD\_Absent}(W) \\
&\times \left(T_{DVD\_Engaged} + T_{DVD\_Absent} - T_{TV\_Engaged} - T_{IR\_Timer}\right)(Hr/Day)\ \times (365.25)
\end{aligned}
$$

Chapter 3: Equipment and Setup

This section involves a detailed explanation of the equipment used in our test and how they are set up with the devices under test.

3.1 Advanced Power Strip Plus

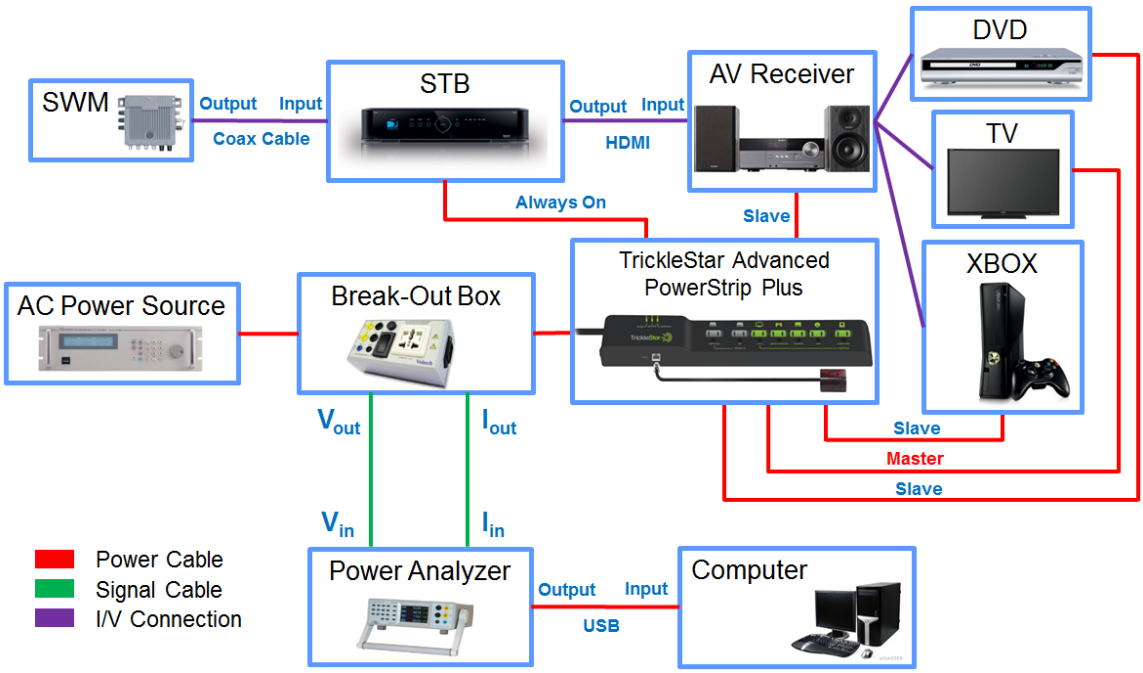


Figure 3.1: Cable Box Setup. **Chroma 61601:** AC Power Source; **Voltech PM1000+:** Power Analyzer; **Breakout Box:** Used to insulate electronic equipment avoiding the electromagnetic interference and simplify connections between the Voltech Power Analyzer and the STB; **Computer:** Control and synchronize different electronic modules with the aid of LabVIEW; **SWM:** DirectTV Muti-Switch.

3.2 SIM Lab Living Room Setup

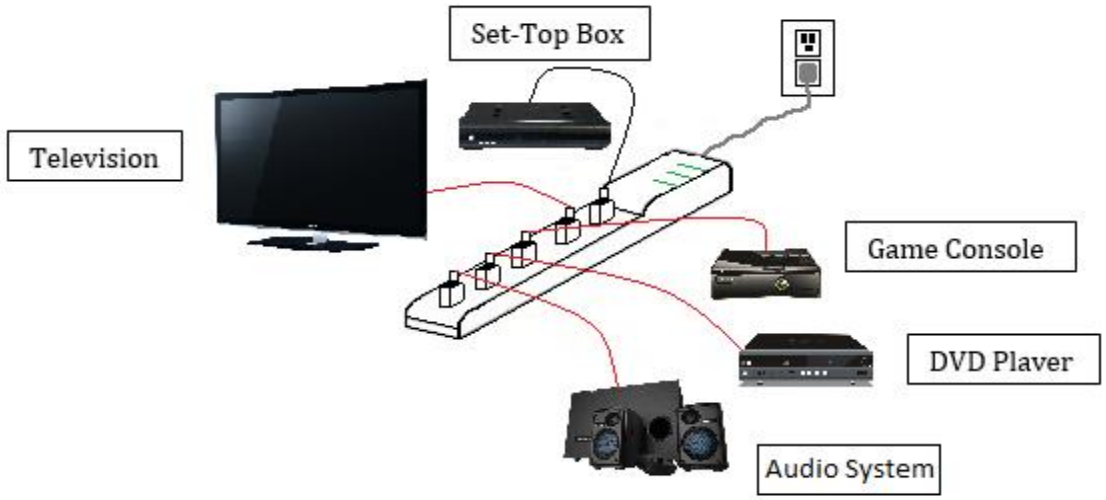


Figure 3.2: APS+ Connection Setup

The Tier 2 APS+ connection setup (refer to Figure 3.2) utilized was to ensure proper functionality of the product, according to the specifications outlined by TrickleStar. This setup is to simulate a typical living room with such peripherals connected as shown.

The Audio system, DVD player, game console, and television are all connected to the manually controlled or the "Switch" part of the APS. The Set-Top Box is connected to the "Always On" part of the APS. The Set-Top box in the experiment is always left ON; so user does not have to wait for too long for it to turn on and initialize, it is set up like that for convenience for the user.

3.2.1 List of Appliances in Home Entertainment Center

The appliances used in this test are listed in alphabetical order and a higher rank does not imply greater importance in the configurations. The specific models listed are the ones we chose as typical for our tests; actual results might vary with different choices.

Audio System: Onkyo HT-S3500 5.1-Channel Home Theater Speaker/Receiver

DVD Player: Sony DVPSR510H DVD Player (Upscaling)

Game Console: Microsoft Xbox 360

Television: VIZIO E390i-A1 39-Inch 1080p 120Hz Smart LED HDTV

Set-Top Box: DirecTV HR44

Chapter 4: Standard Test Procedures

This chapter introduces energy testing standards that are observed at CalPlug Engineering Lab.

4.1 Test Procedures

4.1.1 IEC (International Electrotechnical Commission)

- Use of a stable power supply (<2% harmonics).
- Stable ambient test room conditions.
- Digital power meter with fundamental active power accuracy of 0.5% or better – capable of measurements of 0.01W or better, capable of including components up 49th harmonic (2.5 kHz) strongly recommended.
- Calibrate the power meter using the IEC 62301 software.
- Data logging capability recommended.

4.1.2 ENERGY STAR

Average power shall be measured from the AC power source to the equipment being tested.

1. **General:** Unless otherwise specified, measurements shall be made under test conditions and with equipment specified below.
2. **Test room:** The tests shall be carried out in a room that has an air speed close to the UUT of ≤ 0.5 m/s, and the ambient temperature shall be maintained at 23°C ± 5°C throughout the test. The UUT shall be tested on a thermally non-conductive surface.
3. **Test voltage:** An AC power source shall be used to provide input voltage and frequency of 115± 1% at 60 Hz to the UUT. (The Total Harmonic Distortion (THD) of the supply voltage when supplying the UUT in the specified mode shall not exceed 2%, up to and including the 13th harmonic. The peak value of the test voltage shall be within 1.34 and 1.49 times its RMS value.)

Test leads: All leads used in the test set-up shall be of a sufficient gauge and length in order to avoid the introduction of errors in the testing process. Note: For further guidance see Table B.2, "Commonly used values for wire gages and related voltage drops" in IEEE 1515.

4.1.3 CEA-2043 (ANSI – American National Standards Institute)

4.1.3.1 Accuracy

Power measurements of 0.5 W or greater shall be made with an uncertainty of less than or equal to 2% at the 95% confidence level. Power measurements of less than 0.5 W shall be made with an uncertainty of less than or equal to 0.01 W at the 95% confidence level. The power measurement instrument shall have a resolution of,

a. 0.01W or better for power measurements of 10 W or less;
b. 0.1 W or better for power measurements greater than 10 W and less than 100 W;
c. 1 W or better for power measurements greater than 100 W.

For equipment connected to more than one phase, the power measurement instrument shall be equipped to measure the total power of all of the phases connected.

4.1.3.2 Test Voltage

An AC power source shall be used to provide the UUT with an input voltage of 115 V ± 1% and a frequency of 60 Hz ± 1%. The total harmonic distortion of the supply voltage when supplying the UUT in the specified mode shall not exceed 2%, up to and including the 13th harmonic. The peak value of the test voltage shall be between 1.34 and 1.49 times its root-mean-square (rms) value.

4.1.3.3 Test Equipment

The following should be considered when selecting test equipment:

1. An oscilloscope with a current probe for AC current waveform, amplitude, and frequency;
2. A true rms voltmeter to verify voltage at the input of the UUT;
3. A frequency counter to verify frequency at the input of the UUT.

Note: Items (1) and (2) may be considered optional when the AC source output has sufficient accuracy.

4.1.3.4 Calibration

Test instruments shall be calibrated annually to traceable national standards to ensure that the limits of error in measurement are not greater than ± 0.5% of the measured value over the required bandwidth of the output.

4.1.3.5 True Power Wattmeter

4.1.3.5.1 Crest Factor

A true power wattmeter shall be used and shall have

1. Accuracy and resolution in accordance with previous section;
2. Sufficient bandwidth;
3. A crest factor rating that is appropriate for the waveforms being measured and capable of reading the available current waveform without clipping the waveform. The peak of the current waveform measured during SLEEP and ON modes for the UUT shall be used to determine the crest factor rating and the current range setting. The full-scale value of the selected current range multiplied by the crest factor for that range shall be at least 15% greater than the peak current to prevent measurement error.

4.1.3.5.2 Bandwidth

The current and voltage signal shall be analyzed to determine the highest frequency component (i.e., harmonic) with a magnitude greater than 1% of the fundamental frequency under the test conditions. The minimum bandwidth of the test instruments shall be determined by the highest frequency component of the signal.

4.1.3.5.3 Frequency response

A wattmeter with a frequency response of at least 3 kHz shall be used in order to account for harmonics up to the 50th harmonic.

4.1.3.5.4 Sampling Interval

The wattmeter shall be capable of sampling at intervals less than or equal to 1s.

Chapter 5: SIM Lab Living Room Tests – User Engagement

5.1 Introduction

To determine the average period of inactivity during television viewing, CalPlug conducted a consumer behavior study for thirteen days involving a total of twenty undergraduate and graduate students. In order to accurately simulate the television viewing environment of an average American household, the test was conducted for two hours in CalPlug SIM lab's living room set up during the American public's two most active television watching time periods: daytime from 12:00pm to 2:00pm and primetime from 8:00pm to 10:00pm. All participants were told that they would be participating in a consumer behavior study where they would watch television for two hours and were invited to bring and use phones, laptops, tablets, or anything else they usually use while watching television at their homes.

Figure 5.1: SIM Lab Living Room Setup

5.2 Methods

To acquire data indicating participants' engaged viewing time, a control board, containing a microcontroller programmed with LabView, obtained data through an IR sensor whenever the participant clicked a button on the remote control. The program recorded each participant's number of clicks and automatically stored the data in an Excel spreadsheet which was used to further analyze the data. The test did not simulate the IR sensor of the Tier 2 APS+ to actually turn off if the participants did not activate the TV remote for more than an hour, in order to record actual user behavior without implementing the APS.

The Microcontroller in the circuit is the Arduino Uno Board; it collects the data from the experiment using Labview, then Labview records the data accordingly on a spreadsheet in real time.

Each participant's largest period of inactivity during television viewing was determined by his or her largest interval between two consecutive clicks over the period of the activity (2 hours).

Table 5.1: TV Viewing by Day-Part [9]

	6 – 10 AM	10 AM -- 12 PM	12–2 PM	2-4 PM	4 -- 6 PM	6 -- 8 PM	8 – 11 PM	11PM -- 1AM	1 – 6AM
Pay-TV subscribers	Morning	Daytime (10AM-4.30PM)			Early Fringe (4:30-7:30)		Prime Time (8-11PM)	Late Night	Overnight
358min/day	6.70%	22.60%			14.60%		27.70%	19.40%	9.00%
189min/day	6.30%	19.8%			14.5%		31.1%	19.70%	8.60%
125min/day	6.10%	18.3%			13.9%		32.1%	20.40%	9.20%
81min/day	6.00%	17.1%			13.1%		31.5%	21.80%	10.60%

According to the secondary research in Table 5.1, CalPlug determined the two most optimal TV viewing periods to be daytime, between 10:00AM—4:30PM , and primetime, between 8:00PM—11:00PM. With this information, it was decided that the tests would be conducted during daytime viewing hours between 12:00PM till 2:00 PM and primetime viewing hours between 8:00PM till 10:00PM.

Table 5.2: Distribution by Day Parts [10]

	2007	2008	2009	2010	2011
6AM-9AM	9%	9%	9%	9%	9%
Mon-Fri 10AM-4PM	17%	17%	17%	17%	17%
Sat-Sun 10AM-4PM	15%	15%	15%	16%	16%
4PM-7PM	12%	12%	12%	12%	12%
Prime Time 8PM-11PM	23%	24%	22%	22%	22%
11PM-1AM	10%	10%	10%	10%	10%
Over Night	8%	8%	8%	8%	8%
Other	6%	5%	7%	6%	6%

According to the secondary research in **Error! Reference source not found.**, it was determined that most TV viewing among American audiences occurs during weekdays (Mondays-Fridays) from 10AM to 4PM and 8PM to 11PM. With this knowledge, the test was conducted only on weekdays.

5.3 Results

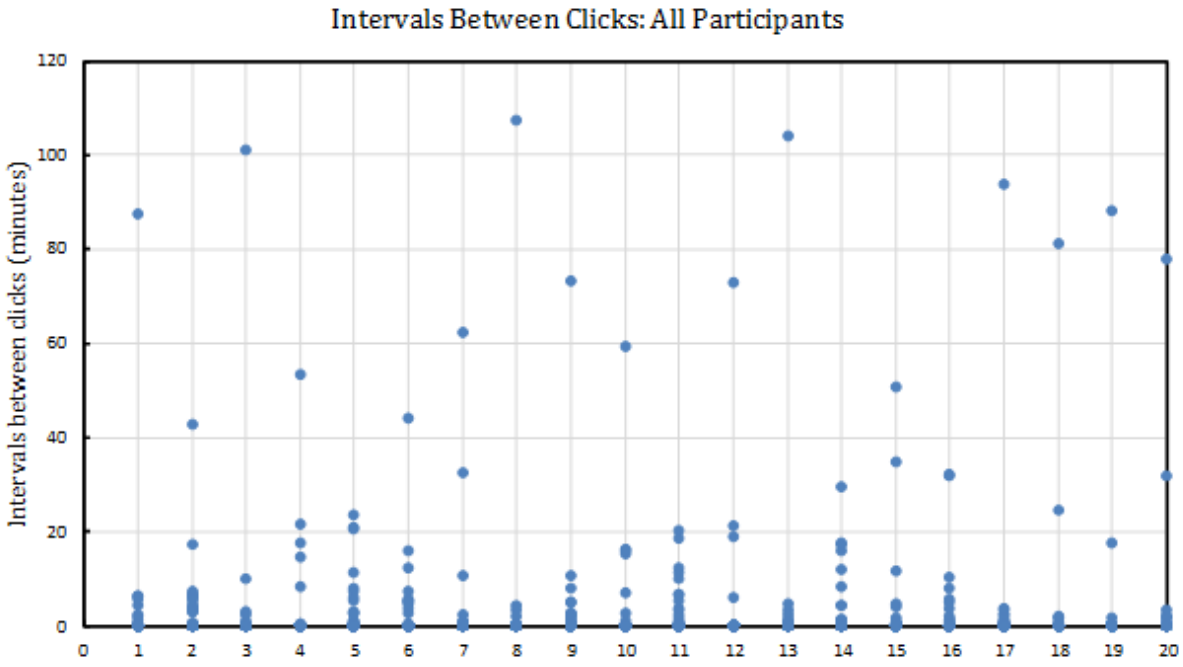


Figure 5.2: Intervals between clicks for all participants

Figure 5.2 includes all of the intervals between clicks for all participants during prime time (8 to 10 PM) and day time (12 to 2 PM) viewing hours. The results indicate that most intervals between clicks occur in the 0-10 minute range. This occurred because TV viewers frequently clicked when choosing a channel to watch or changing the volume. Since participants were asked to behave as they would do while watching TV at home, some participants had unusually large intervals. For example participant 13 fell asleep while watching television and participant 3 immediately found a channel and actively watched the program until the end of the study.

Since users' behavior can be significantly different depending on their patterns, demographics, and geographic locations, limited data points (20 points in this research) merely indicated the preliminary results of the average American TV view pattern. Obviously more accurate results will be obtained when more data points are investigated through primary research to provide better prediction of the user behavior.

The average engaged hours of all the users was found through analysis of the intervals shown in Figure 5.2 . In this figure, average engaged hours refers to the average time the user was not multitasking with other devices and was fully engaged with the television.

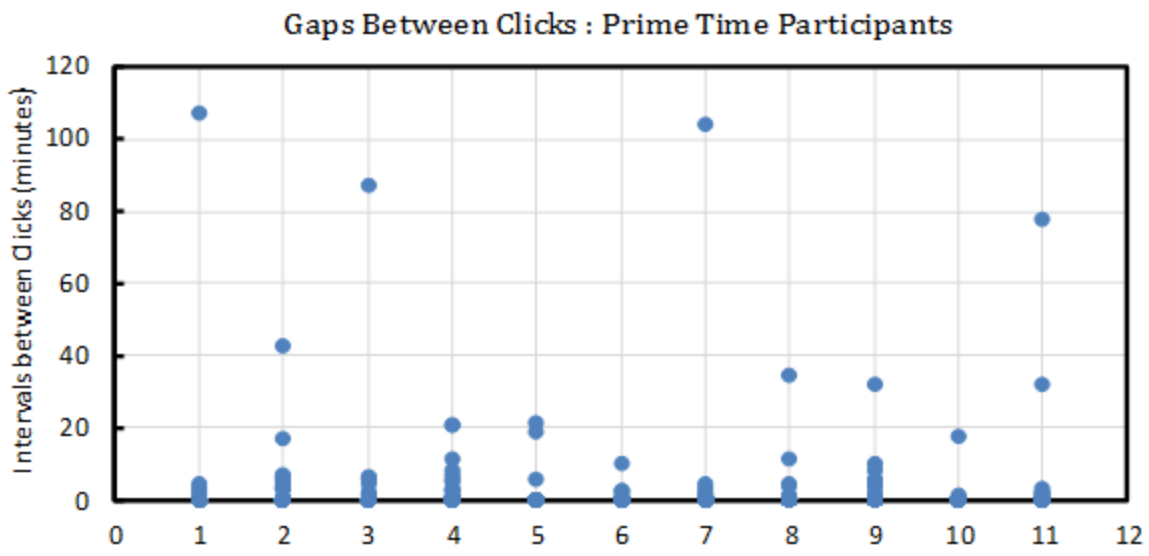


Figure 5.3: Intervals between clicks for primetime participants

Figure 5.3 shows the intervals between clicks when users watched TV during prime time viewing hours between 8:00PM to 10:00PM. Although the prime time participants were included in Figure 5.2 , the participant numbers in Figure 5.3 are not equivalent to those listed in Figure 5.2. Since it was found that the highest television viewership occurs during primetime television hours through our secondary research, it can be deduced that the largest interval between clicks will be slightly larger than the largest interval between clicks during day time viewing hours and that participants watching primetime television will change the channel slightly less. Thus the device could be designed to adapt to different user behaviors during different time periods.

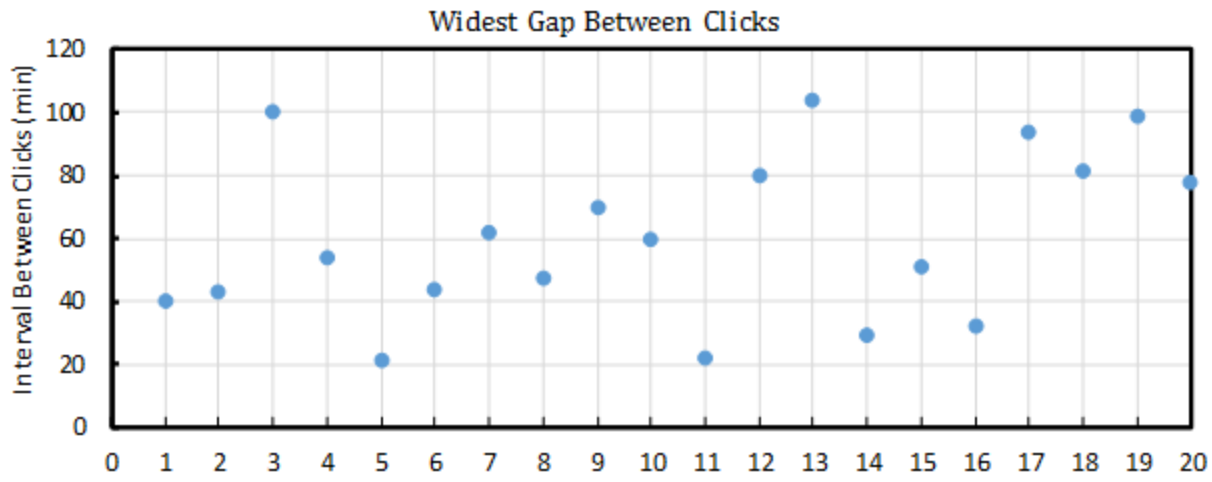


Figure 5.4: Widest gap between clicks for all participants

Figure 5.4 indicated the largest interval between clicks for all paricipants. The average largest interval can be used as a bound. If the user does not click within the average largest interval , the device can turn of the TV.

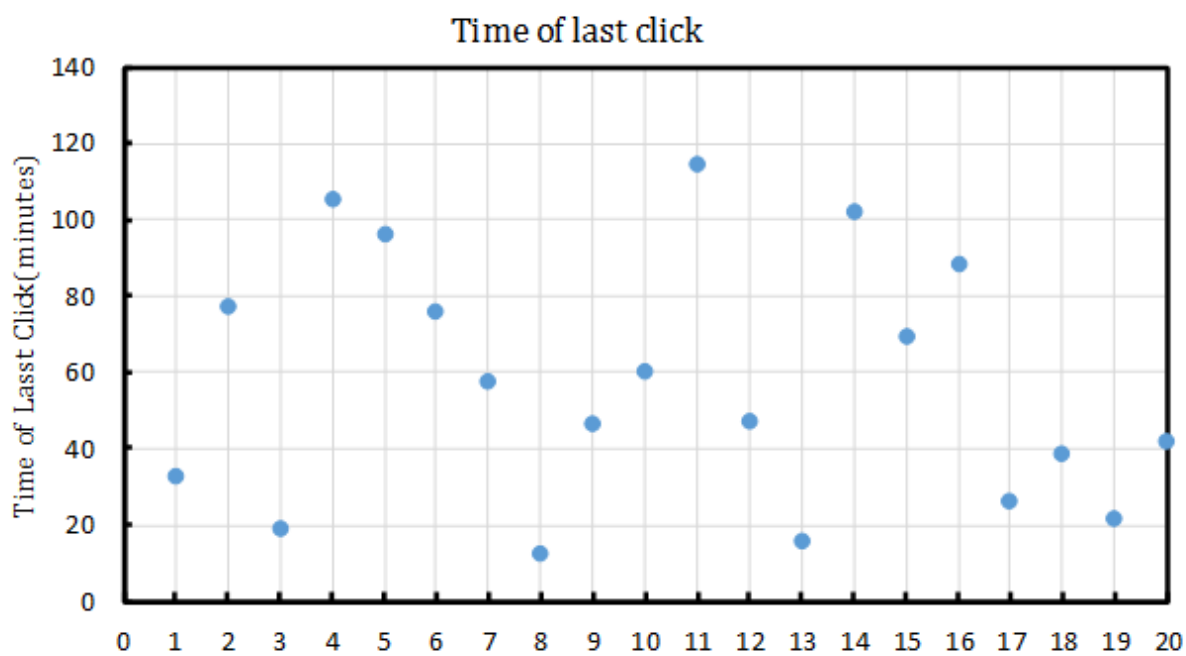


Figure 5.5: Minutes between last click and end of experiment for all participants

The result in Figure 5.5 is a supplement for the largest interval between clicks because in certain cases the interval between our participants' last click and the end of the test (2 hour time) is larger than any interval between clicks. This graph helps us to find the accurate largest interval between clicks.

The data gathered from this consumer behavior study indicates that the average largest interval between clicks over a two hour period is 59.64 minutes and that the average time of a participant's last click is 58.27 minutes into the experiment.

Assumption is made for calculate the user absent hour based on the primary research data:

- After a time interval T, user has a probability of P entering the absent mode (for example, user walks away or falls sleep). In our case, we assume T = 59.64 min (average largest interval between clicks) and P = 100%.

Therefore, the absent hours is obtained by summing up the differential between intervals and T (if the interval is less than T, we take the differential as zero) with averaging among 20 data points. We have,

$$Absent\ Hrs = \mathbf{1.94}\ hrs/day$$

Chapter 6: Secondary Research for User Engagement

6.1 Introduction

In addition to CalPlug's primary research of the SIM lab tests, secondary research of usage pattern, such as total TV hours watched per week in America or total time certain peripherals are used per week, was obtained in order to determine the energy saving potentials.

CalPlug's main secondary research resource was Nielsen—a company dedicated to study consumers' trends and habits around the world. CalPlug primarily focused on US TV related information and reports provided by Nielsen, particularly the 'Cross-Platform' reports released quarterly and 'Social Media Reports' released yearly. Nielsen "tracks down viewing behavior down to the second, revealing detailed programming and commercial engagement" by using 'electronic metering technology' through Set-Top Boxes to obtain real-time stream of information, which is coupled with detailed analysis of consumer viewing behavior and demographic information [11].

Other secondary research sources include data from reports by the Consumer Electronics Association (CEA), New York State Energy Research and Development Authority (NYSERDA), Ericsson Consumer Lab, among others.

6.2 TV Engaged Hours

6.2.1.1 From Secondary Research

Until today's date, there has not been research tracking specifically user engagement hours while watching TV in a regular basis. In order to tackle this issue, CalPlug's approach to approximate the user engaged hours was to look at 'simultaneous usage of media while watching TV.' This would represent the user's activity other than watching TV, while still watching TV.

CalPlug's Methodology:

$$Formula\ used \rightarrow Engaged\ Hrs\ = (Total\ ON\ Time) - (Non\_engaged\ Hrs)$$

$$Total\ ON\ time\ =\ \mathbf{146.62}\ hrs/month\ based\ on\ medium\ =\ \mathbf{4.887}\ hr/day\ [12]$$

Non-engaged hours are from "Mobile Media Consumption Research," *InMobi & On Device Research, Q2 2012*.

6.2.1.2 From Primary Research

In this report, the definition of power states is different from the usual terms. In Table 6., it is seen that the new definition of power states is based on a more active role played by the consumer. The main difference from the general terms defined is that the new definition defines engagement as the "active clicking behavior on a remote control" as opposed to generally defining it as the attention of a user.

Table 6.1: Comparison of Device Operation Modes Definition

Conventional Definition of Device Operation Modes	**CalPlug Definition of Device Operation Modes**
• Active Mode: The television is turned on and is displaying an image. • Standby Mode: The television is turned off by the remote control and is not displaying an image but still remains plugged in and drawing wasted power. • Off Mode: The television is turned off by a power button/switch on the television and is not displaying an image but still remains plugged in and drawing wasted power.	• On/Active Mode: The appliance is turned on and the user is actively engaged with the appliance (pressing buttons on the remote control) • On/Absent Mode: The appliance is turned on and the user is not engaged with the appliance (They don't press any buttons and are not actively using the product, but the device is still displaying images) • Standby Mode: The appliance is waiting to be turned on • Off Mode: The appliance is turned off but is still plugged into the outlet

Since this is a substantial divergence, both the User Engaged Hours and the User Absent Hours would vary from those estimated in other reports. The User Absent Hours is defined as the time that the user is not actively engaged with the devices and is calculated using the primary research data in found in Chapter 5.

In order to find User Absent Hours, the Idle Time percentage must be calculated and inserted into Equation 1. This is done by the sum of all the data points above one hour is divided by the product of the number of subjects and the total time duration of the test as shown in Equation 2. Only data points above one hour are considered because these are the times that can potentially draw savings when using the 1-hour configuration for the Tier 2 APS+. The User Absent Hours is the same as the T_{TV_Absent} variable used in the savings formula found in Chapter 8.

$$Absent\ Hrs = \mathbf{1.94}\ hrs/day$$

$$Using\ our\ formula \rightarrow Engaged\ Hrs = 4.887 - 1.94 = \mathbf{2.95}\ hrs/day^{*}$$

*During our test, we assume that user is considered to be engaged in the "watching TV" activity by actively pressing the remote control button. This assumption doesn't include all the scenarios, for example, user is watching a show while multi-tasking his work.

$$User\ Absent\ Hours = Idle\ Time(\%) \times (Total\ On\ Time) \qquad (1)$$

$$Idle\ Time\ (\%) = \frac{(Sum\ of\ time\ between\ clicks\ gretaer\ than\ 1\ hr)(min.)}{20\ (people)\ \times\ 120\ (min.)} = \mathbf{39.6\%} \qquad (\mathbf{2})$$

$$Total\ On\ Time = (User\ Engaged\ Hours) + (User\ Absent\ Hours) \qquad (3)$$

Chapter 7: SIM Living Room Tests

7.1 SIM Lab 1

In SIM Lab Test 1, the purpose of the test was to determine preliminary power measurements on the Tier 2 APS+ with the most common household appliances in the living room. All of the devices in this setup are in the Active Mode and raw data was collected for 8.9 hours. The 8.9 hours comes from the national average on time of an STB per day (NYSERDA 2011). The reason that the on time for the STB was used rather than any of the other appliances is because it was the one with the longest on time and covers the average amount of power consumption in a single day of normal activity. Table 7.1 below shows the raw data for the total power consumption of the Tier 2 APS+ under this setup.

Table 7.1: Total Power Consumption of Tier 2 APS+

Configuration	Power Consumption (W)
TV + Audio + Xbox(Idle) + DVD(Idle) + STB	194

7.2 SIM Lab 2

In SIM Lab Test 2, the power consumption of the Tier 2 APS+ was recorded under four different configurations that were determined from secondary research to be the most common configurations in an American household entertainment center. Table 7.2 summarizes the raw data for these findings under a 12-hour test for each configuration. In this table, the first peripheral device is the main one that the consumer would be using in the given configuration. The other peripherals are in the active mode because they must be on in order to perform the desired function. It should be noted that the STB is always in the Always On socket and is not included in the calculations for total savings.

Table 7.2: Power Consumption of Tier 2 APS+ for Most Common Configurations for TEST 2

Configuration	Power Consumption (W)
TV + Audio + STB (With Subwoofer)	118
TV + Audio + STB (No Subwoofer)	123

Xbox + Audio + TV + STB	203
DVD + Audio + TV + STB	126

7.3 SIM Lab 3

In SIM Lab Test 3, the power consumption of the Tier 2 APS+ was recorded under four different configurations that were determined to be the most common configurations in an American household entertainment center. Table 7.3 summarizes the raw data for these findings under a 48-hour test for each configuration. In this table, the first peripheral device is the main one that the consumer would be using in the given configuration. The other peripherals are in the active mode because they must be on in order to perform the desired function. It should be noted that the STB is always in the Always On socket and is not included in the calculations for total savings. The 48-hour test results are more accurate than the 12-hour test results since the final results are not as susceptible to power consumption fluctuations that can be attributed to the amount of motion on a screen. For example, a sports game requires more drastic pixel change than the commentary after the sports game, which would increase the instantaneous power consumption for a certain time frame.

Table 7.3 Power Consumption of Tier 2 APS+ for Most Common Configurations for TEST 3

Configuration	Power Consumption (W)
TV + Audio + STB (With Subwoofer)	108
TV + Audio + STB (No Subwoofer)	104
Xbox + Audio + TV + STB	201
DVD + Audio + TV + STB	110

Chapter 8: Energy Savings Evaluation

8.1 Tier 2 APS Energy Savings

8.1.1 Overview

The energy savings for the different configurations must be calculated separately as not all of the devices will be in use at the same time. Each common configuration in an American household can be classified under one of the following three cycles: TV cycle, Xbox cycle, DVD cycle. In addition to these cases, there could be a situation where cycles overlap. This would happen if the IR Timer has not reached the full hour and the user has switched their engagement to a different device.

8.1.2 Typical Configurations in US Household

Table 8.1: Typical Configurations in US Household [1] & [5]

Number of Households with Each Configuration		
Total # of Households (US Census 2011)	100%	132,312,404
DVD + TV	86%	113,788,667
Game Console + TV	56%	74,094,946
STB + TV	85%	112,465,543

Table 8.2: Annual unit energy consumption estimate of electronic devices in living room

UEC of DVD players, recorders or DVD VCR combinations	28.2 kWh/year[10]
UEC of television	184 kWh/year[10]
UEC of video game consoles	330 kWh/year[10]
UEC of audio system	81 kWh/year[16]
Total energy consumption of living room	**623.2 kWh/year**

Base on the US census 2011, the power consumption under four different modes of four most common appliances, TV Set (TV + Audio System with subwoofer), DVD and XBOX were measured.

8.1.3 Power Consumption for Each configuration

The power consumption data was based on SIM Lab final (3rd) test run

Table 8.3: Power consumption for each appliance

	TV Set (W)		XBOX (W)	DVD (W)	STB (W)
	TV (W)	Audio (W)			
User Engaged	90		100	5.3	18
User Absent	90		93	5.3	18
Standby	/		/	1.0	/
Off	<0.2		<0.2	<0.2	<0.2

Note: "/" means this appliance doesn't have this mode or it's not activated during our test. It's the same for the following tables.

Table 8.4: Power Consumption of Tier 2 APS+ for Most Common Configurations

Configuration	Power Consumption (W)
TV + Audio + STB	108
Xbox + Audio + TV + STB	201
DVD + Audio + TV + STB	110
TV + Audio + Xbox + DVD + STB	216

8.1.4 Average usage hours for each appliances

Table 8.5: Average usage hours under different modes [14] (*Based on preliminary primary research conducted by CalPlug from 10/03/2013-10/25/2013) and secondary research)

	TV (Hr/Day)	XBOX(Hr/Day)	DVD(Hr/Day)	Audio(Hr/Day)
User Engaged Hours	2.95	1.4	0.778	/
User Absent Hours	1.94*	7.46	23.2	/
Standby	/	/	/	/
Off	20.11	15.1	/	/

* The TV engaged & absent hours are obtained based on CalPlug SIM Living Room primary research. The engaged and absent hours for audio system are the same as TV since they are tested as a set.

8.1.4.1 TV Cycles

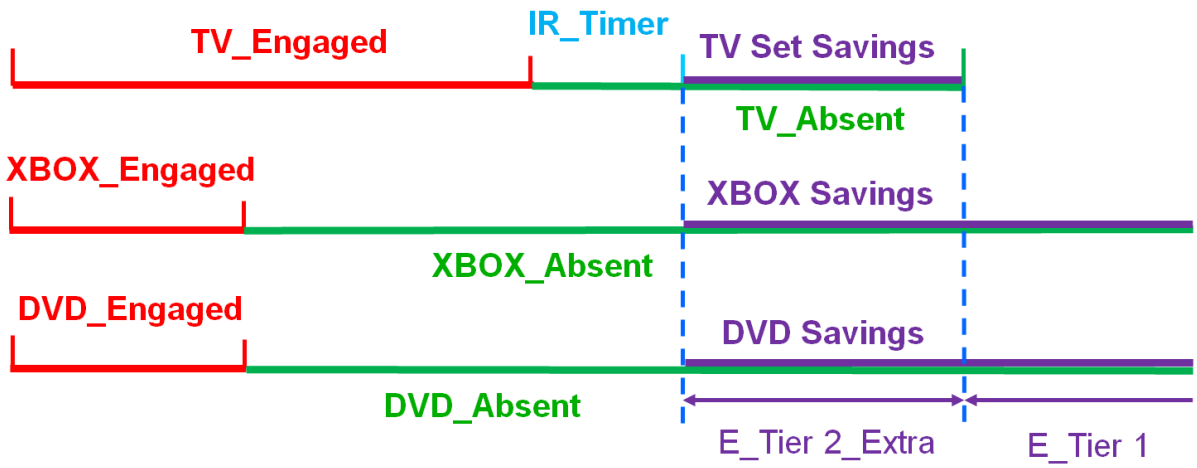
Below we describe the appliance usage cycle when TV is the dominate appliance that will determine the user behavior. For example, user will only watch TV or related activities during TV cycle.

$$\boldsymbol{TV\ Set\ Savings\ (WHr)} = \boldsymbol{P_{TV\_Absent}(W)} \times \left(\boldsymbol{T_{TV\_Absent}} - \boldsymbol{T_{IR\_Timer}}\right)\boldsymbol{(Hr/Day)} \times \boldsymbol{(365.25)(Days)}$$

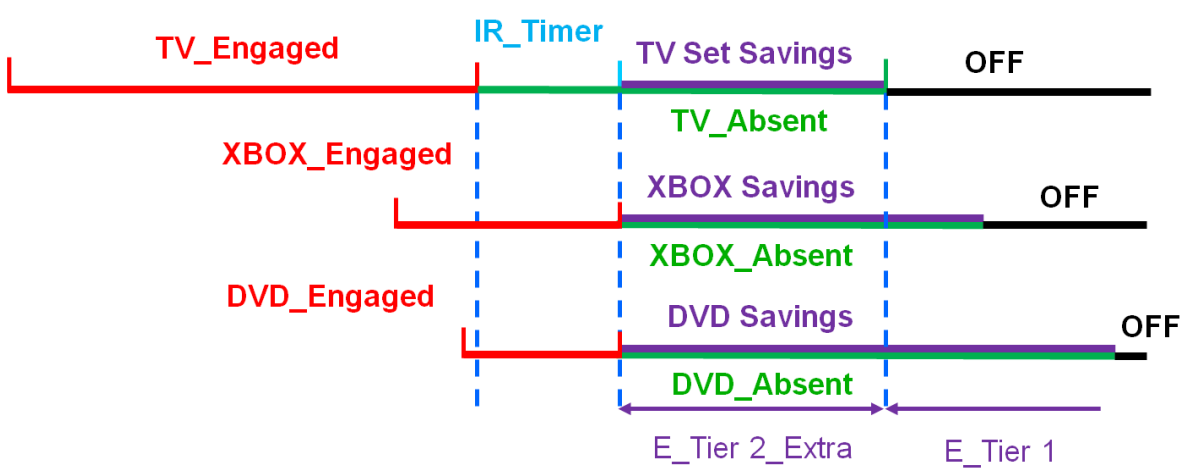
Note: TV Set = TV + Audio System (With Subwoofer)

8.1.5 Overlapping cycles

Conservative Savings:



Maximum Savings:



8.2 Equations for Tier 2 APS+ Energy Savings

8.2.1 Condition

The appliances are connected to the Tier 2 APS+ in the following format:

- STB is plugged to Always ON
- TV is plugged to Master; XBOX, DVD, and Audio System are plugged to Slave
- IR sensor timer is set to 1 hour.

The main differentiation of the energy savings of TrickleStar's Tier 2 APS+, relative to Tier 1 APS, lies in exclusively the user absent hours. The total savings should be simply:

$$\boldsymbol{E\_Tier\ 2\_Total(WHr) = E\_Tier\ 2\_Extra\ +\ E\_Tier\ 1}$$

Here **E_Tier 1** is what NYSERDA have previously tested and reported, and **E_Tier 2** is what CalPlug is characterizing in our labs.

Based on the 118W TV set we are using for the power consumption measurement, the additional savings generated by Tier 2 APS+ can be calculated by following formulas.

$$\begin{aligned}
&\boldsymbol{E_Tier\ 2_Extra\ (WHr)} \\
&\qquad = (\boldsymbol{P_{TV_{Absent}}(W) + P_{XBOX_{Absent}} + P_{DVD_{Absent}}}) \times (\boldsymbol{T_{TV_{Absent}} - T_{IR_{Timer}}})\left(\frac{\boldsymbol{Hr}}{\boldsymbol{Day}}\right) \\
&\qquad \times (\boldsymbol{365.25})(\boldsymbol{Days}) \\
&\qquad = (\boldsymbol{90 + 93 + 2}) \times \boldsymbol{0.94} \times \boldsymbol{365.}\frac{\boldsymbol{25}}{\boldsymbol{1000}}\boldsymbol{KWHr} \\
&\qquad = \boldsymbol{63.5\ KWH}
\end{aligned}$$

The overall energy **E_total** can be obtained under the following assumptions since the engaged hours and absent hours varies tremendously based on different user behavior pattern, demographics, and geographic locations. Thus the average engaged/absent hours from our primary/secondary research are employed in the formulas below.

Based on the key assumptions mentioned in the previous chapters and the values in Table 8. and Table 8., we can have the annual minimum and maximum energy savings for APS+ **E_Tier 2_Total** according to the following formula

Conservative case according to section 8.1.5,

$$E_{Tier}2_{Total}(WHr) = P_{TV_{Absent}}(W) \times \left(T_{TV_{Absent}} - T_{IR_{Timer}}\right)\left(\frac{Hr}{Day}\right) \times (365.25)(Days) + P_{XBOX_{Absent}}(W) \times \left(T_{XBOX_{Engaged}} + T_{XBOX_{Absent}} - T_{TV_{Engaged}} - T_{IR_{Timer}}\right)\left(\frac{Hr}{Day}\right) \times (365.25) + P_{DVD_{Absent}}(W) \times \left(T_{DVD_{Engaged}} + T_{DVD_{Absent}} - T_{TV_{Engaged}} - T_{IR_{Timer}}\right)\left(\frac{Hr}{Day}\right) \times (365.25) = 30.9 + 166.8 + 38.8\ KWHr = 236.5\ KWHr/Year$$

Maximum savings according to section 8.1.5,

$$E_{Tier}2_{Total}(WHr) = P_{TV_{Absent}}(W) \times \left(T_{TV_{Absent}} - T_{IR_{Timer}}\right)\left(\frac{Hr}{Day}\right) \times (365.25)(Days) + P_{XBOX_{Absent}}(W) \times \left(T_{XBOX_{Absent}}\right)\left(\frac{Hr}{Day}\right) \times (365.25) + P_{DVD_{Absent}}(W) \times \left(24 - T_{TV_{Engaged}} - T_{IR_{Timer}}\right)\left(\frac{Hr}{Day}\right) \times (365.25) = 30.9 + 253.4 + 38.8\ KWHr = 323.1\ KWHr/Year$$

8.2.2 Assumptions

1. User has all 5 appliances in his/her living room (STB, TV, Audio, DVD, XBOX);
2. Three cycles (TV, XBOX and DVD) are all involved during user's activity;
3. The engaged hours of XBOX or DVD are less than TV engaged hours;
4. 30% of users leave their game console idle when not in use, with the remainder putting their console into standby mode. (So absent hours will NOT be 24 hours – Engaged Hours);
5. User will leave their DVD idle when not in use. But before the DVD turns to the standby mode, it is already shut down by APS (Standby timer >> IR sensor timer).

Chapter 9 : Summary

9.1 Summary

CalPlug tested the Tier 2 APS+ power consumption in both bench-top and simulated environments. According to average American usage pattern and average user behavior, the energy savings of Tier 2 APS+ can be obtained and thus the annual energy savings can be determined.

Calplug utilized secondary research on the US average user usage pattern and primary research of consumer behavior pattern in order to determine the user engaged hours and absent hours during the appliance usage activities.

Three test runs were conducted in CalPlug SIM living room with four of the most common in the US appliance configurations attached to TrickleStar's Tier 2 APS+. The average power consumption of each configuration was measured and recorded.

Following the tests and methodologies outlined in this report, the annual energy savings o TrickleStar's Tier 2 APS+ are determined at 323 KWH.

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Attachment B

Environmental Claim Verification letter

TrickleStar Tier 2 APS

UL Environment, Inc.

07 Jan 2015

01/07/2015

Bernard Emby
Tricklestar
2711 Centerville Road
Suite 400
Wilmington, Delaware 19808
United States

ULE Project No.: 13CA35994
ULE Order No.: 7598879
Subject: Environmental Claims Validation for Advanced Powerstrip+ (APS+) – IR Sensor, Model 188LV-IR-4F

Dear Bernard,

Congratulations! All testing, auditing and analysis work associated with above mentioned project number has been completed. Please refer to the following page for all environmental claims that were validated and the methods used for validation. The products listed in this report are eligible to bear the ULE Environmental Claims Validation Logo, in accordance with the ECV Guidelines.

Please be informed that in some cases, UL Environment Inc. did not select the samples. Auditing conducted to validate environmental claims was performed on a sample of available documentation, products and materials.

The issuance of this report in no way implies ULE Sustainable Product Certification, ULE Environmental Product Declaration, Underwriters Laboratories Inc. (UL) Product Safety Listing, Classification or Recognition and does not authorize the use of ULE certification marks or UL Safety Listing, Classification or Recognition Marks or any other reference to UL on or in connection with the safety of the product or system. This letter is solely intended to report the environmental claims that were found to be valid and the methods used by ULE to validate such claims. Any modifications to electrical components, mechanical components, materials, manufacturing processes, purchasing policies or other items, which may affect the environmental claims validated, may invalidate the claims and require full reassessment.

We appreciate the opportunity to have worked with you on this project. Should you have any questions regarding this letter or the attachments, please let us know.

Sincerely,

Tony Tran

Environmental Project Manager
UL Environment Inc.

UL Environment, Inc.
2211 Newmarket Parkway, Marietta, GA 30067-9399 USA
T: 888.485.4733 / F: 770.980.0072 / W: UL.com/environment

Report Date: 01/05/2015
Valid Through: 01/05/2016
Original Issue Date: 01/05/0215

Company	Tricklestar
Manufacturing Location(s)	Powertech Industrial Co (Dongguan Quan Sheng Electric Co., Ltd)
Product Description	Power strip
Model Number(s)	188LV-IR-4F

The following environmental claims were validated in accordance with the following methods:

Environmental Claim	**Method**
Validated energy savings of 20% a year (Estimated 79.20 kWh/yr. savings)[1]	ULE ECVP 108 Version 3 - Estimating Energy Savings for Energy Saving Power Strips
Validated energy savings of 26% a year (Estimated 115.53 kWh/yr. savings)[2]	
Validated energy savings of 47% a year (Estimated 333.48 kWh/yr. savings)[3]	

[1] Home entertainment center equipment savings are based on the times the average American falls asleep in front of the television each night. This instance is if the user does not fall asleep in front of the TV. Estimates based on using APS+ - IR Sensor power strip with Energy Star AV peripherals with different Standby and Idle Mode capabilities specified in ULE ECVP 108 Version 3 - Estimating Energy Savings for Energy Saving Power Strips. Savings may vary based on usage and actual equipment connected.

[2] Home entertainment center equipment savings are based on the times the average American falls asleep in front of the television each night. This instance is if the user falls asleep 1 night a week in front of the TV. Estimates based on using APS+ - IR Sensor power strip with Energy Star AV peripherals with different Standby and Idle Mode capabilities specified in ULE ECVP 108 Version 3 - Estimating Energy Savings for Energy Saving Power Strips. Savings may vary based on usage and actual equipment connected.

[3] Home entertainment center equipment savings are based on the times the average American falls asleep in front of the television each night. This instance is if the user falls asleep every night in front of the TV. Estimates based on using APS+ - IR Sensor power strip with Energy Star AV peripherals with different Standby and Idle Mode capabilities specified in ULE ECVP 108 Version 3 - Estimating Energy Savings for Energy Saving Power Strips. Savings may vary based on usage and actual equipment connected.

Test Method

Number of samples tested: Three (3)
Model Number: 188LV-IR-4F
Voltage tested: 120V
Frequency tested: 60 Hz

Load Sensor Test

The load sensor test was used to determine the status of the switched/master controlled outlets by applying a load at the sensor/master outlet. Each load was applied to the sensor/master outlet for 30 seconds before determining the status of each switched/master controlled outlet. The load applied to the sensor/master outlet varied as indicated in Table 1, the status of each switched/master controlled outlet was recorded. The procedure was applied for each sample submitted and tested for each switched/master controlled outlet.

Table 1: APS+ IR Sensor Load Sensor Test Results

Sensed Load Wattage (W)	Switched Outlet Status (On/Off)
36	On
1	Off
8.7	On
0.6	**
1.3	On
1	**
3	On
0.7	**

** UNIT DOES NOT TURN OFF. BY SETTING THE WATTAGE TO A MINUMUM OF 15.5 WATTS AND THEN REDUCING IT TO 1 WATT CAUSES THE UNIT TO TURN OFF.

This product is intended for use on televisions 32” or larger which use considerably more than 15W in the On Mode. For the intended use, the load sensor test works as expected. Based on the results UL Environment concluded that the APS+ IR Sensor power strips passed the load sensor test.

Remote Control Test

The remote control test was used to determine the status of an outlet when the remote is a specified distance away from the power strip. Using the remote control or using the IR remote for a TV, turn the outlets on/off and then record the status of the outlet. A calibrated load of 100W was applied to the APS+ IR Sensor. The remote control accuracy was tested by moving a specified distance away from the device, turning the outlets on/off using the remote and then recording the outlet status as shown in Table 2. The procedure was applied for each sample submitted.

Table 2: APS+ IR Sensor Remote Control Test Results - Results for Manufacturing Specifications

Sample:	APS 1	APS 2	APS 3
Remote Distance (m)			
1	Yes	Yes	Yes
2	Yes	Yes	Yes
3	Yes	Yes	Yes
4	Yes	Yes	Yes
5	Yes	Yes	**
6	Yes	Yes	**

** SENSOR ON SAMPLE #3 WOULD NOT PICK UP SIGNAL AT 5 OR 6 METERS
** ONCE THE MASTER OUTLET HAS NO LOAD THE SLAVE OUTLETS SHUT OFF AFTER 1 MIN

This product is intended for use with a remote up to a distance of 5 meters. On average, the IR sensor detects the signal from the remote at a distance of 5 meters or more. For the intended use, the Remote Control test works as expected based on the results, UL Environment concluded that the APS+ IR Sensor power strips passed the remote control test

Current Draw Test

The Current Draw Test is used to determine the current draw of the power strip when it is plugged in and on, plugged in with the IR Sensor attached and on, plugged in with the IR Sensor attached and outlets loaded. A calibrated load of 25W was used for the high/on load and 5W load was used for the low/off load. The sensor controls on the outlet strip was adjusted to allow these loads to activate and deactivate the switched/master controlled outlets or the sensor was used to activate and deactivate the switched outlets. The total power strip load is measured where the power strip plugs into the main power. The calibrated load is subtracted from the total power strip load measurement. The remaining load is reported as the power strip on and off mode loads. The procedure was applied for each sample submitted.

Table 3: APS+ IR Sensor Current Draw Test Results Summary

Sample	On Mode (W)	Off Mode (W)
APS 1	1.51	0.67
APS 2	1.49	0.64
APS 3	1.46	0.59
Average	1.49	0.63

The results of the Current Draw Test are used in the Energy Savings Calculations below.

An evaluation was performed to compute the expected energy savings using ULE ECVP 108 Energy Savings for Energy Saving Power Strips – Version 3 for multiple consumer use cases based on the test results above. For each consumer use case, a comparison was drawn between using a standard power strip that is always on versus a power saving power strip that will shut off the master controlled/switched outlets when not in use.

Consumer Use Case #1: AV System Equipment with running in Idle, Standby and Off Modes

A consumer will have their AV System equipment that will be running in Idle, Standby and Off Modes during a typical evening at home where the consumer will not fall asleep in front of the television. For the base energy use within a 24 hour day, the consumer will leave the system on and leave the peripheral equipment either running in Idle, Standby and Off Modes. For the power energy savings energy use, the customer will leave the television on until the sensor detects no IR signals from the remote control and shuts off on its own, and consequently will turn off the peripheral equipment. The energy savings are provided in Table 4.

Table 4: Energy Savings for an AV System including a 42" LCD Television with a Mix of AV Equipment in Idle, Standby and Off Modes vs Shutting Off the Outlets

Base Energy Use	395.05	kWh/year
Power Savings Energy Use	315.85	kWh/year
Energy Savings	***79.20***	***kWh/year***
	20%	

Consumer Use Case #2: A consumer will have their AV System equipment that will be running in Idle, Standby and Off Modes during a typical evening at home where the consumer will fall asleep in front of the television for one night a week. For the base energy use within a 24 hour day, the consumer will leave the system on and leave the peripheral equipment either running in Idle, Standby and Off Modes. For the power energy savings energy use, the customer will leave the television on until the sensor detects no IR signals from the remote control and shuts off on its own, and consequently will turn off the peripheral equipment. The energy savings are provided in Table 5.

Table 5: Energy Savings for an AV System including a 42" LCD Television with a Mix of AV Equipment in Idle, Standby and Off Modes vs Shutting Off the Outlets

Base Energy Use	438.97	kWh/year
Power Savings Energy Use	323.44	kWh/year
Energy Savings	***115.53***	***kWh/year***
	26%	

Consumer Use Case #3: A consumer will have their AV System equipment that will be running in Idle, Standby and Off Modes during a typical evening at home where the consumer will fall asleep in front of the television every night. For the base energy use within a 24 hour day, the consumer will leave the system on and leave the peripheral equipment either running in Idle, Standby and Off Modes. For the power energy savings energy use, the customer will leave the television on until the sensor detects no IR signals from the remote control and shuts off on its own, and consequently will turn off the peripheral equipment. The energy savings are provided in Table 6.

Table 6: Energy Savings for an AV System including a 42" LCD Television with a Mix of AV Equipment in Idle, Standby and Off Modes vs Shutting Off the Outlets

Base Energy Use	702.46	kWh/year
Power Savings Energy Use	368.98	kWh/year
Energy Savings	***333.48***	***kWh/year***
	47%	

*The Second Consumer Use Case is the best representative scenario and best represents a real world setting.

Attachment C

Advanced Power Strip Common Terminology

NEEP APS Working Group

June 2014

Advanced Power Strip Common Terminology

As Put Forward by the NEEP APS Working Group, Working Document, June 2014

Subcategories of Advanced Power Strips

These subcategories are to be used by manufacturers to describe their Advanced Power Strip and its associated control strategy in more detail. Please use this specific language to increase consistency within the region. With better consistency in how the APS works,

- Activity Monitor Power Strip (*includes tier 2*)
  - Definition: Power strip looks for signs of activity in the room, and turns off outlets if none is detected.
  - Use additional phrase "Active Power Down" when describing Tier 2 APS.
- Master-Controlled Power Strip
  - Definition: When a primary device (such as a computer or TV) is turned off by the use, the power strip automatically turns off (de-energizes) the controlled outlets where the peripheral devices (such as a task light or printer) are plugged in.
- Masterless Power Strip
  - Definition: When all of the controlled devices are turned off, the power strip turns off power to those outlets completely, eliminating all of the vampire loads.
- Remote Switch Power Strip
  - Definition: Power strip can be turned off by the user via a remote switch.
- Timer Power Strip
  - Definition: Power strip automatically turns off outlets based on pre-set schedule

Please note that some APS products might fit into more than one category. In that case, it is at the discretion of the manufacturer to determine if they would like to list all possible categories or

Sample uses (on manufacturer website, promotional material, and/or product packaging):

- (Tier 1) This is Acme Brand's *PowerPlus Pro* Advanced Power Strip, a Remote Switch Power Strip!
- (Tier 2) This is Beta Brand's *SuperStrip Beyond* Advanced Power Strip, an Activity Monitor Power Strip that uses active power down technology to save you even more energy!
- (Tier 1, fits within multiple categories) This is Kappa Tech's *PowerSaver* Advanced Power Strip, a Master-Controlled and Timer Power Strip!

NEEP APS Working Group Recommendations on Terminology for Tier 1 and Tier 2 Technology

While the phrase "Tier 2" is not perfect and does not provide a detailed description of the technology, the phrase has gained recognition amongst the energy efficiency industry and is well-known enough to refer to specific products. Neither "tier 2" nor "tier 1" are customer facing terms, and it is the opinion of this working group that they do not become so. Rather, this working group recommends the continued use of the phrase "tier 2" to refer to APS that target active power down savings for internal, industry conversations, and use "Activity Monitor Power Strip" with "active power down" savings as the customer facing phrasing. The terminology "Advanced Power Strip" to refer to both tier 1 and tier 2 devices is well established both internally and externally and should be the starting point for customer-facing messaging.

For additional internal clarity or for industry members new to this technology, the expanded phrase "Tier 2 (advanced plug load management device)" may be helpful, but the acronym APMD as a substitute for "tier 2" should be avoided.