ADVANCED POWER STRIPS
DEEMED SAVINGS METHODOLOGY

DEVELOPED AND SUBMITTED BY THE
NEEP DATA WORKING GROUP

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SECTION 1: INTRODUCTION

The use of advanced power strips (APSs) is one approach to eliminate standby power loss from various electronic products commonly used in the home. Entertainment and office electronics make up 60%[1] and 31%[1] respectively of all plug load consumption by home electronics. With such a large percentage of home electronics representing plug load consumption, deployment of APSs for entertainment and home office electronics would reduce energy consumption across the residential market. To increase awareness and understanding of this product category, the Northeast Energy Efficiency Partnerships (NEEP) initiated working groups in August 2010 to focus on marketing best practices, product testing, and deemed saving for APSs to help the energy efficiency industry better market and understand the savings potential of these products.

The Data Group was tasked with identifying the average savings APSs can create based on eliminating standby passive power waste. The Data Group is a collaborative of multiple industry stakeholders including consultants, engineers, manufacturers, retailers, national testing labs, and efficiency program implementers, including Embertec, NYSERDA, Lockheed Martin, Ecova, Tricklestar, Tenrehte, Sustainable Life Solutions, PG&E, VEIC, NREL, EPRI and the Advance Group (disclaimer – these findings are only the views of the collective Data Group, and not those of each participant's employer).

Many concepts and methodologies were evaluated, and the following is the result of the Data Group's efforts to produce deemed savings numbers. These results are baseline potential energy savings, and are intended to give regulators, utilities, and evaluators the savings based on minimal products plugged into the APS utilized in a residential environment. It should be noted that APSs can deliver significantly higher savings beyond the Data Group's findings, depending on the number of peripherals in a user's home. It is worth mentioning that direct install programs can optimize the installation location and therefore realize savings higher than reported in this study.

It is also important to note that these savings findings are based on "Tier 1" APS products, those devices that only address standby power reduction via basic master/control technologies. There are "Tier 2" APS products that also address standby power reduction and reduce active power consumption, thereby representing a significantly higher savings potential. However, Tier 2 product availability is just entering the market at this time and, based on the timeline of the Data Group, it was determined that current available data and immediate savings opportunities should be focused on Tier 1 products until field studies can be conducted to further determine the extra savings potential of Tier 2 products.

[1] http://efficientproducts.org/documents/Plug_Loads_CA_Field_Research_Report_Ecos_2006.pdf

SECTION 2: METHODOLOGY

Over much of 2011, the Data Group collected information from multiple APS studies (outlined in Section 2) that identified the frequency of electronics used in home entertainment centers and home offices, their power consumption levels, and the average hours of use per day. This data was analyzed to understand the power consumption of these products in active, standby-passive, and off modes. As shown in Table 1, a total of 36 home electronics were gathered to characterize the national market and savings potential for APS devices. Active, standby, and off modes are defined as follows:

Active mode: Is the mode which the appliance is connected to a power source and at full power consumption.

Standby-passive mode: Commonly called standby mode, it is the mode in which the appliance is connected to a power source, does not perform any mechanical function and is waiting to be switched into another mode on receipt of a signal from the consumer.

Standby-active mode: For example: “ready to record” mode; e.g., the mode in which the appliance is connected to a power source, does not perform any mechanical function, is in an active mode communicating for part or all of the time, or is waiting to be switched to "on (record)" by means of an internal or external signal.

Off mode: Is the mode which the appliance connected to a power source has a power consumption of zero.

Table 1: List of Entertainment and Office Home Electronics Analyzed

Entertainment Home Electronics	Office/IT Home Electronics
CRT Television	Desktop Computer
LCD Television	Laptop Computer
Plasma Television	Modem
Projection Television	Router
Cable Set Top Box	CRT Monitor
Cable Set Top Box with DVR	LCD Monitor
Satellite Set Top Box	Inkjet Printer
Satellite Set Top Box with DVR	Laser Printer
DVR Set Top Box	Scanner
DVD Player	Copier
DVD Player/Recorder	Inkjet Facsimile Machine
VCR	Laser Facsimile Machine
DVD/VCR Player	External Hard Drive
BluRay Player	Speakers
PlayStation 2	
PlayStation 3	
Nintendo Wii	
Xbox	
Xbox 360	
AV Receiver	
Powered Subwoofer	
Surround Sound Speakers	

Two separate analyses were completed to understand the average consumption and potential savings resulting from the use of APSs – the typical household and the national market. A typical household in the United States has a Cathode Ray Tube (CRT) television, Liquid-Crystal Display (LCD) Television, cable set top box, DVD player, VCR, video game console, desktop computer, LCD monitor, and inkjet printer. For a typical household, the use of one APS for entertainment purposes and one for home office purposes would result in an estimated savings of 106.1 kWh (75.1 kWh home entertainment and 31 kWh home office) per year. The development of these values coincided with a study conducted for The New York State Energy Research Development Authority (NYSERDA), creating an opportunity for data exchanges and cross vetting savings findings. It was confirmed that these results were consistent with the outcomes of NEEP's APS Data Group and NYSERDA's Power Management Study.

SECTION 3: DATA

Three main factors contributed to the final deemed savings calculation: power consumption, hours of use, and type and number of products controlled by the APS.

Power Consumption and Hour Use Data

The Data Group reviewed approximately 21 studies conducted throughout the U.S., Canada, and overseas that addressed APSs and plug load. The Data Group analyzed each study and came to group consensus to utilize the most statistically consistent studies regarding power consumption and hour use for reference throughout this effort. The Data Group settled upon the following studies for review of average power consumption and hour usage in various states of operation. **(Appendix B):**

- *Electricity Savings Opportunities for Home Electronics and Other Plug-In Devices in Minnesota Homes,* (Energy Center of Wisconsin)
- *Standby and Energy Saving Sockets. A Status for Denmark.* (IT Energy)
- *AutoPowerOff plug banks – a story with energy savings perspectives,* (Jensen, Fjordbak)
- *Energy Trust of Oregon Smart Plug Strip Project: Final Meeting*, (Ecos Consulting)
- *Low-Power Mode Energy Consumption in California Homes*, (Lawrence Berkeley National Laboratory)
- *Residential Miscellaneous Electrics Loads: Energy Consumption Characterization and Savings Potential in 2006 and Scenario-based Projections for 2020*, (TIAX LLC)
- *2005 Intrusive Residential Standby Survey Report*, (Energy Efficient Strategies)

Products in the Home

Due to the vast differences in product occurrences throughout the multiple studies reviewed, the Data Group sought out additional market research to identify home entertainment and home office electronics most commonly found in the home. NYSERDA agreed to share data from Experian^{SM} Simmons, (a commercial information services company) a study that identified electronics in over 24,000 homes in the United States **(Appendix: C).**

SECTION 4: SAVINGS

To determine the estimated savings for a typical household in the United States, a configuration of home electronics—along with the power consumption in each mode for each product and the average hours of use in each mode per day—were used. A product was included in the typical configuration if the average number of products per household for the national market was 0.5 or greater. Products meeting the 0.5 or greater occurrence threshold are shown in Table 2.

Table 2: Consumer Electronics in a Typical Household

Home Entertainment	Home Office
CRT or LCD Television (Master device)	Desktop Computer (Master device)
Cable Set Top Box (Always on)	LCD Monitor (Controlled device)
DVD Player (Controlled device)	Printer (Controlled device)
VCR (Controlled device)	
Video Game Console (Controlled device)	

There are various types of video game consoles including the Nintendo Wii, Sony PlayStation, and Microsoft Xbox, and two types of printers (inkjet and laser) on the market today. Although there was a higher home penetration of some game consoles over others in 2010, the video game market is very dynamic. Therefore, each video game console was given equal weight and the power consumption in each mode of all video game consoles was used to calculate the average power consumption and potential energy savings from using an APS in a typical household. Similarly, although inkjet printers are found more often in households across the nation, laser printers are becoming more popular on the market. Therefore, for the typical household, the inkjet and laser printer were given equal weight and the power consumption in each model of both printers was used to calculate the average power consumption and energy savings potential. Tables 3 and 4 provide further detail regarding the average home set up and hours of use per day from selected entertainment and home office devices.

Table 3: Average Number of Entertainment Devices and Hours of Use per Household

	Average Number per Household						Average Hours of Use per Device per Day		
	DVD Player	DVDR	VCR	DVD/ VCR Player	BluRay Player	Video Game Console	Active	Standby	Off
National:									
National	0.9	0.3	0.6	0.1	0.2	0.6	DVD Player: 0.7 DVDR: 0.7 VCR: 0.4 DVD/VCR: 1.2 BluRay: 0.7 Video Game Console: 1.1	DVD Player: 2.5 DVDR: 2.5 VCR: 2.2 DVD/VCR: 2.5 BluRay: 2.5 Video Game Console: 1.5	DVD Player: 20.8 DVDR: 20.8 VCR: 21.4 DVD/VCR: 20.4 BluRay: 20.8 Video Game Console: 21.4
County Size A	0.9	0.4	0.5	0.1	0.2	0.6	Media Player: 0.6 Video Game Console: 1.0	Media Player: 1.7 Video Game Console: 1.5	Media Player: 21.7 Video Game Console: 21.5
County Size B	0.9	0.3	0.6	0.1	0.2	0.6	Media Player: 0.7 Video Game	Media Player: 2.0 Video Game	Media Player: 21.3 Video Game

	Average Number per Household						Average Hours of Use per Device per Day		
	DVD Player	DVDR	VCR	DVD/ VCR Player	BluRay Player	Video Game Console	Active	Standby	Off
							Console: 1.0	Console: 1.5	Console: 21.5
County Size C&D	0.8	0.3	0.6	0.1	0.2	0.6	Media Player: 0.4 Video Game Console: 0.9	Media Player: 1.0 Video Game Console: 1.5	Media Player: 22.6 Video Game Console: 21.6
House	0.9	0.4	0.6	0.1	0.2	0.6	Media Player: 0.6 Video Game Console: 1.2	Media Player: 1.6 Video Game Console: 1.5	Media Player: 21.8 Video Game Console: 21.3
Apartment/Condo	0.7	0.2	0.4	0.1	0.2	0.5	Media Player: 0.4 Video Game Console: 0.6	Media Player: 1.2 Video Game Console: 1.6	Media Player: 22.3 Video Game Console: 21.9

Table 4: Average Number of Home Office Devices and Hours of Use per Household

	Average Number per Household						Average Hours of Use per Device per Day		
	Monitor	Printer	Scanner	Copier	Fax Machine	Speakers	Active	Standby	Off
National:									
National	0.8	0.6	0.2	0.1	0.1	0.4	Monitor: 5.1 Printer: 0.1 Scanner: 0.0 Copier: 0.0 Fax Machine: 0.2 Speakers: 5.3	Monitor: 2.4 Printer: 4.4 Scanner: 0.0 Copier: 0.0 Fax Machine: 0.5	Monitor: 16.5 Printer: 19.5 Scanner: 24.0 Copier: 24.0 Fax Machine: 23.3 Speakers: 18.7
County Size A	1.0	0.6	0.2	0.1	0.1	0.4	Monitor: 5.7 Printer: 0.1 Scanner: 0.0 Copier: 0.0 Fax Machine: 0.2 Speakers: 5.9	Monitor: 2.7 Printer: 4.4 Scanner: 0.0 Copier: 0.0 Fax Machine: 0.5	Monitor: 15.7 Printer: 19.5 Scanner: 24.0 Copier: 24.0 Fax Machine: 23.3 Speakers: 18.1
County Size B	1.0	0.6	0.2	0.2	0.1	0.4	Monitor: 5.6 Printer: 0.1 Scanner: 0.0 Copier: 0.0 Fax Machine: 0.2 Speakers: 5.8	Monitor: 2.6 Printer: 4.4 Scanner: 0.0 Copier: 0.0 Fax Machine: 0.5	Monitor: 15.7 Printer: 19.5 Scanner: 24.0 Copier: 24.0 Fax Machine: 23.3 Speakers: 18.2
County Size C&D	1.0	0.6	0.2	0.1	0.1	0.4	Monitor: 2.8 Printer: 0.1 Scanner: 0.0 Copier: 0.0 Fax Machine: 0.2 Speakers: 2.9	Monitor: 1.3 Printer: 4.4 Scanner: 0.0 Copier: 0.0 Fax Machine: 0.5	Monitor: 19.9 Printer: 19.5 Scanner: 24.0 Copier: 24.0 Fax Machine: 23.3 Speakers: 21.1
House	0.9	0.7	0.2	0.1	0.1	0.5	Monitor: 5.7 Printer: 0.1 Scanner: 0.0 Copier: 0.0 Fax Machine: 0.2 Speakers: 5.9	Monitor: 2.7 Printer: 4.4 Scanner: 0.0 Copier: 0.0 Fax Machine: 0.5	Monitor: 15.6 Printer: 19.5 Scanner: 24.0 Copier: 24.0 Fax Machine: 23.3 Speakers: 18.1
Apartment/	0.5	0.4	0.1	0.0	0.0	0.3	Monitor: 2.1	Monitor: 1.0	Monitor: 20.9

	Average Number per Household						Average Hours of Use per Device per Day		
	Monitor	Printer	Scanner	Copier	Fax Machine	Speakers	Active	Standby	Off
Condo							Printer: 0.1 Scanner: 0.0 Copier: 0.0 Fax Machine: 0.2 Speakers: 2.2	Printer: 4.4 Scanner: 0.0 Copier: 0.0 Fax Machine: 0.5	Printer: 19.5 Scanner: 24.0 Copier: 24.0 Fax Machine: 23.3 Speakers: 21.8

Using these home electronics as a typical configuration in a household, the total consumption, energy savings from using an APS and total dollar savings were calculated and shown in Table 5. To achieve these calculations, it is assumed that: 1) one APS is used for home entertainment and one is used for home office purposes; 2) the average cost per kWh is $0.11 (EIA 2011); 3) the difference in the cost of an APS and a standard power strip is $20 (**Appendix D**); and 4) the mechanical and electrical life expectancy of an APS is a minimum of 10 years, though individual results may be less due to consumers changing equipment plugged into the APS. Detailed information regarding the formulas used can be found in **Appendix A.**

Table 5: Estimated Power Consumption and Savings from using an APS, Typical Household (as outlined in Tables 2 and 3)

Total Annual Entertainment Energy Consumption per Household (kWh)	602.8
Total Annual IT Energy Consumption per Household (kWh)	197.9
Total Annual Consumer Electronics Energy Consumption per Household (kWh)	800.8
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**

APPENDIX A: APS ENERGY SAVINGS EQUATIONS

The equations to determine the change in kilowatt hours per year by using an 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 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 total savings. When plugged into an 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 calculator is*:

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

where:

e	=	type of home electronic equipment
m	=	shutdown mode (standby or off)
$SDW_{e,m}$	=	shutdown watts, the watts drawn by *e* in shutdown mode *m*
$SDHrs_{e,m}$	=	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 active/on mode for more hours per day than the products in the controlled outlets, then the potential energy savings in kWh for each electronic device included in the APS Savings Tool can be determined with the equation:

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

where:

e	=	type of home electronic equipment
i	=	type of home electronic equipment in the master control outlet
m	=	shutdown mode (standby or off)
$SDW_{e,m}$	=	shutdown watts, the watts drawn by *e* in shutdown mode *m*
$SDHrs_{i,m}$	=	number of hours *i* is in shutdown mode *m;* = 24 – number of operating hrs

Before completing the summation, these equations can be multiplied by the average number of products per household in order to determine a savings for an entire market, if needed. The change in power consumption for each product is added over all home entertainment and home office products to determine the total potential savings by using an APS. The equations use the number of hours that the product in the master control outlet is in each mode.

**Suggested APS products consume 1 watt or less and that consumption value is separate from our calculations*

APPENDIX B: EXPERIAN SIMMONS DATA COLLECTION METHODOLOGY

Experian[SM] Simmons, a commercial information services company, supplied the data used for the number of electronics per household, the electronics hours of use, and some consumer behavior analysis for this report. Experian compiled the data from their fall 2010 Adult 12-Month Study regarding consumer electronics, consumer attitudes, opinions, behaviors, and daily activities of consumers.

Experian's Study uses a probability sample design that measures all American adults with a standard questionnaire and consistent data collection and data processing procedures. The study provides single-source measurement for products that consumers buy, brands they prefer, lifestyles and attitudes, and media preferences. All respondents – regardless of origin or language ability – are asked the full range of questions measured by the National Consumer Survey.

The data collection process occurs in two phases. The first phase consists of a telephone placement interview which is conducted with an adult 18+ in the contacted household. If an adult is contacted and agrees to the survey, the second phase occurs by mailing a survey package to the household. Incentives are provided if the adult participates by completing the personal booklet including the standard questionnaire and returning it to Experian.

This Study is based on a sample of 24,463 interviews with English and Spanish speaking adults 18 years or older residing in the United States, excluding Alaska and Hawaii. Respondents participated between late October 2009 and early December 2010.

Experian's fall 2010 12-Month NCS study is comprised of four quarterly waves:

- Winter 2010 wave (fielded from late October 2009 through mid March 2010).
- Spring 2010 wave (fielded from early February 2010 through early June 2010)
- Summer 2010 wave (fielded from late April 2010 through early September 2010)
- Fall 2010 wave (fielded from late July 2010 through early December 2010)

APPENDIX C: REFERENCES

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APPENDIX D: COST DIFFERENTIAL DATA

Sourced from the NYSERDA market characterization worksheet titled “NYSERDA APS worksheet 011211”.