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Overview of the Tier 1 Advanced PowerStrip: Potential Savings and Programmatic Uses

White Paper

September 15, 2014

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EXECUTIVE SUMMARY

The explosive growth of the consumer electronics industry, including the regular introduction of new gaming consoles, set top cable/satellite boxes, DVD's and Blue-Ray DVD players that typically remain powered on in an inactive or standby mode, has had a significant impact on household plug load. This presents program planners with an opportunity to decrease the "vampire" load of these devices through increased adoption of PowerStrips that can save energy by turning off devices when they are not in use.

The Advanced PowerStrip saves energy by turning off the entertainment system peripherals when the master device is turned off. Typically the television is set as the master device, when turned off, the Advanced PowerStripAPS then completely shuts off DVD players, gaming systems and other items that would have otherwise remained on in active mode and/or on in idle or standby mode. TV set top cable and satellite boxes are typically not controlled by the APS due to re-booting times and reprogramming issues. Despite the potential, program planners are currently wrestling with a means to understand the amount of energy savings these devices may offer and how to develop cost effective programs to support them.

ILLUME Advising, LLC completed an independent, third party review of Technical Resource Manuals (TRMs), energy efficiency program evaluations, industry studies, and industry reports that showed there are large variations in savings assumptions for Advanced PowerStrips. These variations arise from three main differences in the approach used or assumptions drawn from when developing the savings:

- Device-specific assumptions: Electronic devices such as TVs and game consoles come in a wide variety of sizes, manufacturers, and technologies. At their core, savings calculations make assumptions about the base case configuration and energy use in homes before the introduction of a power strip. These assumptions vary widely by study, region, and TRM.
- Changing trends: The types of electronics present in homes and how consumers use those electronics changes rapidly. For example, while VCRs were once found in 93 percent of households, in 2012 their penetration dropped to 55 percent[1]. More households now own video game consoles and many households also use their game consoles for watching movies[2]. These rapid changes impact base energy use and energy savings. Trends may not be reflected in studies and findings that are even a few years old.
- IT Systems: The savings calculations presented here are based on home entertainment systems. Some TRMs and programs assume power strips will

[1] Nielsen 2012
[2] Nielsen Cross-Platform 2012

be used with home computer systems. Assumptions about savings from home computers and peripherals will vary widely from home entertainment systems.

Rather than developing a single deemed savings estimate for the Advanced PowerStrip device, ILLUME Advising developed a savings calculator designed to help determine savings based on a wide variety of system configurations. This calculator allows the user to modify inputs based on individual program parameters and accommodates changes in assumptions of market penetration, enabling the user to understand savings estimates based on the customers that will be targeted by a program.

Utilizing the savings calculator, we analyzed two different potential rebate program designs using energy use and market penetration estimates developed based on market research.[3] The first targets the "average" household which represents a broad swath of market penetration for different devices and entertainment system configurations. The second program targets the "average" household with a gaming console.

We found that, for a program that provides a rebate to the "average"[4] customer, calculated savings for a Tier 1 Advanced PowerStrip is 75 kWh/year. Savings can be increased by targeting programs to owners or new purchasers of gaming systems, for example. Gaming systems such the Xbox and PlayStation tend to have high energy use even in idle or sleep mode. Households with these systems can save up to 122 kWh/year. Both scenarios pencil out as cost effective; with the average household coming at 1.67 and households with a gaming system at 2.71.

The consumer electronics industry moves at an incredibly fast pace, devices that did not exist a few years ago are commonplace in many homes and their efficiency levels are constantly changing. As those numbers and the number of households with gaming consoles grows, this unlocks even more potential for cost effective programs models that include the Tier 1 Advanced PowerStrip.

[3] A full list of assumptions can be found in the main paper.
[4] An Average customer represents the blend of equipment penetration across all households, e.g. weighted savings based on US equipment penetration rates.

OVERVIEW OF THE TIER 1 ADVANCED POWERSTRIP:

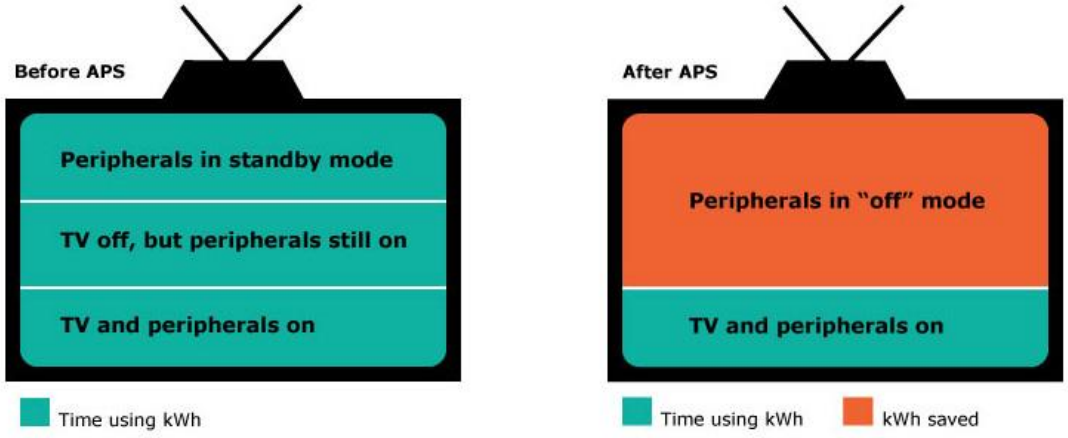
Consumer electronics represent a growing challenge for DSM program planners. Approximately 12%[5] of household electricity use is consumed by TVs, entertainment, and home office or computing devices. The digital TV signal conversion has prompted many homeowners to upgrade their television sets from CRT to LCD or LED TVs, with the volume of TVs per home anticipated to continue growing in the near future. Combined with the regular introduction of new gaming consoles, set top cable boxes, and Blue-Ray DVD players that typically remain powered on in an inactive or standby mode, there is an opportunity to curtail some of the "vampire" electricity use of devices that are not being actively engaged.

This paper will discuss the Tier 1 Advanced PowerStrip, a piece of technology designed to save energy by completely turning off home entertainment peripherals (DVD, gaming system, etc.) when the television is turned off[6]. We will discuss the results from the third party review and validation of the estimated energy savings being presented in the market as it relates to Advanced PowerStrips and, in particular, the Tier 1 Advanced PowerStrip product line. We will also discuss the development of a savings calculator that can be used to fine tune savings estimates based on the system configuration and finally, we will discuss three potential program design scenarios, including the results from a cost/benefit analysis.

Introduction to the Tier 1 Advanced PowerStrip

Tier 1 Advanced PowerStrips save energy by turning off peripherals when the master device (usually the TV in home entertainment systems) is turned off. A graphic example of this concept is shown in Figure 1.

Figure 1. Savings Potential for the Tier 1 Advanced PowerStrip



[5] Consumer Electronics Association (CEA) by the Fraunhofer USA Center for Sustainable Energy Systems

[6] This is opposed to peripherals sitting in a standby mode.

1. CURRENT ENERGY SAVINGS ESTIMATES FOR TIER 1 ADVANCED POWERSTRIP DEVICES

Energy savings, in terms of kWh, for the Tier 1 Advanced PowerStrip vary depending on the combination of home entertainment devices attached to the strip. To determine the most appropriate way to calculate the savings for the device, ILLUME completed a review and validation of the estimated energy savings currently being presented in the market. This review included two research studies conducted specifically for the Advanced PowerStrip (APS) as well as industry market research, technical reference manuals (TRMs), and evaluations from a variety of energy efficiency programs.

Our review found that the most referenced study in Technical Reference Manuals (TRMs) is the NYSERDA Advanced PowerStrip report published in August 2011. Interestingly, the NYSERDA study estimated that the savings for the Tier 1 APS at 106 kWh/year. With that noted, this number assumes the installation of two devices, one controlling IT systems and one controlling entertainment systems. Reading more closely you find that the report suggests that the savings for entertainment systems is estimated to be 75.1[7] kWh and savings for IT systems is 30.1 kWh. While this is very clearly outlined, several states take the total NYSERDA number and divide it by two, attributing that number to all APS devices in their TRM. This assumes that all programs market to both IT and entertainment market areas and that the devices are evenly installed in IT and entertainment systems in homes. Many, if not most, of the other TRMs we reviewed referenced this study and the numbers cited in those documents were typically some sort of derivative of the NYSERDA savings values.

After reviewing over a dozen TRMs we found that there are three areas where assumptions are leading to the wide variability in the savings for APS devices. First, generally speaking, there is considerable variability in the assumptions around base watts drawn by the controlled devices. This variance can cause considerable differences in the savings reported in the TRM. For example, in the case of video game systems the range of base Watts being used to calculate savings for APS ranges from .57 to 73.8.[8]

Second, assumptions about system configurations also had a large effect on the savings being reported in TRMs. Studies assume mixes that range from the very basic TV, DVD, and Gaming System configuration to much more extensive configurations. As more peripherals are assumed controlled by the device, the

[7] This is almost the same number calculated by ILLUME during this effort.

[8] Note that the .57 number is questionable given the number of idle Watts reported by the gaming manufacturers and the distribution of gaming systems by type in the US.

savings obviously goes up. However, the likelihood of an average home having that same configuration is very low which can put the deemed savings at significant risk at evaluation time. While it may seem ideal to optimize savings using this approach, it is recommended that programs start with a lower deemed savings, associate with a more realistic configuration, as this mitigates the risk of a very low realization rate in the evaluation.

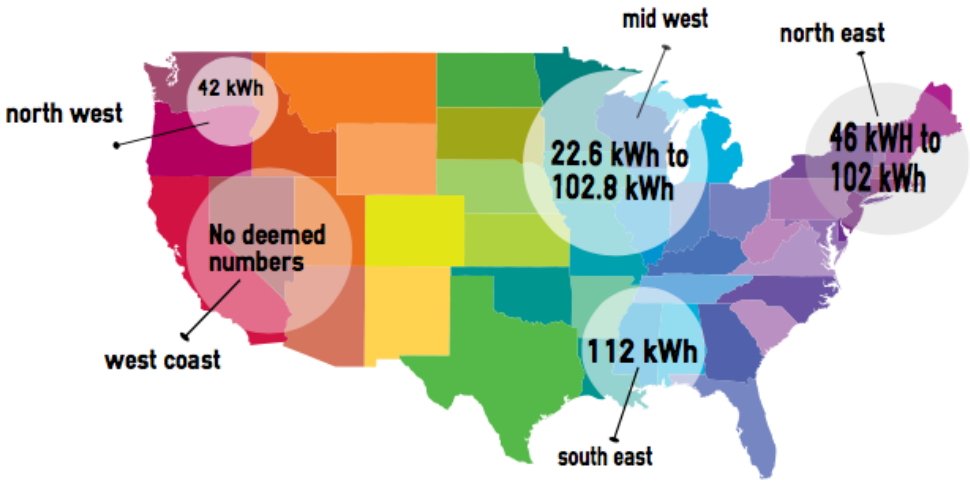
Finally, there are significant differences between studies on the assumption of equipment penetration and usage patterns. Penetration and usage patterns for the purpose of this memo are defined as follows:

- Penetration = the percent of homes in the U.S. that actually have a specific device or configuration of devices.
- Usage Patterns = the hours of use for each device in all of the operable modes including on, idle, standby, and off.

These two elements can have a significant impact on the savings that can be claimed for Tier 1 devices moving forward. For example, if a TRM is assuming that all homes will have a TV, DVD, and XBOX controlled by a device but it turns out that only 25% of homes who participate in the program have this configuration, the savings can be significantly impacted.

The variances in reviewed studies cannot be taken lightly; the wide range reported has created uncertainty around the savings potential for these devices. For Advanced PowerStrips, the savings range being reported across the industry ranges from 10 kWh to 103 kWh. This wide range reflects the ambiguity around inputs and assumptions being used to calculate these savings and is primarily a result of differing calculation methodologies and different inputs. This is exacerbated by a lack of critical review of the assumptions and primary research on the devices. Further, because these devices make up relatively small portions of energy savings portfolios (when compared to items like CFLs) little time or resources are invested in vetting the inputs used in TRMs and in conducting EM&V. Further because there is a lack of primary research, personal inferences and a level of industry skepticism seems to be influencing savings results in some of the published studies. The figure below illustrates the wide range of savings seen in TRMs and other published resources from around the nation.

Figure 2: Current Estimates of Savings Ranges for Tier 1 APS Devices



It is also critical to note the influence of savings from the control of gaming systems. The configuration and penetration of controlled peripherals is critical to this discussion, while TVs, set top boxes, and DVD players can be found in nearly all households in the U.S., gaming systems cannot. That noted, according to a recent study by Neilson, 57% of U.S. households have a gaming system and this number has been increasing dramatically in the last decade.

Figure 3: Growth in Household Video Game Console Penetration[9]

In short gaming systems, their prevalence and increasing penetrations, will likely only increase the potential savings for these devices. This is made more opportune by systems like the Xbox One, which remain in a constant "active" mode so that it can respond to the voice control option. The table below shows the changing penetrations by gaming systems as of 2013; this is paired with shipping data which shows the units that have higher energy use in on and standby modes are gaining significantly in the market over lower energy usage units like the Nintendo Wii.

[9] Growth projection based on modeling done by ILLUME using the historic growth in sales trends.

Table 1: Gaming Systems Market Share

Household Penetration of Game Consoles Q1 2013				
	% of Households	**Trending**	**Shipping Data[10]**	**Source**
Nintendo Wii	37%	↓	3%	Nielsen Gaming 2013
XBox360/One	27%	↑	47%	
Sony PlayStation 3/Slim	20%	↑	6%	
Sony PlayStation 4	16%	↓	35%	
Nintendo Wii U	4%	↓	9%	

Based on this data alone, many of the savings assumptions in the current slate of TRMs are misrepresenting gaming system wattage, default settings that leave the system in "On Idle" mode, and penetration; thus over and underrepresenting savings potential for all APS devices.

2. POTENTIAL SAVINGS AND PROGRAMMATIC USES

Approach to Calculating Energy Savings

Following the review of the estimated energy savings in TRMs, it was concluded that rather than developing a single deemed savings estimate for the device, it would be more appropriate to develop a savings calculator that allows users to modify inputs based on individual program parameters. This approach accommodates changes in assumptions of market penetration, enabling the user to customize savings depending on the customers that will be targeted by a program. For example, in a program that provides a rebate to any interested customer, expected savings for a Tier 1 Advanced PowerStrip in an "average" home is 75 kWh/year. Savings can be increased by targeting programs to owners or new purchasers of gaming systems, for example gaming systems such the Xbox One and PlayStation tend to have high energy use even in idle or sleep mode. Households with these systems can save up to 122 kWh/year.

The model calculates energy savings by identifying the target devices that are intended to be plugged into the Tier 1 Advanced PowerStrip, and uses information about each of those devices (an estimate of current market penetration, values for

[10] Data represents the percent of the total number of units each gaming system represents of all units shipped into the US by manufacturers for sale.

reported device energy usage in active, standby and idle modes, etc.) to calculate anticipated savings.

Appendix B provides the key assumptions, including their sources, for the savings calculations presented in this paper.

3. PROGRAM DESIGN OPTIONS FOR THE TIER 1 ADVANCED POWERSTRIP

Tier 1 APS devices can be utilized in a variety of energy efficiency program designs, including direct install and rebate programs. Direct install programs utilizing the Tier 1 APS devices are a cost effective option addressing systems that often use substantial power even in idle or sleep modes, do not ship with sleep modes activated, and tend to be left on even when not in use[11]. Adding Tier 1 Advanced PowerStrips to existing direct install programs can allow program administrators to selectively install the devices in homes configurations have the highest potential for savings. Layering them on top of existing direct install efforts would require little additional effort and would further increase the cost savings achieved.

The Tier 1 Advanced PowerStrip can also be cost effective when delivered via a retail rebate or products program. The device is low cost, easy to install, and there are a high percentage of homes with entertainment systems containing devices that would benefit from the control offered by Advanced PowerStrips.

Using the savings calculator, we calculated the energy savings for two different possible rebate program scenarios showing a variety of entertainment system configurations. Table 3 displays the two possible scenarios: 1) installation in an "average" home; and 2) installation in homes with a gaming system. While the "average" home saves an estimated 75 kWh/year with the Tier 1 Advanced PowerStrip, higher savings can be achieved in homes with gaming systems due to the energy use during idle and sleep modes that is eliminated when the power strip turns off all devices.

[11] NRDC study

Table 3. Savings assumptions for two program scenarios

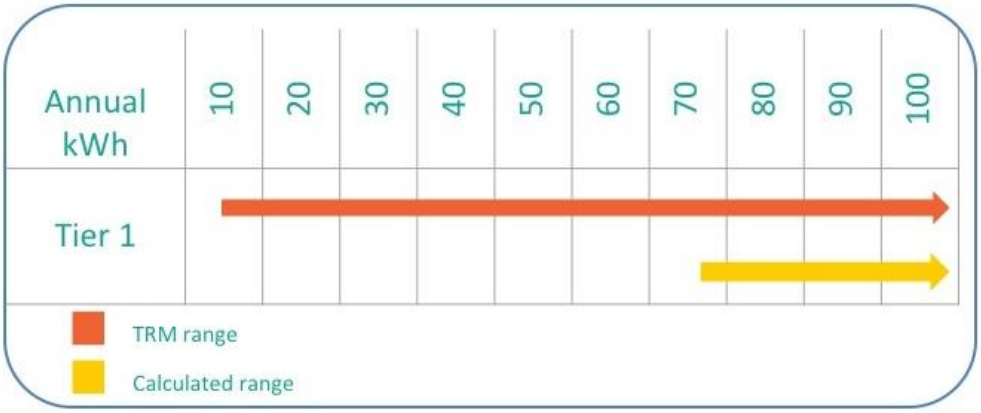
Equipment		"Average" Household	"Average" Household with a Gaming System
Household Penetration of Equipment	42" LCD TV	63%	100%
	42" Plasma TV	8%	
	36" CRT TV	23%	
	56" Projection TV	4%	
	SD DVD Player	83%	100%
	Amplifier/Surround System	20%	
	Subwoofer	20%	
	Sound Bar	4%	
	VCR	55%	
	Wii	22%	41%
	Sony PS	20%	36%
	Xbox One	15%	27%
Energy Use per Year - No Power Strip (kWh)		391.5	486.1
Energy Savings per Year – Advanced Power Strip (kWh)		75	122

The "average" household is estimated to save 75 kWh per year, while the "average household with a gaming system" is estimated to save 122 kWh per year.

We then compared the results of the savings calculator to the range of savings reported in TRMs. Figure 3 shows the results of that comparison[12]. Note this range overlaps on the high end with what is seen in many studies and TRMs with an overall range that is much smaller than was found in the TRM and research report review. Also note the data on gaming systems used for this study is more up to date than any data in the reviewed TRMs.

[12] The underlying calculations for the Tier 1 Advanced PowerStrip provided above are based on critically reviewed engineering and the assumptions are based on the best data available.

Figure 3: Calculated APS savings compared to savings range reported in TRMs



Cost Effectiveness

Each of the scenarios described above can be implemented as cost-effective energy efficiency programs.

For the purposes of this paper, we assumed a relatively small program that issues rebates for 2,500 units with a unit cost of $18[13]. Each unit had an effective useful life of ten years and we assumed a 1:1 net-to-gross ratio[14]. We then applied an industry standard administration budget of 20% total program cost and a marketing budget of 5% program costs. Table 4 shows costs, benefits, and savings for each scenario.

Table 4. Cost-Benefit Analysis Results for Rebate Model

	"Average" Household	"Average" Household with a Gaming System	"Average" Household with a Direct Install
TRC Benefits	$93,824	$152,621	$152,621
TRC Costs	$56,250	$56,250	$143,750
TRC Net Benefits	$37,574	$96,371	$8,871
TRC Benefit/Cost Ratio	1.67	2.71	1.06
First Year KWh Savings	187,500	305,000	305,000
Lifecycle KWh Savings	1,875,000	3,050,000	3,050,000

[13] Wholesale price provided by TrickleStar

[14] For Net to Gross we presumed very few people are not buying in absence of the program. Avoided energy supply costs New England: 2013

Each of the two program scenarios pencil out as cost effective with a cost-benefit ratio over 1.00. For a rebate program, households with the average system come in at 1.67. For the gaming system household the benefit cost comes in at 2.71 in a retail scenario and 1.06 in a direct install scenario confirming the potential for cost effective programs models that include the Tier 1 Advanced PowerStrip. With retailer-based programs Install or In-Service Rates (ISR) cannot be ignored, in order to address this the analysis was run to determine what the "worse case scenario" ISR rate can be before the program is no longer cost effective. Based on this it was found that even with an ISR as low as 50% the program is still passes the benefit costs analysis.

4. CONCLUSIONS

The Tier 1 Advanced PowerStrip helps manage one of the most difficult to capture energy users in the household, consumer electronics and entertainment systems. By including them in a properly designed program the Tier 1 Advanced PowerStrip provide a cost effective option for energy efficiency program portfolios. By taking a more nuanced look at the types of participants, configurations, and technologies that offer the most savings, program planners can develop cost effective programs that use these devices to increase savings in the home entertainment category.

The home entertainment and electronics market is rapidly changing as new devices become available, and as consumers change their buying and usage habits the savings potential offered by the Tier 1 Advanced PowerStrip will continue to be significant. The "hot" devices, especially gaming systems, can change rapidly from year to year and new features like voice activation means they are using more energy when in "idle" modes than past generations of systems. The Tier 1 Advanced PowerStrip will play an important role in helping manage that energy use.

A. SOURCES

Source	URL
ACEEE 2012	http://www.aceee.org/files/proceedings/2012/data/papers/0193-000295.pdf
CEA 2010	http://www.soundandvision.com/content/component-audio-bounces-back
CEA 2014	https://www.ce.org/Blog/Articles/2014/April/The-Long-Goodbye-46-Percent-of-Households-Still-Ha
CNET	http://www.cnet.com/news/ps3-slim-uses-half-the-power-of-ps3-fat/
Display Search 2012	http://www.displaysearch.com/cps/rde/xchg/displaysearch/hs.xsl/120529_global_tv_replacement_cycle_falls_below_7_years_as_households_continue_to_replace.asp
ESA 2013	http://www.theesa.com/facts/pdfs/esa_ef_2013.pdf
FutureSource 2013	http://webcache.googleusercontent.com/search?q=cache:nlv46NIwfFwJ:www.twice.com/magazine/news/suppliers-stoke-soundbar-surges/104492PLUS&cd=4&hl=en&ct=clnk&gl=us
IPTV 2013	http://www.iptv-news.com/2013/08/roku-beating-apple-in-connected-tv-market/
Nielsen 2012	http://www.nielsen.com/content/dam/corporate/us/en/reports-downloads/2013%20Reports/Nielsen-US-Consumer-Usage-Report-2012-FINAL.pdf
Nielsen 2013	http://www.nielsen.com/us/en/newswire/2013/consumer-electronics-ownership-blasts-off-in-2013.html
Nielsen Cross Platform 2013	http://www.slideshare.net/mapleaikon/crossplatform-report-june-2013-nielsen
Nielsen Gaming 2013	http://www.nielsen.com/us/en/events-and-webinars/2013/webinar--us-gaming-a-360-view-2013.html
NRDC	http://www.nrdc.org/energy/game-consoles/default.asp
NYSERDA 2011	http://www.nyserda.ny.gov/-/media/Files/EERP/Residential/Energy-Efficient-and-ENERGY-STAR-Products/Power-Management-Research-Report.pdf
Reddit	http://www.reddit.com/r/Games/comments/1r2zsp/power_consumption_comparisons_ps4_wii_u_xbox_one/
VGChartz	http://www.vgchartz.com/weekly/41728/USA/
SDEnergy Smart	http://www.sdenergysmart.com/Rotator-videogame.aspx

B. SAVINGS ASSUMPTIONS AND SOURCES

Equipment	Household Penetration	Source	Active Power (W)	Idle Power (W)	Standby/ Sleep Power (W)	Off Power (W)	Source
42" LCD TV	63%	ACEEE 2012; Display Search 2012; CEA 2014	51.56	51.56	0.14	0.14	ENERGY STAR
42" Plasma TV	8%		70.00	70.00	10.00	1.10	ENERGY STAR
36" CRT TV	23%		79.30	79.30	5.30	1.60	NYSERDA 2011
56" Projection TV	4%	Nielsen 2013	186.00	86.00	6.96	6.60	ENERGY STAR
SD DVD Player	83%	Nielsen 2013	5.51	5.51	0.28	0.28	ULE
Amplifier/Surround System (mid range medium size)	20%	NYSERDA 2011	9.00	9.00	0.48	0.48	ULE
Subwoofer	20%	NYSERDA 2011	9.10	6.90	0.48	0.48	ULE
Sound Bar	4%	FutureSource 2012	7.40	4.90	0.10	-	ENERGY STAR
VCR	55%	Nielsen 2012	17.00	13.00	0.78	0.78	ULE
Wii	22%	Nielsen Gaming 2013/Nielsen 2013	17.70	17.50	1.70	1.70	Reddit, NYSERDA, CNET, Nielsen Gaming. Models within manufacturer weighted by penetration, NRDC.
Sony PS	20%		132.00	89.00	8.50	0.70	
Xbox One	15%		112.00	74.00	15.70	3.10	
Other Assumptions	**Assumption**	**Source**					
Average Daily TV Hours	5.95	Nielsen Cross Platform 2014					