Energy Savings Opportunities and Market Descriptions for Four Residential Consumer Electronics Products

Prepared by:

Marti Frank, Ph.D.
Jane S. Peters, Ph.D.
Joe Van Clock
Research/into/action

Gregg Hardy
Matt Krick
Ecos

Northwest Energy Efficiency Alliance
PHONE
503-688-5400
FAX
503-688-5447
EMAIL
info@neea.org

ACKNOWLEDGEMENTS

TABLE OF CONTENTS

APPENDICES

LIST OF TABLES

LIST OF FIGURES

EXECUTIVE SUMMARY

This report is an opportunity assessment and market characterization for four residential consumer electronics products: TVs, desktop PCs, game consoles, and streaming media devices. These products, along with other entertainment and IT plug load devices, represent a growing portion of residential electricity consumption. The study is intended to support program development in these areas by identifying, quantifying, and characterizing measure-level savings opportunities.

The study used market research and targeted interviews with market experts to identify opportunities. The research team vetted each opportunity to determine whether it had savings potential and if that potential was achievable by 2014. Opportunities judged to have near-term potential were quantified using a standardized approach and set of constant values. Thirteen opportunities were selected as having a "high confidence" of success due to the projected energy savings and NEEA's assessment of the level of engagement required from a program perspective.

KEY FINDINGS

High Confidence Opportunities

This project identified 34 energy efficiency opportunities, 13 of which are *high confidence*. Table 1 summarizes these opportunities.

Table 1: Summary of *High Confidence* Opportunities

OPPORTUNITY	TOTAL ACHIEVABLE POTENTIAL SAVINGS 2012-2014		APPLIES TO PRODUCTS THAT ARE…	REDUCES ACTIVE MODE	OPPORTUNITY TYPE [I]
	GWh	**aMW**			
TVs					
Occupancy Sensing Technology: Increase penetration of occupancy sensing technology	48	5.4	New	Duty cycle	Introduction
Optimize Brightness: Optimize brightness settings on existing TVs using direct install approach	42	4.8	Existing	Power draw	Saturation
Efficiency Tips: Add energy efficiency tips/options to menu	28	3.2	New	Other	Saturation

Continued

research/into/action inc

ENERGY SAVINGS OPPORTUNITIES IN CONSUMER ELECTRONICS

OPPORTUNITY	TOTAL ACHIEVABLE POTENTIAL SAVINGS 2012-2014		APPLIES TO PRODUCTS THAT ARE…	REDUCES ACTIVE MODE	OPPORTUNITY TYPE [i]
	GWh	aMW			
TVs (CONT.)					
ES v6 Test Procedure: Ensure final ENERGY STAR v6 test procedure incorporates improved ABC test procedure	18	2.0	New	Other	Adoption
Early Retirement: Incent retirement of larger, inefficient TVs when user purchases a new TV meeting the highest energy efficiency standards	12	1.4	Existing	Other	Adoption
ABC: Increase penetration of automatic brightness control (ABC)	5	0.6	New	Power draw	Saturation
TV APD: Increase penetration of auto-power-down (APD) capability enabled by default	5	0.6	New	Duty cycle	Adoption
DESKTOP PCs					
Installed Base Power Management: Increase penetration of power management on residential installed base	21	2.4	Existing	Duty cycle	Adoption
Power Supply: Improve efficiency of internal power supply	7	0.8	New	Power draw	Saturation
Voltage Regulator: Improve efficiency of voltage regulator	6	0.6	New	Power draw	Saturation
Hard Drive: Reduce size of hard disk drive from 3.5" to 2.5"	3	0.4	New	Power draw	Saturation
GAME CONSOLES					
Game Console APD: Increase the penetration of consoles shipped with auto-power-down (APD) enabled by default (set to 1 hour)	17	2.0	New	Duty cycle	Saturation
STREAMING MEDIA					
Eliminate Multi-Room DVRs: Increase the replacement of multi-room DVR set-top boxes with a thin client set-top box	7	0.8	New	Power draw	Adoption

[i]   NEEA defines three types of opportunities, also referred to as the *NEEA play*. **Introduction** is the accelerated or earlier initial adoption of a product, service, practice or behavior. **Adoption** is the accelerated adoption of an already introduced product, service, practice or behavior. **Saturation** is the increase of the final saturation of an already introduced product, service, practice, or behavior.

Product Market Characteristics

The study also provides descriptions of each product market that will be essential for program administrators developing interventions in these areas. These nuanced discussions cover: product types, technologies, and market share; supply-chain structure and key players; and market trends.

A CAVEAT

The consumer electronics market changes constantly. New products and technologies gain significant market share seemingly overnight. As a result, program administrators must be extremely sensitive to the "date stamp" on the data they use in their program designs.

Market data in this study – both the energy savings opportunities and characterization reports, were accurate as of **May 2011**. They should be considered "expired" after **May 2012**. After this date, care should be taken to verify whether they are still accurate.

1 | **INTRODUCTION**

This report is an opportunity assessment and market characterization for four residential consumer electronics products: TVs, desktop PCs, game consoles, and streaming media devices. The study is intended to support program development in these areas by identifying, quantifying, and characterizing measure-level opportunities with achievable savings in the 2012-2014 timeframe.

The Northwest Energy Efficiency Alliance (NEEA), a non-profit organization working to maximize energy efficiency and meet the Pacific Northwest's future energy needs, initiated this project in late 2009. In early 2009, NEEA piloted a consumer electronics program, in tandem with California utilities, to incentivize retailers to stock and sell qualifying digital TVs, home computers, and computer monitors. NEEA continued funding the consumer electronics program in 2010 and wanted to enhance its ability to act in the market by conducting additional research. To that end, NEEA and Ecos developed a scope of work and Ecos began the project in mid-2010. Research Into Action, Inc. joined the team in late 2010; the project concluded in mid-2011.

This document contains:

➡ A summary of the 34 energy efficiency opportunities identified

➡ Detailed descriptions of the 13 *high confidence* opportunities

➡ Market characterizations of each product that include: product types, technologies, and market share; supply-chain structure and key players; and market trends

The report is supplemented by four *Excel* workbook tools with detailed energy savings calculations. The workbook tools show the full calculations used to arrive at the savings estimates, including all inputs and their sources. Program administrators, planners, and researchers can use these workbooks to:

➡ Modify the opportunity calculations due to changing market data or to reflect different assumptions

➡ Estimate savings for a different geographic region

➡ Model different opportunities – the workbook tools can be used to model plug load opportunities not included here or savings projections for opportunities in other market sectors

RESEARCH APPROACH

This project included three distinct stages. The stages were completed sequentially, and each had its own methodology and goals:

➡ **First, the research team conducted primary and secondary market research in each product area**, including an extensive literature review and in-depth market expert interviews. The output of this stage was a draft market characterization report for each product and a list of potential energy efficiency opportunities.

➡ **Next, the team vetted each opportunity to determine whether it had savings potential and if that potential was achievable by 2014**. The team developed a standardized approach to quantifying the opportunities and used it to estimate the technical and achievable savings potential of each vetted opportunity. The outcome of this stage was a revised list of opportunities, with savings estimates.

➡ **Finally, the team and NEEA selected thirteen opportunities as *high confidence*** based on their energy savings potential and the level of engagement required from a program perspective. The product of this stage was a detailed write-up of each *high confidence* opportunity.

A complete description of the study methodology is included in Appendix A.

2 | SUMMARY OF OPPORTUNITIES

This project identified 34 energy efficiency opportunities in each of the four product areas: TVs, desktop PCs, game consoles, and streaming media. The research team selected 13 opportunities as having a high confidence for success due to the projected energy savings and NEEA's assessment of the level of engagement required from a program perspective.

Across all product types, most of the identified opportunities apply to new unit sales. These opportunities propose adding new functionality to a product or improving the efficiency of a particular component. We found fewer opportunities for the installed base. Yet, as another recent study noted, there is significant savings potential in existing products, which can be obtained primarily by optimizing settings like power management.[1]

There is a wide range in the number of opportunities identified for each product type. TVs yielded the greatest number of opportunities (20) and streaming media the fewest (2). The projected three-year energy savings of the opportunities also varies, from opportunities with an estimated 3 GWh (0.4 aMW) of savings to those with savings over 40 GWh (4.6 aMW).

We identified three program approaches with the potential to increase penetration of the opportunities: direct install, education, and incentive (upstream, midstream, and end-user). All opportunities for new products could be implemented with an upstream incentive and most could also utilize a midstream incentive. All opportunities for existing products could be implemented with a direct install and/or end-user incentive approach, and most could also be the subject of an education program. Nearly all of the opportunities could be implemented in more than one way.

The tables below summarize the identified opportunities. Table 2 quantifies the identified opportunities by product type. Table 3 lists each opportunity and its key details. Table 4 shows potential program approaches for each opportunity. The thirteen *high confidence* opportunities are described in detail in the relevant product chapters.

*An important note: The opportunities were identified, and their projected savings quantified, between March and June 2011. Given the fast-paced nature of the consumer electronics market, care should be taken to reevaluate both validity and energy savings estimates after **May 2012**.*

---

[1] Energy Center of Wisconsin. 2010. *Electricity Savings Opportunities for Home Electronics and Other Plug-in Devices in Minnesota Homes: A technical and behavioral field assessment.* Report #257-1. Madison, Wisc. May 2010: 21.

Table 2: Summary of Identified Opportunities for TVs, Desktop PCs, Game Consoles, and Streaming Media

PRODUCT TYPE	OPPORTUNITIES IDENTIFIED		APPLICABLE PRODUCTS *		OPPORTUNITIES REDUCE:		
	Total	High Confidence	New	Existing	Active Mode Power Draw	Duty Cycle	Other
TVs	20	7	17	4	12	2	6
Desktop PCs	8	4	7	1	3	2	3
Game Consoles	4	1	2	2	—	3	1
Streaming Media	2	1	1	1	1	—	1
TOTAL	**34**	**13**	**27**	**8**	**16**	**7**	**11**

* Opportunities that apply to both new and existing products are counted in each row.

Table 3: Description of All Identified Opportunities

TVs

CONFIDENCE LEVEL	OPPORTUNITY	TOTAL ACHIEVABLE POTENTIAL SAVINGS 2012-2014		APPLIES TO PRODUCTS THAT ARE...	REDUCES ACTIVE MODE...	OPPORTUNITY TYPE
		GWh	aMW			
High Confidence Opportunities	**Occupancy Sensing Technology**: Increase penetration of occupancy sensing technology	48	5.4	New	Duty cycle	Introduction
	Optimize Brightness: Optimize brightness settings on existing TVs using direct install approach	42	4.8	Existing	Power draw	Saturation
	Efficiency Tips: Add energy efficiency tips/options to menu	28	3.2	New	Other	Saturation
	ES v6 Test Procedure: Ensure final ENERGY STAR v6 test procedure incorporates improved ABC test procedure	18	2.0	New	Other	Adoption
	Early Retirement: Incent retirement of larger, inefficient TVs when user purchases a new TV meeting the highest energy efficiency standards	12	1.4	Existing	Other	Adoption
	ABC: Increase penetration of automatic brightness control (ABC)	5	0.6	New	Power draw	Saturation
	TV APD: Increase penetration of auto-power-down (APD) capability enabled by default	5	0.6	New	Duty cycle	Adoption
Other Opportunities	Increase penetration of LED backlighting on entry-level LCD models	3	0.4	New	Power draw	Saturation
	Increase penetration of digital CMOS tuners	3	0.4	New	Power draw	Saturation
	Increase number of cable TV subscribers who use the TV's download acquisition mode (DAM) in place of a cable set-top box	0	0	Existing	Other	Adoption

Continued

ENERGY SAVINGS OPPORTUNITIES IN CONSUMER ELECTRONICS

research/into/action℠

CONFIDENCE LEVEL	OPPORTUNITY	TOTAL ACHIEVABLE POTENTIAL SAVINGS 2012-2014		APPLIES TO PRODUCTS THAT ARE…	REDUCES ACTIVE MODE…	OPPORTUNITY TYPE
		GWh	aMW			
	TVs (CONT.)					
Other Opportunities (cont.)	Increase penetration of TVs with forced menu functionality (FMF) AND standard/home mode brightness as default	0	0	New	Power draw	Saturation
	Increase penetration of 2D dimming in LCD TVs	0	0	New	Power draw	Saturation
	Increase penetration of TVs >50" that meet ENERGY STAR v5.3	Not quantified	—	New	Power draw	Saturation
	Engage with manufacturers to promote NEEA's energy efficiency goals	Not quantified	—	New	Other	—
	Include RVU software in new TVs	Not quantified	—	New	Other	Adoption
	Improve efficiency of TV power supply	Not quantified	—	New	Power draw	Saturation
	Improve luminance efficiency for plasma TVs	Not quantified	—	New	Power draw	Adoption
	Increase penetration of dim room viewing conditions	Not quantified	—	New & Existing	Power draw	Saturation
	Increase penetration of OLED TVs	Not quantified	—	New	Power draw	Introduction
	Field sequential color	Not quantified	—	New	Power draw	Introduction

Continued

CONFIDENCE LEVEL	OPPORTUNITY	TOTAL ACHIEVABLE POTENTIAL SAVINGS 2012-2014		APPLIES TO PRODUCTS THAT ARE…	REDUCES ACTIVE MODE…	OPPORTUNITY TYPE
		GWh	aMW			
	DESKTOP PCs					
High Confidence Opportunities	**Installed Base Power Management**: Increase penetration of power management on residential installed base	21	2.4	Existing	Duty cycle	Adoption
	Power Supply: Improve efficiency of internal power supply	7	0.8	New	Power draw	Saturation
	Voltage Regulator: Improve efficiency of voltage regulator	6	0.6	New	Power draw	Saturation
	Hard Drive: Reduce size of hard disk drive from 3.5" to 2.5"	3	0.4	New	Power draw	Saturation
Other Opportunities	Shift new standard desktop PC purchases from standard/tower products to mini/compact products	11	1.3	New	Other	Adoption
	Increase penetration of PC power management on new unit sales	0	0	New	Duty cycle	Adoption
	Increase number of qualified models by working with "consumer marketing organizations" at top brands	Not quantified	—	New	Power draw	Saturation
	Increase number of qualified models by working with ODMs	Not quantified	—	New	Power draw	Saturation

Continued

CONFIDENCE LEVEL	OPPORTUNITY	TOTAL ACHIEVABLE POTENTIAL SAVINGS 2012-2014 GWh	aMW	APPLIES TO PRODUCTS THAT ARE…	REDUCES ACTIVE MODE…	OPPORTUNITY TYPE
	GAME CONSOLES					
High Confidence Opportunity	**Game Console APD**: Increase the penetration of consoles shipped with auto-power-down (APD) enabled by default (set to 1 hour)	17	2.0	New	Duty cycle	Saturation
Other Opportunities	Educate console owners to turn on APD	5	0.6	Existing	Duty cycle	Saturation
	Educate console owners to turn consoles off when not in use	1.4	0.2	Existing	Duty cycle	Saturation
	Work in collaboration with other efficiency organizations like NRDC to encourage manufacturers to make next-generation consoles more efficient	Not quantified	—	New	Other	Introduction
	STREAMING MEDIA					
High Confidence Opportunity	**Eliminate Multi-Room DVRs:** Increase the replacement of multi-room DVR set-top boxes with a thin client set-top box	7	0.8	New	Power draw	Adoption
Other Opportunity	Increase the number of pay-TV subscribers that "cut the cord" and thus no longer require a set-top box (or multiple boxes)	12	1.3	Existing	Other	Adoption

Table 4: Opportunities and Implementation Strategies

PRODUCT TYPE	OPPORTUNITY	DIRECT INSTALL	EDUCATION	INCENTIVE PAYMENT		
				Upstream	Midstream	End-User
TVs						
High Confidence Opportunities	**Occupancy Sensing Technology**: Increase penetration of occupancy sensing technology			X	X	
	Optimize Brightness: Optimize brightness settings on existing TVs using direct install approach	X	X			X
	Efficiency Tips: Add energy efficiency tips/options to menu			X		
	ES v6 Test Procedure: Ensure final ENERGY STAR v6 test procedure incorporates improved ABC test procedure	*Participate in ENERGY STAR specification development*				
	Early Retirement: Increase retirement of larger, inefficient TVs when user purchases a new TV meeting the highest energy efficiency standards	X				X
	ABC: Increase penetration of automatic brightness control (ABC)			X	X	
	TV APD: Increase penetration of auto-power-down (APD) capability enabled by default			X	X	
Other Opportunities	Increase penetration of LED backlighting on entry-level LCD models			X	X	X
	Increase penetration of digital CMOS tuners			X	X	
	Increase number of cable TV subscribers who use the TV's download acquisition mode (DAM) in place of a cable set-top box	X	X			X

Continued

research/into/action℠

PRODUCT TYPE	OPPORTUNITY	DIRECT INSTALL	EDUCATION	INCENTIVE PAYMENT		
				Upstream	Midstream	End-User
	TVs (CONT.)					
Other Opportunities (cont.)	Increase penetration of TVs with forced menu functionality (FMF) AND standard/home mode brightness as default			X	X	
	Increase penetration of 2D dimming in LCD TVs			X	X	
	Increase penetration of TVs >50" that meet ENERGY STAR v5.3			X		
	Engage with manufacturers to promote NEEA's energy efficiency goals			X		
	Include RVU software in new TVs			X		
	Improve efficiency of TV power supply			X	X	
	Improve luminance efficiency for plasma TVs			X		
	Increase penetration of dim room viewing conditions	X	X			X
	Increase penetration of OLED TVs			X	X	X
	Field sequential color			X		

Continued

PRODUCT TYPE	OPPORTUNITY	DIRECT INSTALL	EDUCATION	INCENTIVE PAYMENT		
				Upstream	Midstream	End-User
DESKTOP PCs						
High Confidence Opportunities	**Installed Base Power Management**: Increase penetration of power management on residential installed base	X	X			X
	Power Supply: Improve power supply efficiency			X	X	
	Voltage Regulator: Improve efficiency of voltage regulator			X	X	
	Hard Drive: Reduce size of hard disk drive from 3.5" to 2.5"			X	X	
Other Opportunities	Shift new standard desktop PC purchases from standard/tower products to mini/compact products		X	X	X	X
	Increase penetration of PC power management on new unit sales			X	X	
	Increase number of qualified models by working with "consumer marketing organizations" at top brands	*Strategic approach targeting desktop PC brands*				
	Increase number of qualified models by working with ODMs	*Strategic approach targeting desktop PC ODMs*				
GAME CONSOLES						
Game Consoles	**Game Console APD**: Increase the penetration of consoles shipped with auto-power-down (APD) enabled by default (set to 1 hour)			X		
	Educate console owners to turn consoles off when not in use	X	X			
	Educate console owners to turn on APD	X	X			X
	Work in collaboration with other efficiency organizations like NRDC to encourage manufacturers to make next-generation consoles more efficient	*Strategic approach targeting game console manufacturers*				

research/into/action℠

PRODUCT TYPE	OPPORTUNITY	DIRECT INSTALL	EDUCATION	INCENTIVE PAYMENT		
				Upstream	Midstream	End-User
	STREAMING MEDIA					
High Confidence Opportunity	**Eliminate Multi-Room DVRs:** Increase the replacement of multi-room DVR set-top boxes with a thin client set-top box		X		X	X
Other Opportunity	Increase the number of pay-TV subscribers that "cut the cord" and thus no longer require a set-top box (or multiple boxes)		X			X
TOTAL NUMBER OF OPPORTUNITIES		7	9	21	15	11

3 TELEVISIONS

This chapter leads with descriptions of the seven high confidence TV opportunities. The market characteristics follow and are important reading for program administrators and designers. The contents are more nuanced than the opportunity descriptions below and they provide context, and hopefully an understanding, of the markets in which programs seek to intervene.

HIGH CONFIDENCE TV OPPORTUNITIES

Occupancy Sensing Technology: Increase penetration of occupancy sensing technology

Occupancy sensing technology enables a TV to distinguish the presence or absence of viewers, typically by detecting motion and/or heat, or by use of a camera. Occupancy sensing technology is a relatively new TV feature and one with great potential to decrease energy consumption by reducing the amount of time a TV spends in *on* mode when not being viewed. A TV with occupancy sensing technology can, after a brief time delay, turn off the display (leaving the audio on) and, after a longer delay, turn off the entire device. Greater adoption of occupancy sensing technology, shipped *on* by default and with a time delay of one-hour or less, could result in savings of **48 GWh** (5.4 aMW) in NEEA territory in 2012-2014.

Sony was the first TV brand to debut occupancy sensing technology, in 2009, and is still the only brand with the feature. The company's *presence sensor* detects motion *and* heat to identify when a viewer is present. Their *intelligent presence sensor* incorporates a camera with face detection capability to show when viewers are watching the TV. Currently, eight Sony TV product lines ship with presence sensors or intelligent presence sensors.[2]

Energy Savings Calculation and Key Assumptions

Table 5 shows the calculation method for this opportunity.

---

[2] Gregg Tarr. April 18, 2011. "Sony ships 2011 Bravia LCD line." *TWICE*. Retrieved from *http://www.twice.com/article/466945-Sony_Ships_2011_Bravia_LCD_Line.php*. Each line can have multiple models, for example, with different screen sizes. As of June 2011, Sony has two types of occupancy sensors, the Intelligent Presence Sensor and the Presence Sensor. The former uses a camera and has greater sensing capabilities, for example, to detect facial expressions and tell when users are actively watching TV, as opposed to talking to someone in the room or sleeping. The latter uses a motion sensor and can only detect when a user leaves room. Both sensors ship *off* by default.

Table 5: Occupancy Sensing Technology Opportunity Calculation

INPUT	2012	2013	2014	NOTES / SOURCES
Percent of new unit sales currently employing measure	0%	0%	0%	Estimate
Percent of new unit sales that cannot employ measure	19%	17%	16%	50% of TVs under 32" (small, entry-level)
Technical Opportunity Penetration Potential (TOPP): percent of units sold	**81%**	**83%**	**84%**	*Calculation:* 100% – (Percent of new units currently employing) – (Percent of new units that cannot employ)
Technical Opportunity Penetration Potential (TOPP): number of units sold	**1,327,567**	**1,387,560**	**1,444,335**	*Calculation:* (TOPP percent) * (Projected annual unit sales in NEEA territory)
Market share of 7 top brands	79%	80%	81%	
Achievable Opportunity Penetration Potential (AOPP): percent of units sold	**64%**	**66%**	**68%**	*Calculation:* (TOPP percent) * (Market share of 7 top brands)
Achievable Opportunity Penetration Potential (AOPP): units	**1,048,778**	**1,110,048**	**1,169,911**	*Calculation:* (AOPP percent) * (Projected annual unit sales in NEEA territory)
TV duty cycle (hours/month)	168	171	175	Constant
Default auto-power-down time (hours)	1	1	1	Estimate
Time TV is on w/o a viewer (hours/month)	60	60	60	Estimate
Percent of time TV is on w/o a viewer >1 hour	25%	25%	25%	Estimate
Maximum occupancy sensor duty-cycle savings (hours/month)	15	15	15	*Calculation:* (Time TV is on w/o a viewer) * (Percent of time TV is on >1 hour w/o a viewer)
Power reduction delta between *On* and *No Visual*	50%	50%	50%	Estimate
Given TV is on w/o a viewer, time spent on 30-60 min (hours/month)	5	5	5	Estimate
Power reduction delta between *On* and *Sleep*	100%	100%	100%	Estimate, assumes on w/o idle displays, black screen, and APD in *Standby*
Maximum occupancy sensor APD savings	10%	10%	10%	*Calculation:* (Duty cycle savings) / (Total duty cycle) * (Power reduction delta)
Persistence of measure over 3 years	90%	90%	90%	Estimate
Average annual unit energy consumption (UEC) savings per TV (kWh/year)	16	15	13	*Calculation:* (Maximum occupancy sensor UEC savings) * (Annual unit sales UEC)
Annual Achievable Savings (GWh/yr)	**16**	**16**	**15**	*Calculation:* (AOPP number) * (Average annual UEC savings per TV) / 1,000,000
TOTAL Achievable Savings: 2012-2014		**48 GWh**		

The key assumptions for this calculation are:

➡ **Duty cycle savings**. We estimate motion sensors have the potential to reduce TV duty cycle by 15 hours per month. This is based on the assumption that TVs are on without active viewers about one-third of the time (60 hours out of a total *on* mode duty cycle of 168 hours per month) and that one-fourth of this time TVs are on longer than one hour. However, there are no studies documenting TV viewing habits in sufficient detail to provide empirical support for these estimates. Higher on-without-viewer hours will increase savings and lower hours will decrease them.

➡ **Persistence of the measure**. Studies of all types have documented that people "go with the flow" and rarely change the default settings with which they are presented. We estimate 90% of TV occupancy-sensing features remain on when shipped *on* by default. Poor functionality is likely to decrease savings by increasing users' desire to disable the feature (for example, sensors that turn the TV off when motionless viewers are watching a movie).

➡ **Optimum functionality is assumed**. This calculation assumes the sensor turns off the panel when no viewers are present. If the sensor does not function correctly, savings will be reduced, for example, by failing to turn off when no viewers are present because non-human movement is detected.

➡ **Achievable opportunity penetration potential (AOPP)**. The opportunity calculation assumes the program can affect all TVs sold by the top seven brands that could potentially employ the measure. If the program succeeds in working with fewer brands, or affecting only a fraction of total models, projected savings will decrease.

Key Program Design Considerations

➡ **The program may be more effective at convincing brands to incorporate the measure if it coordinates a nation-wide effort**. It seems unlikely that brands will be willing to alter product designs or feature sets on TVs sold only into some regions of the U.S.

➡ **Most brands do not yet make a product with the measure**. This opportunity is premised on the increased penetration of this measure. This is believed to be feasible in the 2012-2014 timeframe because one brand (Sony) already incorporates the measure, the technology is available, and it is not believed that major investment in R&D is required.

➡ **An important goal of any program design should be to increase adoption of the measure by manufacturers**. Because very few products currently employ the measure, program design should include activities to stimulate the incorporation of the measure by additional manufacturers and into more product models. This could be done through incentives paid directly to the manufacturer or by using other approaches to stimulate qualified product sales.

➡ **Occupancy-sensing technology must be proven to function correctly in order to produce the projected energy savings**. This could require independent testing and verification, and there is not yet a recognized test procedure for this feature.

➡ **Programs must stay apprised of market changes to avoid incenting free-riders**. As with other new features, it is likely that most brands are working to develop occupancy-sensing technology. Programs should assess a brand's willingness and actions already underway before paying incentives to manufacturers. If incentives are provided to retailers for products including the measure, care should be taken to ensure incentives are provided based on *lift*, or the increase in sales of the measure over a baseline (rather than on all sales of the measure).

Barriers

➡ **Programs may need to be national in scope** to convince TV brands to incorporate the measure.

➡ **TV brands control their product feature sets**. The program will need to work closely with these brands to convince them to incorporate the measure.

➡ **The measure is not widely available.** Only one manufacturer has the measure and only in eight of their product models.

➡ **Nothing is known about whether other brands will incorporate the measure in the near future.**

➡ **The savings estimate is not based on empirical data.**

➡ **There are no data on the incremental cost of the measure**.

➡ **TV feature sets change quickly and with every new product model**. As a result, programs will need resources and a plan for staying "ahead of the curve" to ensure they are not incentivizing free-riders.

Leverage Points

➡ **Top TV brands.** Seven brands account for nearly 80% of all flat panel TVs sold in the U.S. The top brand, Samsung, accounts for nearly 20% of the market. By targeting the top brands, programs can affect a large share of units sold. In addition, brands control feature selection and the incremental costs tend to be lower at this point in the supply chain.

➡ **Retailers' private label TVs** may be another effective target, as the retailer maintains much control over the design of these products. Vestel, the OEM with the second largest market share (17.2%), primarily manufactures private label products and could be a good

place to start in order to identify retail contacts and to assess the incremental cost and feasibility of the measure.

➡ **Sensor manufacturers**. A program could presumably target sensor manufacturers to reduce the incremental cost of the components required for occupancy-sensing functionality. We were unable to obtain component level detail for Sony presence sensors, but one of the leading manufacturers of such components is TAOS (Texas Advanced Optoelectronic Solutions).

➡ **Retailers**. A retail program similar to the 2009-2011 BCE program could be used to increase penetration of TVs with the measure, provided evaluation issues can be overcome.

➡ **End-user** education about the added benefits of a qualified product has the potential to increase sales, and could be combined with other messages and/or programs.

Other Implementation Options

➡ **Educate buyers and owners of TVs already employing the measure to keep it on**. To the best of our knowledge, TVs currently employing occupancy sensing technology (eight Sony models) ship with it on by default. Energy savings could result from educating purchasers of the qualified devices, and current owners, about the benefits of keeping the feature on and using the shortest possible delay time. One way to implement this is to include a feature on the device menu that indicates (in numbers, charts, or arrows) how changes to settings affect energy consumption (see the *Efficiency Tips* opportunity, below)

Optimize Brightness: Optimize brightness settings on existing TVs using a direct install approach

A recent study estimated that all TVs were shipped in *bright* or *retail* mode prior to November 2008, and that 90% of TVs remain in this mode.[3] This level of brightness is suboptimal for most home viewing conditions (it's too bright) and uses more energy than a dimmer setting. Adjusting TV brightness can be as simple as switching to *standard* or *home* mode, if the TV has these preset options, or may require more sophisticated calibration. In either case, optimizing TV brightness settings (i.e., reducing brightness) will likely improve the viewer's experience in addition to reducing energy consumption. Optimizing brightness through a direct install approach, in which a service provider manually adjusts settings while in the user's home, has the potential to save **42 GWh** (4.8 aMW) in NEEA territory in 2012-2014.

---

[3]   Kurt W. Roth and Bryan Urban. October 2009. *Assessment of the Energy Savings Potential of policies and Measures to Reduce Television Energy Consumption: Final Report to the Consumer Electronics Association.* Fraunhofer Center for Sustainable Energy Systems..

Energy Savings Calculation and Key Assumptions

Table 6 shows the calculation method for this opportunity.

Table 6: Optimize Brightness Opportunity Calculation

INPUT	2012	2013	2014	NOTES / SOURCES
Percent of TV-installed base currently employing measure	38%	50%	60%	Estimate, based on Roth and Urban 2009 estimate of 90% IB older than 2008
Percent of TV-installed base that cannot employ measure	0%	0%	0%	Estimate
Technical Opportunity Penetration Potential (TOPP): percent of TVs	**62%**	**50%**	**40%**	*Calculation:* 100% – (Percent of installed base currently employing) – (Percent of installed base that cannot employ)
Technical Opportunity Penetration Potential (TOPP): number of TVs	**8,507,630**	**7,026,284**	**5,710,082**	*Calculation:* (TOPP percent) * (Installed base in NEEA territory)
Technical Opportunity Penetration Potential (TOPP): number of TVs per household	**1.62**	**1.33**	**1.07**	*Calculation:* (TOPP number) / (number of NEEA households)
Percent of U.S. households with pay-TV	83%	83%	83%	Roth and Urban 2009
Percent of pay-TV households visited annually by service providers	15%	15%	15%	Roth and Urban 2009
Percent of households willing to change brightness	50%	50%	50%	Roth and Urban 2009
Persistence of measure over 3 years	90%	90%	90%	Estimate
Achievable Opportunity Penetration Potential (AOPP): percent of households	**6%**	**6%**	**6%**	*Calculation:* (Percent of households with pay-TV) * (Percent visited annually) * (Percent willing to change) * Persistence
Achievable Opportunity Penetration Potential (AOPP): number of households	**293,676**	**296,613**	**299,579**	*Calculation:* (AOPP percent) * (Number of NEEA households)
Percent unit energy consumption (UEC) savings from optimizing brightness	13.5%	13.5%	13.5%	Roth and Urban 2009
Achievable Opportunity Penetration Potential (AOPP): number of TVs	**476,640**	**393,648**	**319,907**	*Calculation:* (AOPP number of households) * (AOPP number of TVs per household)
Average UEC savings per TV (kWh/year)	36	36	35	*Calculation:* (Installed base UEC) * (Percent savings)
Annual Achievable Savings (GWh/yr)	**17**	**14**	**11**	*Calculation:* ((AOPP number) * (Average UEC savings per TV)) / 1,000,000
TOTAL Achievable Savings: 2012-2014		**42 GWh**		

The key assumptions for this calculation are:

➡ **Achievable opportunity penetration potential (AOPP).** The number of reachable households is a key determinant of projected energy savings. The more households a program reaches, the higher the savings. For this opportunity, we estimated penetration using the percent of pay-TV subscribers visited annually by a pay-TV service provider – both because this is a reasonable implementation approach and because the number is known. If the measure is implemented differently (for example, in association with one or many stand-alone programs, or through a trade ally approach), energy savings projections should be adjusted accordingly.

➡ **Percent of households willing to change brightness.** We estimate 50% of users will be willing to change their TV's brightness. We base our estimate on a recent study that found PC users had "a high level of willingness" to implement aggressive power management. However, because brightness settings affect picture quality (where power management does not affect PC functionality), it is possible the percent of willingness could vary. We disagree with another recent study that suggested very few people would be willing to adjust brightness.[4] This study did not offer a reason for its pessimistic outlook and we believe the attendant non-energy benefits of optimizing brightness (improved picture quality) will be sufficient motivation for viewers.

Key Program Design Considerations

➡ **There are at least two approaches to optimizing brightness: simple and complex.** In the simple approach to optimizing brightness, the implementer puts the TV into the appropriate preset mode for home viewing, usually called *home*, *standard*, or some variant of *eco* or *energy saving*. In the complex approach, the implementer is typically a trained professional who adjusts multiple settings (including contrast, brightness, and color), sometimes using calibration equipment. It is unclear whether the two approaches (simple vs. complex) will result in different per-unit energy savings.

➡ **The selected approach (simple vs. complex) determines implementation and program design options**. The simple approach to optimizing brightness will likely require minimal training or specialized knowledge, and could be conducted by a variety of in-home professionals. The complex approach will require specialized training and equipment for implementers.

➡ **All in-home implementers must be trained to quickly and accurately adjust settings on a wide variety of TV models.** There are thousands of TV models in the installed base. Implementers must be taught to navigate these menus quickly. Implementers must

---

[4]   Ibid.

also be taught to consider both energy efficiency *and* picture quality when adjusting brightness. Merely reducing brightness to the lowest possible level is not sufficient. If poor picture quality results, viewers will be frustrated with the program and revert to their previous settings, reducing measure persistence and negating potential energy savings.

➡ **Educate viewers about the benefits of dim-room viewing conditions and modify room brightness if necessary.** TV brightness is directly related to the viewing conditions in the room. A brighter room requires a brighter TV and thus greater energy use. Picture quality and energy efficiency are best in a dim room. Implementers should educate viewers and assist them in obtaining optimum room brightness before adjusting TV settings.

➡ **In-home implementers must also be trained to explain the benefits of brightness optimization to the viewer**. Implementers will need to sell the measure's benefits, beyond just its energy-saving potential. Programs can borrow strategies from TV calibration professionals, like before-and-after pictures demonstrating improvements to display quality. The ability of the implementer to "sell" the measure has a direct impact on the program's energy savings.

➡ **Collect information on the duty cycle of the TV, and pre- and post-measure energy use**. The program will improve the accuracy of the impact evaluation if it collects data from all or a sample of implemented measures. This should include the TV duty cycle (the number of hours the TV spends in *on*, *sleep*, and *off* modes) and energy consumption pre- and post-measure.

➡ **Collect participant contact information (email and phone number) and consider conducting a follow-up persistence study**. The persistence of measures that are easy to change is uncertain. This is particularly true of measures like brightness control, in which TV settings can be easily modified by the user. Programs should thus consider a follow-up participant survey to improve the accuracy of the impact evaluation.

Barriers

➡ **Viewers may be unwilling to modify their TV settings**. Education on the benefits of the measure will likely overcome this barrier for some (if not most) viewers.

➡ **Implementers may have difficulty adjusting TV settings**. The sheer number of TV models will likely make it difficult for implementers to be able to quickly adjust the settings of every TV they encounter. Using experienced professionals to implement the program and training them well will help reduce this barrier.

Leverage Points

➡ **Simple brightness optimization (using a preset brightness mode) could be implemented in combination with existing direct install or home energy audit**

programs, or any efficiency program that sends a program representative into a customer's home.

➡ **Simple brightness optimization could also be implemented by any trade ally that visits a customer's home**. For example, trade allies who are already participating in efficiency programs (i.e., HVAC installers) or trade allies newly engaged for this effort (i.e., pay-TV service providers).

➡ **Complex brightness optimization is likely best implemented by specially trained professionals**. A few companies and many independent consultants offer in-home TV calibration services. We identified three companies serving NEEA territory: Best Buy's Geek Squad, Service Valet, and Firedog.[5] Imaging Science Foundation (ISF), a private company, is the leading trainer and certifier of independent calibration professionals. Calibration professionals could be leveraged in several ways:

> Calibration professionals could be trained to optimize energy efficiency when performing their job, including optimizing brightness and turning on all efficiency features.

> The organizations that offer calibration services, or highly qualified independent consultants, could be tasked with training program implementers.

> The calibration professionals could be contracted to implement the program.

Other Implementation Options

➡ **Add a feature to the TV menu alerting the user to the energy implications of changing brightness settings**. A feature on the device menu could indicate (in numbers, charts, or arrows) how changes to settings affect energy consumption.

➡ **Simple brightness optimization instructions could also be included with other program marketing and/or point of sale materials** (rather than or addition to through a direct install approach). Typical TV viewers could be instructed to change their TV's brightness from *bright/retail* to *home/standard* mode. Instructions could be provided by home energy auditors, at the point-of-sale for other electronics products, or with other program materials.

➡ **Efficiency tips and brightness optimization could be added to end-user calibration tools**. Numerous calibration tools are available to TV viewers. Efficiency tips could be added to these tools. The ease of doing so will vary by tool type and be easiest/cheapest

---

5   Best Buy charges $199.99: *http://www.bestbuy.com/site/Geek+Squad&%23174%3B+-+TV+Calibration/8586559.p?id=1190677437119&skuId=8586559*. Service valet charges $204.99: *http://www.amazon.com/Service-Valet-Premium-TV-Calibration/dp/B004LS886U*. Firedog charges $269.99: *https://www.firedog.com/calibrate-my-tv*.

for online instructional tools, and more costly for hardware and software tools. Currently available calibration tools include:

How to articles on leading technology websites like *CNET* and *PCWorld* that provide step-by-step instructions. Several calibration articles were published in 2007-8. Programs could provide content for updated articles that include energy efficiency considerations.

How-to videos on *YouTube*

Calibration hardware, which costs around $200 and includes the Datacolor *SypderTV* [6]

Calibration software, which costs $25 to $100 and includes DVDs and downloadable applications:

- ISF HDTV *Calibration Wizard*[7]
- THX *Optimizer*[8]
- Digital Video Essentials *HD Basics*[9]
- *DisplayMate*[10]

Efficiency Tips: Add energy efficiency tips/options to menu

User behavior affects TV energy consumption. Even today's best-in-class TVs will not meet expectations if users do not utilize efficiency features like motion sensors and the automatic brightness control, or watch their TV in a bright room. Although some TV menus have an *ENERGY STAR* setting option, most viewers are likely unaware of how their settings affect energy consumption. Efficiency tips in the TV menu could be textual and/or visual and could include providing users with instructions to optimize their TV's energy performance and indicating (in numbers, charts, or arrows) how changes to settings affect energy consumption. Adding efficiency tips to TV menus has the potential to save **28 GWh** (3.2 aMW) in NEEA territory in 2012-2014.

6   See *http://www.topmic.com/270-0110.html.*

7   See *http://www.imagingscience.com/index.php.*

8   See *http://www.thx.com/consumer/home-entertainment/home-theater/thx-optimizer/thx-optimizer-overview/.* The TXH Optimizer is included on many DVD and Blu-ray discs and requires the viewer to purchase special glasses for optimal calibration (cost: $1.99).

9   See *http://www.jkpi.net/DVE_HDBasics.php.*

10 See *http://www.displaymate.com/.*

Energy Savings Calculation and Key Assumptions

Table 7 shows the calculation method for this opportunity.

Table 7: Efficiency Tips Opportunity Calculation

INPUT	2012	2013	2014	NOTES / SOURCES
Percent of new unit sales currently employing measure	0%	0%	0%	
Percent of new unit sales that cannot employ measure	0%	0%	0%	
Technical Opportunity Penetration Potential (TOPP): percent of units	**100%**	**100%**	**100%**	*Calculation:* 100% – (Percent of new units currently employing) – (Percent of new units that cannot employ)
Technical Opportunity Penetration Potential (TOPP): number of units	**1,632,831**	**1,670,904**	**1,709,936**	*Calculation:* (TOPP percent) * (Projected annual unit sales in NEEA territory)
Market share of 7 top TV brands	79%	80%	81%	Constant
Percent of people who implement efficiency tips	50%	50%	50%	Estimated, based on Energy Center of Wisconsin 2010.
Achievable Opportunity Penetration Potential (AOPP): percent of units	**40%**	**40%**	**41%**	*Calculation:* (TOPP percent) * (Market share of 7 top brands)
Achievable Opportunity Penetration Potential (AOPP): number of units	**644,968**	**668,362**	**692,524**	*Calculation:* (AOPP percent) * (Project annual unit sales in NEEA territory)
Percent unit energy consumption (UEC) savings from implementing efficiency tips	10%	10%	10%	Estimate, based on estimated savings from dim room viewing conditions
Average UEC savings per TV (kWh/yr)	15	14	12	*Calculation:* (Average UEC) * (Percent UEC savings)
Annual Achievable Savings (GWh/yr)	**10**	**10**	**8**	*Calculation:* ((AOPP number) * (Average annual UEC savings per TV)) / 1,000,000
TOTAL Achievable Savings: 2012-2014		**28 GWh**		

The key assumptions for this calculation are:

➡ **Percent of people who implement efficiency tips**. We estimate 50% of users will implement the efficiency tips. We base our estimate on the Energy Center of Wisconsin (2010) study that found PC users had "a high level of willingness" to implement aggressive power management.

➡ **Percent of unit energy consumption (UEC) savings from implementing efficiency tips**. We estimate 10% UEC savings as a conservative figure, based on an estimated 20% savings from watching a TV with the automatic brightness control in a *dim* setting.

However actual savings are difficult to determine. The measure combines technical and behavioral elements and will vary by duty cycle.

➡ **Estimated reachable TVs**. The opportunity calculation assumes the program can affect all TVs sold by the top seven brands that could potentially employ the measure. If the program succeeds in working with fewer brands or affecting only a fraction of total models, projected savings will decrease.

Key Program Design Considerations

➡ **The program may be more effective at convincing brands to add efficiency tips if it coordinates a nation-wide effort**. It seems unlikely that brands will be willing to put custom menus on TVs sold only into some regions of the U.S.

➡ **Efficiency tips must be clear and actionable in order to increase user implementation**.

➡ **Efficiency tips should appear as frequently as possible and as close as possible to the relevant menu items in order to increase implementation**. For example, tips about brightness levels and dim-room viewing should appear every time the user adjusts brightness and, if possible, on the menu screen where brightness is adjusted.

➡ **Efficiency tips should be customized to each model's features**. For example, TVs with motion sensors should include a tip instructing users how to turn this feature on and to select the shortest time delay.

➡ **Programs may want to consider test-marketing the efficiency tips to ensure they use the most effective messages**. The Energy Center of Wisconsin study (2010) is one place to start, as this study tested a variety of power management messages and identified those that worked well.

➡ **Programs may want to consider a co-branded marketing campaign to increase awareness of the tips** as a new TV feature and to increase implementation.

➡ **Energy savings potential should be revisited during program design**, based on updated UEC estimates and changes to default TV settings. Potential savings for this measure are based on the estimated UEC of TVs sold in 2012-2014, a figure that may change as these dates draw near. In addition, changes to default TV settings (i.e., whether a TV ships with efficiency features enabled by default) will affect potential savings.

Barriers

➡ **Programs may need to be national in scope to convince TV brands to implement efficiency tips on their product menus**.

➡ **TV brands control the content and appearance of their product menus**. The program will need to work closely with these brands to both convince them to incorporate efficiency tips, and to have a say in their content.

➡ **Efficiency tips will need to be updated as new features are introduced**. New product features may require new tips to encourage users to utilize them. A program will need to stay in close touch with manufacturers to keep apprised of and respond to technical developments.

Leverage Points

➡ **Top TV brands**. Seven brands account for nearly 80% of all flat panel TVs sold in the U.S. The top brand, Samsung, accounts for nearly 20% of the market. By targeting the top brands, programs can affect a large share of units sold.

➡ **Retailers' private label TVs** may be another effective target, as the retailer maintains much control over the design of these products. Vestel, the OEM with the second largest market share (17.2%), primarily manufactures private label products and could be a good place to start, in order to identify retail contacts and assess the incremental cost and feasibility of the measure.

➡ **Retailers**. A retail program similar to the 2009-2011 BCE program could be used to increase penetration of TVs with the measure, provided evaluation issues can be overcome.

➡ **CNET and other consumer electronics websites and publications** could be effective partners in this effort, helping to develop the tips, and co-brand and co-market them.

Other Implementation Options

➡ **Efficiency tips could also be included with other program marketing and/or point-of-sale materials** (rather than, or addition to, in the TV menu). For example, home energy auditors could distribute efficiency tips instructing TV viewers to turn on motion sensors or the automatic brightness control on their existing devices, and to watch TV in a dim room.

ES v6 Test Procedure: Ensure the final ENERGY STAR v6 test procedure incorporates the improved ABC test procedure

Automatic brightness control (ABC) is a TV feature that automatically adjusts the display luminance according to the light it detects in the room. Properly functioning ABC, combined with dim-room viewing conditions, has the potential to reduce TV energy consumption by up to 20%. The current ENERGY STAR test procedure for TVs (version 5.3) "allows televisions that ship with ABC enabled by default to test power use in a dark room condition (0 lux) and a bright room condition (300 lux) and then take a 55/45 weighted average of the two and report that

power value instead of the one obtained in home default mode."[11] In order to report a lower power value, some TV manufacturers program TVs to reduce brightness below a satisfactory viewing level at 0 lux, and dramatically boost picture brightness at 10-25 lux. This is likely not perceived by the consumer because it is extremely rare for a TV to be in a 0 lux setting.

As of June 30, 2011, the draft version of the new ENERGY STAR test procedure (version 6) incorporates changes that close this loophole by specifying devices with ABC enabled by default be tested at specific ambient light levels. Ensuring that the more stringent ABC test procedure is included in the final ENERGY STAR version 6 specification has the potential to save **17.5 GWh** (2.0 aMW) in NEEA territory in 2012-2014.

Energy Savings Calculation

Table 8 shows the calculation method for this opportunity.

Table 8: ES v6 Test Procedure Opportunity Calculation

INPUT	2012	2013	2014	NOTES / SOURCES
Percent of new unit sales currently employing measure (effective ABC)	30%	30%	30%	Estimate based on lab test from *efficientproducts.org*
Percent of new unit sales that cannot employ measure	19%	17%	16%	Half of TVs under 32" (small, entry-level)
Technical Opportunity Penetration Potential (TOPP): percent of units	**51%**	**53%**	**54%**	*Calculation:* 100% – (Percent of new units currently employing) – (Percent of new units that cannot employ)
Technical Opportunity Penetration Potential (TOPP): number of units	**837,718**	**886,289**	**931,354**	*Calculation:* (TOPP percent) * (Projected annual unit sales in NEEA territory)
Percent ENERGY STAR penetration	55%	55%	55%	NEEA assumption
Market share of ENERGY STAR partners	97%	97%	97%	Constant
Achievable Opportunity Penetration Potential (AOPP): percent of units	**27%**	**28%**	**29%**	*Calculation:* (TOPP percent) * (Percent of ENERGY STAR penetration) * (Percent market share of ENERGY STAR partner)
Achievable Opportunity Penetration Potential (AOPP): number of units	**446,923**	**472,835**	**496,877**	*Calculation:* (AOPP percent) * (Projected annual unit sales in NEEA territory)
Effective ABC savings over current ABC	9%	9%	9%	Calculation from *efficientproducts.org sample*

Continued

---

[11]   Ecos Consulting. 2010. *Assessment of Options for Improving Energy Efficiency Test Procedures for Displays*. Prepared for ENERGY STAR, Natural Resources Canada, and NYSERDA.

INPUT	2012	2013	2014	NOTES / SOURCES
Average annual unit energy consumption (UEC) savings per TV (kWh/yr)	14	13	11	*Calculation:* (Average UEC) – (Best-in-class UEC)
Annual Achievable Savings (GWh/yr)	**6**	**6**	**5**	*Calculation:* ((AOPP number) * (Average annual UEC savings per TV)) / 1,000,000
TOTAL Achievable Savings: 2012-2014		**17.5 GWh**		

Key Activity

NEEA should continue to support the revised ABC test procedure in discussions with ENERGY STAR and other partners.

Early Retirement: Incent retirement of larger, inefficient TVs when a user purchases a new TV meeting the highest energy efficiency standards

In the period 2012-2014, only a small percent of the TV installed base in NEEA territory is expected to be large and inefficient TVs – TVs with screen sizes over 32" and manufactured before 2006. Yet these large, inefficient TVs consume about 100 kWh more per year than today's best-in-class models. The early retirement of these TVs, when replaced by a *best-in-class* model, could result in savings of **11.97 GWh** (1.4 aMW) in NEEA territory in 2012-2014.

Energy Savings Calculation and Key Assumptions

Table 9 shows the calculation method for this opportunity. The key assumptions for this calculation are:

➡ **Percent of NEEA households that would be willing to participate in an early retirement program**. We estimate 5% of NEEA households would participate annually. However, we lack data to make an informed estimate. Although there are other examples of early retirement programs for appliances like refrigerators, this opportunity is qualitatively different in that it is premised on an exchange component, in which participants must purchase a best-in-class product in addition to retiring their old TV.

➡ **UEC of the larger, inefficient TVs**. UEC depends on duty cycle. The UEC will likely be accurate for TVs in regular use, but not for those gathering dust in the basement or a less-used secondary TV.

➡ **In basing the penetration rate at the household level, we assume that no NEEA household contains more than one technically reachable unit** (a large, pre-2006 TV).

Table 9: Early TV Retirement Opportunity Calculation

INPUT	2012	2013	2014	NOTES / SOURCES
New installed base: percent of installed base newer than 2006	67%	77%	84%	Estimate
Large installed base: percent of installed base > 32" screen size	62%	66%	70%	Calculation from constant
Technical Opportunity Penetration Potential (TOPP): percent of units	**20%**	**15%**	**11%**	*Calculation:* 100% – (New installed base) * (Large installed base)
Technical Opportunity Penetration Potential (TOPP): number of units	**2,810,357**	**2,168,487**	**1,588,084**	*Calculation:* (TOPP percent) * (Project annual unit sales in NEEA territory)
Households willing to participate (1 TV per HH)	5%	5%	5%	Estimate
Achievable Opportunity Penetration Potential (AOPP): percent of units	**1%**	**1%**	**1%**	*Calculation:* (TOPP percent) * (Households willing to participate)
Achievable Opportunity Penetration Potential (AOPP): number of units	**140,518**	**108,424**	**79,404**	*Calculation:* (AOPP percent) * (Project annual unit sales in NEEA territory)
Average unit energy consumption (UEC) of a TV >32", older than 2006, with 3-hr duty cycle (instead of 5 hrs) (kWh/yr)	113	113	113	Estimated, based on LBNL 1999
Best-in-class UEC (kWh/yr)	81	75	70	*TopTenUSA.org* estimate
Average annual UEC savings per TV (kWh/yr)	32	38	43	*Calculation:* (Average UEC) – (Best-in-class UEC)
Annual Achievable Savings (GWh/yr)	**4**	**4**	**3**	*Calculation:* ((AOPP number) * (Average annual UEC savings per TV)) / 1,000,000
TOTAL Achievable Savings: 2012-2014		**11.97 GWh**		

Key Program Design Considerations

➡ **Retired TVs must be large** in order to produce the projected energy savings. This estimate uses screen sizes >32.

➡ **Replacement TVs must be** *best-in-class* in order to produce the projected energy savings. This estimate uses the top-ranked TVs on *toptenusa.org*.

➡ *Best-in-class* **TVs change constantly and must be continually updated.** A program would need to set a regular and frequent schedule for updating the permissible replacement products. This could be timed to coincide with the *TopTen's* update process.

➡ **Collect information on the duty cycle of the TV prior to retirement.** Energy savings from this measure are based on the duty cycle of the retired TV and this information is

necessary to evaluate program impacts. Because a retired TV may not be the household's primary TV, it may have spent fewer hours in *on* mode than a typical TV prior to retirement, resulting in lower than expected energy savings.

➡ **Retired products should be recycled.** The program will need to coordinate the collection and recycling of retired products. The recycling phase is particularly important when making the lifecycle cost assessment (LCA).

➡ **A program may want to make a LCA before implementing a retirement/ replacement program**. LCA attempts to quantify *cradle-to-cradle* energy and resource costs. These typically include the energy and resources used to manufacture, ship, and operate the product. A program may thus want to confirm that the early retirement of a TV is a net benefit when the LCA is taken into account.

Barriers

➡ **The cost of a *best-in-class* product**, relative to an entry-level product, may deter users from participating in the program.

➡ **TV sales are falling**, so there may be fewer people looking to replace an older TV than in years past.

Leverage Points

➡ **TV buyers may be reached at the point-of-sale** and two TV retailers, Best Buy and Walmart, account for more than 50% of all TV unit sales.

➡ **There is the potential to leverage existing refrigerator recycling programs** to provide the infrastructure for TV recycling and program marketing.

Other Implementation Options

➡ **Incentivize new unit sales of best-in-class TVs**. NEEA's 2009-2011 BCE program incentivized TVs meeting an efficiency criteria a specified percentage above ENERGY STAR. Alternately, a program could incentivize sales of only the ten (or fewer) models in each size category. *TopTenUSA.org* ranks the top ten small (15" to 32"), medium (<32" to <46") and large TVs (<46") currently available to retail consumers in the U.S. Program administrators could use the *TopTen* list to determine qualified products.

ABC: Increase penetration of automatic brightness control (ABC)

Automatic brightness control (ABC) is a TV feature that automatically adjusts the display luminance according to the light it detects in the room. Properly functioning ABC, combined with dim-room viewing conditions, has the potential to reduce TV energy consumption by up to

20%. ABC is already a common feature among ENERGY STAR-qualified TVs, in part because including ABC gives the device an advantage in meeting the specification (even if it's not performing optimally, a loophole ENERGY STAR will likely close in its version 6 specification). Increasing the penetration of ABC among ENERGY STAR-qualified and non-qualified devices has the potential to save **5 GWh** (0.6 aMW) in NEEA territory in 2012-2014.

Energy Savings Calculation and Key Assumptions

Table 10 shows the calculation method for this opportunity.

Table 10: ABC Opportunity Calculation

INPUT	2012	2013	2014	NOTES / SOURCES
Percent of new unit sales currently employing measure	60%	70%	80%	Estimate based on interviews and ENERGY STAR penetration
Percent of new unit sales that cannot employ measure	19%	17%	16%	50% TVs < 32" (small, entry-level)
Technical Opportunity Penetration Potential (TOPP): percent of units	**21%**	**13%**	**4%**	*Calculation:* 100% – (Percent of new units currently employing) – (Percent of new units that cannot employ)
Technical Opportunity Penetration Potential (TOPP): number of units	**347,869**	**217,927**	**76,386**	*Calculation:* (TOPP percent) * (Projected annual unit sales in NEEA territory)
Market share of 7 top TV brands	79%	80%	81%	Constant
Achievable Opportunity Penetration Potential (AOPP): percent of units	**17%**	**10%**	**4%**	*Calculation:* (TOPP percent) * (Market share of 7 top TV brands)
Achievable Opportunity Penetration Potential (AOPP): number of units	**274,816**	**174,342**	**61,873**	*Calculation:* (AOPP percent) * (Projected annual unit sales in NEEA territory)
Dim room viewing savings	20%	20%	20%	Estimate, based on calculations from *Efficientproducts.org*
Delta between best and worst ABC functions	9%	9%	9%	Estimate, based on calculations from *Efficientproducts.org*
Maximum ABC savings (with current ENERGY STAR test procedure)	11%	11%	11%	
Average unit energy consumption (UEC) of new unit sales (not currently employing measure) (kWh/year)	92	87	69	Estimate, based on current ABC penetration in ENERGY STAR qualified models
Average UEC savings per TV (kWh/yr)	10	10	8	*Calculation:* (Average UEC) * (Maximum ABC savings)
Annual Achievable Savings (GWh/yr)	**3**	**2**	**0**	*Calculation:* ((AOPP number) * (Average annual UEC savings per TV)) / 1,000,000
TOTAL Achievable Savings: 2012-2014		**5 GWh**		

The key assumptions for this calculation are:

➡ **Percent of new unit sales currently employing measure**. There are no data on the penetration of ABC. We estimate 60% of all new TVs sold include this feature, based on its high penetration among ENERGY STAR-qualified models and the high penetration of ENERGY STAR among all TVs sold. ABC penetration is inversely related to energy savings potential. If actual penetration is higher, potential savings will be lower because the program will not be able to affect as many units.

➡ **Maximum ABC savings**. Given the loophole in the current ENERGY STAR test procedure, we lowered the potential measure-level savings from ABC to account for the possibility that some TVs with ABC are not performing optimally. If or when ENERGY STAR closes this loophole (expected in version 6), the measure-level energy savings from ABC will rise (at least for ENERGY STAR-qualified units).

➡ **Estimated reachable TVs**. The opportunity calculation assumes the program can affect all TVs sold by the top seven brands that could potentially employ the measure. If the program succeeds in working with fewer brands, or affecting only a fraction of total models, projected savings will decrease.

Key Program Design Considerations

➡ **The program may be more effective at convincing brands to incorporate the measure if it coordinates a nation-wide effort**. It seems unlikely that brands will be willing to alter product designs/feature sets on TVs sold only into some regions of the U.S.

➡ **Programs must engage with the top TV brands to identify the appropriate incentive structure and amount.** This opportunity is premised on an upstream implementation model, in which programs work directly with top brands to increase penetration of ABC. Industry estimates suggest the necessary components for ABC cost manufacturers less than $5 per unit. Programs will need to ascertain what type of incentive brands will require to adjust their product designs for incentives offered in only a limited geographic area.

➡ **This opportunity should be pursued in tandem with the ES v6 Test Procedure.** ABC savings depend on optimal functionality. If a TV does not dim the display in response to low light conditions, savings will be reduced. Changes to the ENERGY STAR test procedure (expected in version 6) will improve the likelihood that ABC functions as expected.

➡ **Programs should educate viewers about the benefits of ABC.** ABC benefits TV viewers by optimizing display brightness based on ambient light conditions.

➡ **Programs should also educate viewers about the benefits of watching TV in a dim room.** ABC savings depend on viewers watching TV in a dim room and thus decreasing the energy required to light the display. TVs with ABC viewed in a bright room will not produce the expected savings.

Barriers

➡ **Programs may need to be national in scope** to convince TV brands to incorporate the measure on a greater number of product models.

➡ **TV brands control product feature sets**. The program will need to work closely with these brands to convince them to incorporate the measure in products that might not otherwise employ it.

Leverage Points

➡ **Top TV brands**. Seven brands account for nearly 80% of all flat panel TVs sold in the U.S. The top brand, Samsung, accounts for nearly 20% of the market. By targeting the top brands, programs can affect a large share of units sold. In addition, brands control feature selection and the incremental costs tend to be lower at this point in the supply chain.

➡ **Retailers' private label TVs** may be another effective target, as the retailer maintains much control over the design of these products. Vestel, the OEM with the second largest market share (17.2%), primarily manufactures private label products and could be a good place to start in order to identify retail contacts, and assess the incremental cost and feasibility of the measure.

TV APD: Increase the penetration of auto-power-down (APD) capability enabled by default

Auto-power-down (APD) is a feature that enables a TV to automatically turn itself off when it is not receiving a signal from another device, like a game console, DVD player, or set-top box. APD is implemented through the HDMI Consumer Electronics Control (CEC). HDMI is a standard interface between audio/video components (and the name of the cable used to connect them) and CEC is a technical protocol that "allows networked devices to communicate with one another."[12]

---

[12] Energy Efficient Strategies. *Standby Power and Low Energy Networks: Issues and Directions*. Report for APP and IEA 4E Standby Annex. September 2010.

APD has the potential to reduce the TV duty cycle by preventing unwatched TVs (those not receiving a signal from an external device) from remaining in *on* mode unnecessarily. There are no data on the penetration of APD among new unit sales, nor is it certain how many hours a typical TV spends in *on* mode without receiving a signal. Given these uncertainties, we estimate greater adoption of APD has the potential to save **5 GWh** (0.6 aMW) in NEEA territory in 2012-2014.

Energy Savings Calculation and Key Assumptions

Table 11 shows the calculation method for this opportunity. The key assumptions for this calculation are:

➡ **Percent of new unit sales currently employing measure**. There are no data on the penetration of APD. We estimate an increase from 50% to 70% between 2012 and 2014. APD penetration is inversely related to energy savings potential. If actual penetration is higher, potential savings will be lower because the program will not be able to affect as many units.

➡ **Inputs to estimated APD savings**. There are very little measured data on how long TVs spend in *on* mode when not receiving a signal. This duty cycle is directly related to energy savings. If the actual time spent in *on* mode while not receiving is higher than our estimate, the energy saving potential of this opportunity will also increase.

➡ **Achievable Opportunity Penetration Potential (AOPP)**. The opportunity calculation assumes the program can affect all TVs sold by the top seven brands that could potentially employ the measure. If the program succeeds in working with fewer brands, or affecting only a fraction of total models, projected savings will decrease.

Table 11: APD Opportunity Calculation

INPUT	2012	2013	2014	NOTES / SOURCES
Percent of new unit sales currently employing measure	50%	60%	70%	Estimate
Percent of new unit sales that cannot employ measure	0%	0%	0%	All new unit sales have HDMI, any TV with HDMI can employ HDMI v1.4 CEC (technical protocol required for APD)
Technical Opportunity Penetration Potential (TOPP): percent of units	**50%**	**40%**	**30%**	*Calculation:* 100% – (Percent of new units currently employing) – (Percent of new units that cannot employ)
Technical Opportunity Penetration Potential (TOPP): number of units	**816,415**	**668,362**	**512,981**	*Calculation:* (TOPP percent) * (Projected annual unit sales in NEEA territory)
Market share of 7 top TV brands	79%	80%	81%	Constant
Achievable Opportunity Penetration Potential (AOPP): percent of units	**40%**	**32%**	**24%**	*Calculation:* (TOPP percent) * (Market share of 7 top TV brands)
Achievable Opportunity Penetration Potential (AOPP): number of units	**644,968**	**534,689**	**415,514**	*Calculation:* (AOPP percent) * (Projected annual unit sales in NEEA territory)
TV duty cycle (hours/month)	168	171	175	Constant
Default auto-power-down time (hours)	1	1	1	Estimate
Time TV is on w/o a signal (hours/month)	15.5	15.5	15.5	Estimate, assumes TV is left on overnight two times per month without a signal
Percent of time TV is on >1 hour without a signal	50%	50%	50%	Estimate
Estimated duty cycle savings from APD (hrs/month)	7.75	7.75	7.75	*Calculation:* (Time TV on w/o a signal) * (Percent time on >1 hour w/o signal)
Power reduction delta between on without signal and standby	50%	50%	50%	Assumes *on* mode w/o idle = black screen, APD puts TV in standby
Estimated APD savings	2.31%	2.31%	2.31%	*Calculation:* (TV duty cycle) * (Estimated duty cycle savings) * (Power reduction delta)
Average unit energy consumption (UEC) savings per TV (kWh/yr)	3.47	3.29	2.8	*Calculation:* (Average UEC) * (Maximum APD savings)
Annual Achievable Savings (GWh/yr)	**2**	**2**	**1**	*Calculation:* ((AOPP number) * (Average annual UEC savings per TV)) / 1,000,000
TOTAL Achievable Savings: 2012-2014		**5 GWh**		

Key Program Design Considerations

➡ **The program may be more effective at convincing brands to incorporate the measure if it coordinates a nation-wide effort**. It seems unlikely that brands will be willing to alter product designs/feature sets on TVs sold only into some regions of the U.S.

➡ **Programs must engage with the top TV brands to identify the appropriate incentive structure and amount.** This opportunity is premised on an upstream implementation model, in which programs work directly with top brands to increase penetration of APD. This study did not determine the cost-per-unit of the components required for APD. Programs will need to ascertain this increment cost and the type of incentive brands will require to adjust their product designs for incentives offered in only a limited geographic area.

➡ **An important goal of any program design should be to increase adoption of the measure by manufacturers.** The majority of top TV brands already include APD in at least one product model. Thus, a program should be designed to increase the number of product models that incorporate it.

Barriers

➡ **Programs may need to be national in scope** to convince TV brands to employ APD on a greater number of product models.

➡ **TV brands control their product feature sets**. The program will need to work closely with these brands to convince them to incorporate APD in products that might not otherwise employ it.

➡ **There are no data on current or projected market penetration of APD.** Devices must include HDMI v1.4 CEC (a technical protocol) as a prerequisite to incorporating APD as a feature. This study did not examine the penetration of HDMI v4.1 CEC, but it is believed that the majority of new devices already include it. A program may want to conduct a baseline study in order to better gauge free-ridership and impacts.

Leverage Points

➡ **Top TV brands**. Seven brands account for nearly 80% of all flat panel TVs sold in the U.S. The top brand, Samsung, accounts for nearly 20% of the market. By targeting the top brands, programs can affect a large share of units sold. In addition, brands control feature selection and the incremental costs tend to be lower at this point in the supply chain.

➡ **Retailers' private label TVs** may be another effective target, as the retailer maintains much control over the design of these products. Vestel, the OEM with the second largest

market share (17.2%), primarily manufactures private label products and could be a good place to start in order to identify retail contacts, and assess the incremental cost and feasibility of the measure.

➡ **End-user education** about the added benefits of a qualified product has the potential to increase sales and could be combined with other messages and/or programs. APD has a clear benefit to users because it allows them to communicate with only one device (typically the TV), rather than each peripheral device individually.

MARKET CHARACTERISTICS

Product Descriptions

Panel Types

Cathode ray tubes (CRT) were the dominant technology for TVs until 2007.[13] However, flat panel TVs have rapidly come to dominate the market (Figure 1). While flat panel TVs constituted fewer than 10% of worldwide TV shipments at the beginning of 2004, by Q2 2010, they made up 82% of TV shipments and 96% of TV revenues.[14] Four of the top five TV retailers no longer carry CRT TVs.[15] Other types of TVs available include front and rear projection, combination TVs, and direct-view receivers; but these types together constituted less than 8% of estimated U.S. TV revenues in 2010.[16]

Because of their dominance in the market, this report focuses on flat panel TVs. Flat panel TVs currently draw on two primary technologies: *liquid crystal display* (LCD) and *plasma*. *Organic light emitting diodes* (OLED) are a notable technology currently in development.

---

[13] Paul Gagnon. 2010. "Global TV Trends in the Flat Panel TV Market." DisplaySearch. Retrieved from *http://www.displaysearch.com/cps/rde/xbcr/displaysearch/Brazil_Latin_Display_2010--gsm.pdf.* Analysts report that by Q4 2007, flat panel TVs had surpassed 50% of worldwide TV unit shipments. Flat panel TVs have accounted for more than 50% of worldwide TV revenues since Q3 2005.

[14] Ibid.

[15] Table 15 lists the top five TV retailers. Visits to each retailer's website in January 2011 found CRT TVs available only from Amazon (the fifth ranked retailer). CRT TVs were only available through third-party sellers.

[16] Consumer Electronics Association [CEA]. 2010. *U.S. Consumer Electronics Sales & Forecasts 2006-2011.* July 2010: 22-25. Consumer Electronics Association: Arlington, VA.

Figure 1: TV Panel Penetration and Average Price, by Type (2006-2011)

Units sold (millions)

LCD 31m
Average sale price (thousands)
$3
$2
OLED $1,640
$1
Plasma $851
LCD $540
All other display types 0.023 - 2.8m
Plasma 3.5m
OLED 0.012m

2006 2007 2008 2009 2010 *estimated* 2011 *projected*
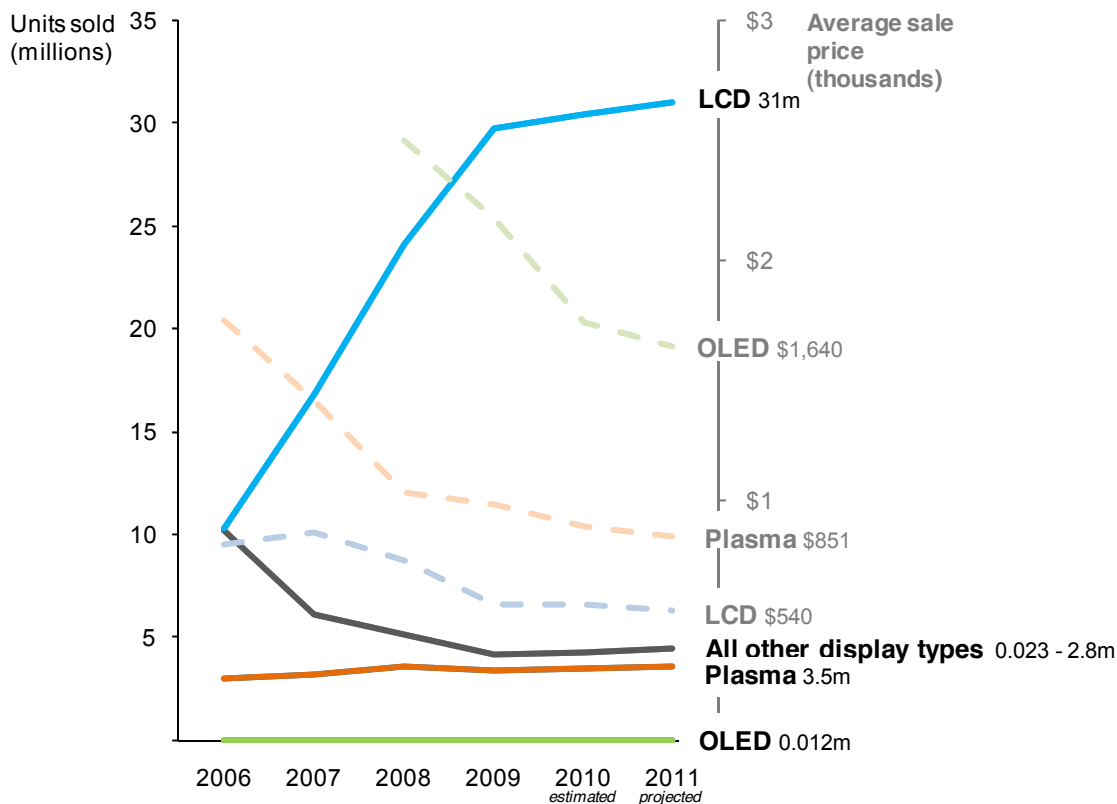
Source: Consumer Electronics Association. 2010. *U.S. Consumer Electronics Sales & Forecasts 2006-2011*. July 2010: 22-25. Consumer Electronics Association: Arlington, VA.

Currently Available Technologies

LCD

In an LCD display, a liquid crystal substance rests between two polarized glass surfaces. Applying an electric current to the liquid crystal causes the shape of the molecules to shift, altering the amount of light that passes through the polarized glass. A thin film transistor (TFT) LCD display (the most common type in televisions) uses switching transistors and capacitors to direct electric currents through the glass surfaces, controlling the amount of light that passes through individual pixels.[17] To produce color, each pixel contains three sub-pixels, which rest behind a red, green, and blue color filter.

---

[17]   *In plane switching,* or IPS, is panel technology that may be used in place of TFT. IPS is growing in popularity, but is still the more expensive of the two.

Unlike CRT or plasma displays, LCD displays are non-emissive. Because the LCD panel does not produce light, LCD displays require backlighting. Most LCD displays utilize cold cathode fluorescent lighting (CCFL) as a backlight.

Backlighting accounts for 70% to 90% of an LCD display's energy consumption. Each element of the LCD panel absorbs some of the light the backlight generates. As a result, researchers estimate that as little as 6% of the light the backlight generates leaves the front of the screen.[18] While LEDs are a more efficient light source than CCFLs, display manufacturers and researchers have identified other ways to reduce the amount of lighting LCD displays require:

➡ **Local dimming** capabilities allow TVs to dim or turn off backlighting behind parts of the screen that are dark. In addition to reducing energy use, this type of dimming increases the contrast ratio of LCD displays, improving picture quality. While displays that use CCFL backlighting typically allow for dimming in only one dimension (for example across the entire top of the screen), full matrix LED backlighting has the potential to allow for more targeted, two-dimensional dimming.

➡ **Edge-lit LED backlighting** requires fewer LEDs and allows for thinner displays, but limits the potential for two-dimensional dimming.

➡ **Adding a yellow sub-pixel** to the existing red, green, and blue sub-pixels in LCD panels can increase the brightness of the display. Light passes through yellow filters more easily than red or green.

➡ **Field sequential color technology** – which illuminates red, green, and blue LED backlights in rapid succession – offers the potential to eliminate color filters in the LCD panel, greatly increasing the panel's transparency. However, cycling through colors in this way would require the LCD panel to refresh very quickly in order to avoid a loss of image quality. Manufacturers and researchers are working to develop prototypes that would overcome this barrier.

Plasma

Plasma displays generate images by applying an electric current to gas-filled cells. Similar to a fluorescent lamp, the charged gas reacts with a phosphor on the edge of the cell to create light. Each pixel in a plasma display contains red, green, and blue sub-pixels, which the display illuminates at varying levels of brightness to create color.

Plasma displays are emissive. Since each cell generates light, plasma TVs do not require backlighting. As a result, plasma TVs typically offer wider viewing angles and higher contrast ratios than LCD TVs, but use notably more energy. To display images in high definition, plasma

---

[18]   Han-Ping D. Shieh and Yi-Pai Huang. 2010. "Advanced Methods for Field-Sequential-Color LCDs with Associated Power Reduction Advantages." *Information Display*. September/October 2010: 18-22.

TVs must be at least 40-inches. As a result, smaller TVs and other types of displays, like laptop computers and stand-alone monitors, rarely utilize plasma display panels. Manufacturers' limited ability to spread investment in plasma display panels across multiple products is one factor that has constrained the market penetration of plasma TVs in relation to LCD TVs.[19]

Technology under Development: OLED

Organic light emitting diodes (OLEDs) contain thin layers of organic compounds that emit light when they receive an electric current. Because different compounds emit different colors of light, OLEDs can form pixels in a display. OLEDs have a variety of advantages over LCD displays, including the potential for thinner displays, wider viewing angles, higher contrast ratios, and faster response times. OLED displays also have the potential for reduced energy use in comparison to LCD displays, since the device can turn OLEDs on and off individually.[20]

There are a variety of technological barriers that have prevented OLED adoption beyond small screens like those on smart phones. While major television manufacturers have introduced prototypes of large OLED TVs, analysts expect that, in the near future, manufacturers will produce OLED TVs only in relatively small volumes and at high costs compared to LCD TVs.[21]

Features

Internet-Enabled TVs

An Internet-Enabled TV (IETV) allows a user to view online content on the TV without the use of an external device.[22] An IETV may provide the user with a general web browser and typically allows access to Internet content like *Netflix* and *Hulu*. Some TV manufacturers plan to offer additional functionality by opening their devices to applications from third-party designers, like those available for smart phones.[23] TV manufacturers and content providers anticipate that IETV will quickly become more common and the content available will expand.[24] One interviewee took the perspective that IETVs are "more than just a TV, it's becoming a central focus of

---

[19] Barry Young. 2010. "When Can I Get My AMOLED TV?" *Information Display*. October 2010: 24-29.

[20] Jennifer Colegrove. September 27-29, 2010. "OLED Display and OLED Lighting Technology and Market Forecast." PowerPoint presentation. *DisplaySearch*. Retrieved from *http://www.displaysearch.com/cps/rde/xbcr/displaysearch/OLED_World_Summit.pdf*.

[21] Young. "When Can I Get My AMOLED TV?" 24-29.

[22] In this document we use *IETV* to refer only to TVs in which Internet access is obtained through the TV itself. IETVs are sometimes referred to as *connected TVs*. However, this term is often used to describe a setup in which Internet access is obtained through a device external to the TV.

[23] Sam Grobart. January 5, 2011. "A Bonanza In TV Sales Fades Away."*The New York Times*.

[24] John Moulding. January 24, 2011. "Connected TV 'Resonates Better than 3DTV.'" *Videonet*. Retrieved from *http://v-net.tv/NewsDisplay.aspx?id=645&title=connected-tv-resonates-better-than-3dtv*.

entertainment: it's got applications, Internet connectivity." Manufacturers anticipate that Internet connectivity will allow TVs to increasingly integrate into home networks and will facilitate place shifting – accessing content from a single device in multiple locations.

There is no definitive study of the energy impacts of IETV, although manufacturers estimate that Internet connectivity increases energy use only slightly, since the largest part of a TV's energy consumption comes from the display panel, regardless of the source of the content. According to one manufacturer, the added energy draw of components necessary for Internet connectivity is "so insignificant that it doesn't compare to [*on*] mode operation."

3D

3D TVs display images that appear three-dimensional. In order to do so, TVs must rapidly alternate between images designed to be viewed by the right and left eyes individually. When the viewer's brain processes and combines these images, it perceives depth. As a result, 3D TVs require the capability to separate a signal into left and right images, and must be able to refresh the image quickly.[25] 3D TVs must also broadcast images more brightly than traditional televisions, because the 3D glasses block some of the light. The extent to which these features increase energy use is not clear. In a limited study of eight 3D plasma and 3D LED TVs, *CNET* found wide variation in the increase in energy use when the devices displayed a 3D image compared to a 2D image. While the energy use of the 3D LED TVs increased by 30% or less, the energy use of 3D plasma TVs increased by at least 60%, with some models more than doubling the amount of electricity they consumed.[26]

Download Acquisition Mode

ENERGY STAR® defines *download acquisition mode* (DAM) as "the power mode in which the product is connected to a main power source, produces neither sound nor picture, and is actively downloading data."[27] A TV would typically enter DAM in order to update listings on an electronic programming guide, although it may also monitor for emergency communications or update its firmware. Channel guides that utilize DAM are typically available in mid- and high-end TVs. One manufacturer estimated 70% of the company's mid- and high-end products are capable of entering DAM. TV manufacturers and cable and satellite service providers contract with third-party providers, who supply the channel guides and other features that utilize DAM.

---

[25]   Corinne Iozzio. January 6, 2010. "How 3-D TV Works".*POPSCI.* Retrieved from
      http://www.popsci.com/gadgets/article/2010-01/its-about-time-3-d-comes-home.

[26]   David Katzmaier. July 2, 2010. "Do 3D TVs Use More Power?" *CNet.* Retrieved from
      http://news.cnet.com/8301-17938_105-20009547-1.html.

[27]   U.S. Environmental Protection Agency [EPA]. January 24, 2011. *ENERGY STAR Program Requirements
      Product Specification for Televisions: Eligibility Criteria Version 5.3.* ENERGY STAR. Retrieved from
      *http://www.energystar.gov/ia/partners/prod_ development/revisions/downloads/television/V5.3_Program_
      Requirements.pdf.*

Currently, only devices that receive content from the Rovi Corporation are eligible to meet ENERGY STAR's DAM requirements. ENERGY STAR specifications limiting the amount of energy TVs draw per day in DAM took effect on May 1, 2010. While DAM increases a TV's energy use over standby levels, manufacturers assert that DAM allows TVs to take on approximately 80% of the functionality of a set-top box (STB).

Supply Chain

Actors in the TV supply chain play five primary roles (Figure 2).

→ **Equipment/Material Suppliers** create components and supply materials to panel makers and original equipment manufacturers.

→ **Panel Makers** produce LCD and plasma panels for original equipment manufacturers and brands.

→ **Original Equipment Manufacturers** (OEMs) assemble the final product.

→ **Brands** design or specify and market products under their own name.

→ **Retailers** sell products to consumers.

Figure 2: Various Companies and Their Role(s) in the TV Supply Chain
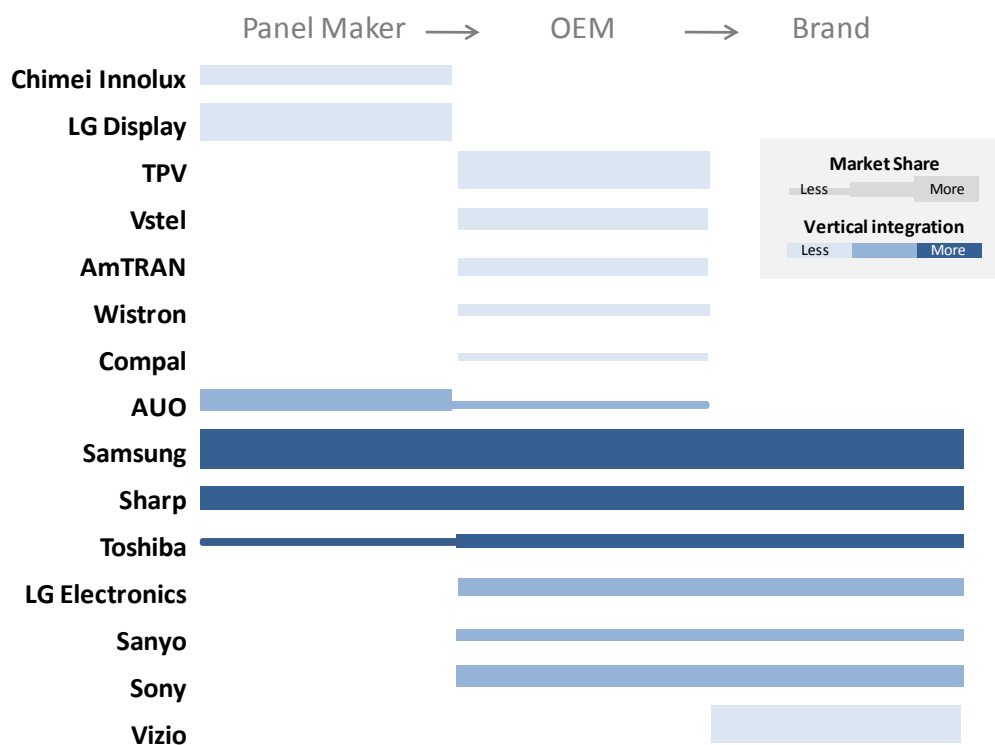
As a result of vertical integration in the TV industry, individual companies often play multiple roles in the supply chain. Eight of the top 10 brands manufacture the majority of their own TVs, with only Vizio and Philips outsourcing more than half of their production in Q1 2009.[28] In the industry as a whole, OEMs produced 25% of the LCD TVs shipped in Q1 2009, although analysts expect that brands will outsource more production as price pressure increases and the devices available become less differentiated.[29]

Vertical integration in the TV industry extends to panel suppliers, as well as product manufacturing. Samsung, among others, not only manufactures its own products, but also produces the panels its displays contain. Samsung's approach contrasts with that of Vizio, the brand with the next largest market share, which outsources all of its production.[30]

Panel Makers

Relatively few panel makers account for large portions of the market for both LCD and plasma panels.

➡ In the market for plasma panels, three manufacturers dominate production: Panasonic, Samsung, and LG Electronics.[31]

➡ In the LCD panel market, the top five manufacturers generated 92% of revenues in December 2010 (Table 12).

---

[28]   DisplaySearch. July 8, 2009. "Globally 25% of LCD TVs Shipped in Q1'09 Were Outsourced." Press release. Retrieved from *http://www.displaysearch.com/cps/rde/xchg/displaysearch/hs.xsl/090708_globally_25_of_lcdtvs_ shipped_in_q1_09_were_outsourced_tpv_remains_the_1_lcdtv_oem_supplier.asp*.

[29]   Ibid.

[30]   Bob Ferrari. May 21, 2010."Inflection Points Within the Global Consumer Electronics Industry."*Supply Chain Matters: Bob Ferrari's Blog on Global Supply Chain Business Process and Technology*. Retrieved from *http://www.theferrarigroup.com/supply-chain-matters/tag/vizio-supply-chain*.

[31]   Paul Semenza. 2010. "A New Chapter for the Display Market." *Information Display*. May 2010: 38-41. Society for Information Display: Campbell, CA.

Table 12: LCD Panel Suppliers

SUPPLIER	LCD PANEL REVENUE 2010 MILLION US$	PERCENT OF TOTAL	PRODUCES COMPLETE TVS	DISPLAY TYPES		
				LCD	Plasma	CRT
LG Display[1]	$1,676	26%		●		
Samsung	$1,673	26%	●	●	●	
AUO	$961	15%		●		
ChimeiInnolux	$957	15%		●		
Sharp	$676	10%	●	●		
Panasonic	$176	3%	●	●	●	
CPT (Chunghwa Picture Tubes, Ltd.)	$92	1%		●		●
InfoVision	$83	1%		●		
BOE	$49	1%		●		
HannStar	$46	1%		●		
Tianma	$34	1%		●		
Toshiba	$9	0%	●	●		
Hydis	$4	0%		●		
Hitachi	$3	0%	●	●	●	●

Source: DisplaySearch. (January 19, 2011). PanelTrack December 2010 results. Retrieved from *http://www.displaysearch.com/ cps/rde/xchg/displaysearch/hs.xsl/resources_paneltrack.asp.*

[1] LG Display is an independent company that manufactures LCD panels and is developing OLED panels. The company was a joint venture between LG Electronics and Philips. Philips sold its stake in 2008. LG Electronics owns approximately 38% of the company's common stock. LG Display Co., Ltd. Filed by Koninklijke Philips Electronics NV. Form 13G/A (Amended Statement of Ownership). Filed 02/13/09. Retrieved from http://idc.api.edgar-online.com/efx_dll/edgarpro.dll?FetchFilingConvPDF1?SessionID= oSiqWMSj5q7U0IS&ID=6407231*.*

OEMs

OEMs assemble finished products, which other companies sell under their own brand names. The top OEM, TPV, manufactures TVs for Vizio, AOC, and Philips. Vestel, the OEM with the next largest market share, primarily manufactures TVs for retailers' private labels (Table 13).[32]

---

[32] DisplaySearch. "Globally 25% of LCD TVs Were Outsourced."

Table 13: Top 10 LCD TV OEMs (Q1, 2009)

ORGANIZATION	RANK	MARKET SHARE
TPV	1	20.6%
Vestel	2	17.2%
AmTRAN	3	12.4%
Wistron	4	7.9%
Compal	5	7.0%
Jabil	6	5.4%
Grundig	7	4.9%
Orion	8	3.1%
Elcoteq	9	2.7%
AUO	10	1.8%

Source: DisplaySearch. July 8, 2009. "Globally 25% of LCD TVs Shipped in Q1'09 Were Outsourced." Retrieved from
*http://www.displaysearch.com/cps/rde/xchg/displaysearch/hs.xsl/090708_globally_25_of_lcdtvs_shipped_in_q1_09_were_*
outsourced_tpv_remains_the_1_lcdtv_oem_supplier.asp.

Brands

Table 14 provides details on the top TV brands in Q3 2010.

Table 14: Top TV Brands (Q3 2010)

ORGANIZATION	ALL FLAT PANEL TVS		LCD TVS	
	Rank	Market Share	Rank	Market Share
Samsung	1	19.3%	2	17.7%
Vizio	2	17.0%	1	19.9%
LG Electronics	3	10.9%	4	9.2%
Panasonic	4	8.6%	N/A	N/A
Sony	5	8.5%	3	9.9%
Sanyo	6	6.9%	5	6.9%
Toshiba	7	5.7%	6	6.6%
Sharp	N/A	N/A	7	4.7%

Source: DisplaySearch. July 8, 2009. "Globally 25% of LCD TVs Shipped in Q1'09 Were Outsourced." Retrieved from
*http://www.displaysearch.com/cps/rde/xchg/displaysearch/hs.xsl/090708_globally_25_of_lcdtvs_shipped_in_q1_09_were_*
outsourced_tpv_remains_the_1_lcdtv_oem_supplier.asp.

Two brands, Samsung and Vizio, lead the market; both brands' market share is nearly twice that of their next largest competitor. According to analysts, Vizio's LED TV offerings allowed it to

surpass Samsung in LCD TV market share, while Samsung maintained leadership of the overall flat panel TV market by lowering prices and offering premium features in plasma TVs.[33]

Product Development Process

Product Design

Both retail chains and manufacturers market TVs directly to consumers. In interviews, manufacturers stated that in designing and marketing products, they focus primarily on consumers' interests. However, manufacturers must also consider retailers' desires. Big retailers in particular may be able to influence product design, while smaller retailers must typically accept the products a manufacturer offers.

The product development cycle for TVs ranges from 12 to 24 months. Manufacturers typically begin their design efforts in the spring or summer and seek to release new products in the first few months of the year, at or soon after the Consumer Electronics Show in January. Retailers place orders for products soon after their release in the first few months of the year and receive the product the following summer.

Product models remain available for a relatively short time, with manufacturers reporting that models are typically on the market between 9 and 18 months. The opportunity to influence product designs and feature sets, and retailer stocking practices, thus occurs at different times of the year, with the former in the spring and the latter in the winter (Figure 3).

Figure 3: TV Design, Order, and Shipment Timeline

---
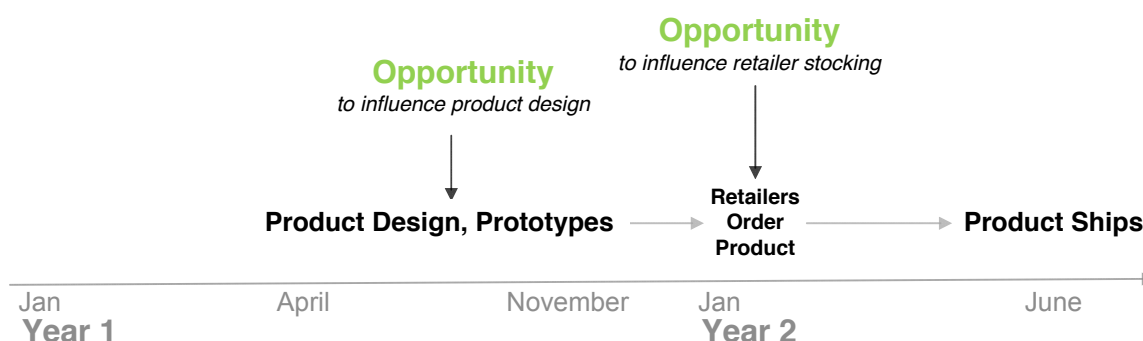
[33]   Riddhi Patel. November 19, 2010. "Globally 25% of LCD TVs Shipped in Q1'09 Were Outsourced." Retrieved from *http://www.isuppli.com/Display-Materials-and-Systems/News/Pages/Vizio-and-Samsung-Split-Leadership-in-US-Television-Market-in-Q3.aspx*.

Distribution

A 2010 study of Pacific Northwest TV owners found that 91% of those in the market for a new TV stated they would make the purchase at a bricks-and-mortar store, as opposed to online. Most intended to purchase at a big box store specifically.[34]

As of May 2009, two major retailers, Best Buy and Walmart, accounted for more than half of TV sales and held commanding leads over their nearest competitors with regard to market share (Table 15).

Table 15: TV Retailer Market Share (2009)

RETAILER	MARKET SHARE
Best Buy	33.2%
Walmart	20.2%
Target	2.8%
Sears	2.7%
Amazon	1.4%

Source: Retailer Daily. June 3, 2009. "Best Buy Gives Up Market Share to Wal-Mart"

In 2009, when this data was released, Best Buy had the largest overall market share, Walmart had recently increased its focus on consumer electronics products and surpassed Best Buy as the most popular retailer among consumers with household incomes under $50,000. Facing increased competition from Walmart and other general merchandise retailers following Circuit City's closure, Best Buy sought to expand its private label offerings and entered the secondary electronics market, offering overstocks, refurbished, and returned equipment.[35]

Manufacturers reported they divide their product lines between *entry-level* models, which they seek to sell in high volumes and at low cost, and *high-end* models, which offer higher performance and additional functionality at a higher price. TV retailers divide their approaches in similar ways. Price-point retailers like Walmart and Costco focus on lower-cost products and offer less support to customers, while value-added retailers like Best Buy, Sears, and regional

---

[34] Opinion Dynamics Corporation [ODC]. 2010. *The Market for Energy Efficient Electronics: Pre-program findings on consumer perceptions and retail shelf stocking practices.* Prepared for the Northwest Energy Efficiency Alliance, Portland, Ore. Nearly all prospective buyers planned to "browse" models in a store, but most also planned to do some online research, either at a manufacturer website (44%), a retailer website (66%), or by reading customer reviews (54%).

[35] Retailer Daily. June 3, 2009. "Best Buy Gives Up Market Share to Wal-Mart".Retrieved from *http://www. retailerdaily.com/entry/41621/best-buy-market-share-wal-mart/?utm_source=rd&utm_campaign= sitenav&utm_medium=entrylink.*

home theater stores employ more knowledgeable salespeople and offer a higher level of support. Online retailers typically compete on price, but may also offer warranties and support.

Key Trends

Market Characteristics

➡ **TV sales grew rapidly from 2000 to 2009, but appear to be slowing.** TV sales grew 20% or more per year from 2007 to 2009 due to the increasing availability of LCD and plasma displays, the switchover from analog to digital broadcasting, and the prevalence of high definition content.[36] However, U.S. shipments of LCD TVs, which make up the largest portion of the U.S. television market, declined 1.2% in 2010, the first year in which sales declined since LCD technology became widely available.[37] While the global recession contributed to the decline, analysts also note that the high penetration of flat panel TVs signals the market is saturated and the growth rate will likely slow.[38] Recent estimates suggest nearly two-thirds of households have a flat-panel TV or, as a recent popular press article put it, "Most people who want a [flat-panel] TV already own one."[39]

➡ **All TVs have gotten cheaper, with the biggest price decreases found among the larger screen sizes.**[40] From 2007 to 2010, LCD TV prices declined 36% and plasma TV prices fell 52%.[41] TVs with larger screens have seen the greatest decline in prices. Year-over-year prices from 2009 to 2010 declined 29% for 60-inch TVs compared to 21% for 42-inch TVs.[42] Analysts credit fierce competition for these declines. However, prices appear to have stabilized recently as manufacturers introduce features like 3D viewing and web connectivity at higher prices.[43] Analysts expect wholesale prices to decline only an additional 4% over 2011.[44]

---

[36] Grobart. "A Bonanza In TV Sales Fades Away."

[37] Riddhi Patel. December 7, 2010. "U.S. LCD TV Market Suffers First Annual Decline in 2010." *iSuppli.* Retrieved from *http://www.isuppli.com/Display-Materials-and-Systems/News/Pages/US-LCD-TV-Market-Suffers-First-Annual-Decline-in-2010.aspx.*

[38] Paul Semenza. "A New Chapter for the Display Market," 38-41.

[39] Grobart. "A Bonanza In TV Sales Fades Away."

[40] Paul Semenza. "A New Chapter for the Display Market," 38-41.

[41] Grobart. "A Bonanza In TV Sales Fades Away."

[42] NPD Group. August 18, 2010. "One Year After Digital TV Transition, Big TV Sales Soar As Small TV Sales Sink, According to the NPD Group." NPD press release. Retrieved from *http://www.npd.com/press/releases/press_100818.html.*

[43] Grobart. "A Bonanza In TV Sales Fades Away."

[44] CEA. *U.S. Consumer Electronics Sales & Forecasts 2006-2011*, 22-25.

➡ **Larger televisions are gaining market share at the expense of smaller models**. In a comparison of TV sales in June 2009 and June 2010, sales of TVs over 40-inches grew 26%, while sales of TVs under 40-inches declined 21%.[45] This may be attributed both to a decline in prices and the likelihood that larger TVs have new and desirable features like Internet connectivity, LED backlighting, and 3D. In addition, analysts suggest large TVs are "the core of the replacement market."[46]

➡ **The length of the TV replacement cycle has decreased** and now more closely resembles that of a personal computer than an appliance. When cathode ray tubes (CRT) were the dominant TV technology, consumers typically kept their TVs for ten years or longer, much like appliances. Now, however, analysts and TV manufacturers expect consumers to replace their TVs every five to seven years, only slightly longer than the PC's three-to-four-year replacement cycle.[47]

➡ **The amount of time Americans spend watching TV is increasing**. In Q1 2010, Americans turned on their TVs for an average of five hours and twelve minutes each day, an increase of two hours per month over Q1 2009.[48]

Panel Technology

➡ **Most TVs sold in the U.S. today are flat-panel LCDs.**[49] LCD has been the best-selling TV technology since 2006 and its market share has grown steadily, from 46% in 2006 to 85% in 2009. Plasma now ranks a distant second at 10% market share, with front and rear projection making up the remaining 5%.[50]

➡ **LCD TV manufacturers are rapidly migrating to LED back- or edge-lighting technology** and sales of TVs with an LED light source (LED TVs) are growing. In Q3 2010, LED TVs made up 20% of all LCD TVs sold in the U.S.[51] Analysts expect their market share to surpass that of cold cathode fluorescent lit (CCFL) TVs in 2011 and to

---

[45]   NPD Group. "One Year After Digital TV Transition."

[46]   Gagnon. "Global TV Trends."

[47]   Grobart. "A Bonanza In TV Sales Fades Away."

[48]   The Nielsen Company. 2010. *Three Screen Report: Television, Internet and Mobile Usage in the U.S.* Volume 8: 1st Quarter 2010. The Nielsen Company: New York, NY. TV viewership hours were obtained from metered data and thus reflect the amount of time a user's television was turned on, not how long it was actively being watched.

[49]   CEA. *U.S. Consumer Electronics Sales & Forecasts 2006-2011*, 22-25.

[50]   Ibid.; iSuppli. September 24, 2010. "LCD-TV Shipment Growth Accelerates in the Second Half of 2010." Retrieved from *http://www.isuppli.com/Display-Materials-and-Systems/News/Pages/LCD-TV-Shipment-Growth-Accelerates-in-the-Second-Half-of-2010.aspx*

[51]   Patel. "LED Backlights Used."

reach 80% of LCD TV shipments by 2014.[52] One manufacturer stated that 90% of their products already use LED backlights. This increase in LED market share coincides with a sharp drop in the price of LEDs, resulting from increased production volumes. Analysts expect the manufacturing costs for LED TVs will continue to decline through 2013.[53]

➔ **TV manufacturers are using new technologies and features to gain market share amidst price pressures and increasing competition**. While a variety of factors, including economic conditions and limited supply, caused LCD TV prices to decline more slowly in 2010 than they had in previous years, analysts note that manufacturers have moved away from cutting prices in order to stimulate demand. Instead, TV manufacturers have taken a *value-added* approach based on more advanced features, like 3D technology and Internet connectivity.[54] An LED light source is such a feature, but will not remain a premium offering as LED prices decline and penetration increases.[55]

➔ **Some panel design changes may result in both cost savings to the manufacturer and energy efficiency improvement.** The backlighting in large LCD televisions can account for up to one-third of the manufacturer's bill of materials and 70% to 90% of the device's energy use.[56] Manufacturers may be able to reduce both the cost and energy use of LED TVs through a number of strategies, discussed in *Product Types and Key Manufacturers: LCD*, below.[57]

Internet Connectivity and 3D

➔ **Sales of Internet-enabled TVs (IETVs) are growing and may account for more than half of all TVs sold by 2014**. Analysts estimate the percent of IETVs shipped increased from less than 10% in 2009 to more than 15% in 2010, and expect penetration to increase further, surpassing 60% in 2014, and up to 76% by 2015.[58]

---

[52] Gagnon. "Global TV Trends."

[53] DisplaySearch. February 16, 2010. "LED Backlight Costs Falling Faster than Conventional LCD Backlights."Press release. Retrieved from *http://www.displaysearch.com/cps/rde/xchg/displaysearch/ hs.xsl/100216_led_ backlight_costs_falling_faster_than_conventional_lcd_backlights.asp*. Data cited in *Quarterly LED & CCFL Backlight Cost Report*. Report available for purchase from DisplaySearch.

[54] Patel. "U.S. LCD TV Market Suffers."

[55] Paul Semenza. "A New Chapter for the Display Market," 38-41.

[56] *Ibid.; DisplaySearch. "LED Backlight Costs Falling." Backlight energy use from research conducted by Ecos Consulting on a 52" Sharp LED LCD TV (September 2010).*

[57] Paul Semenza. "A New Chapter for the Display Market," 38-41.

[58] Gagnon. "Global TV Trends."; Penetration by 2015 from Chris Tribbey. January 28, 2011. "Connected devices proliferate, but what works best?" *Home Media Magazine.* Retrieved from *http://www. homemediamagazine.com/electronic-delivery/connected-devices-proliferate-what-works-best-21830*.

➡ **There is strong consumer demand for IETV features and IETV content is likely to become increasingly diverse.** Although consumers can view Internet content on a TV using an IETV or any number of external devices, nearly half of those who did so in Q3 2010 used their IETV.[59] Manufacturers did not anticipate the sharp increase in consumer demand for Internet functionality in TVs, but are responding quickly. To enhance the online content available through IETVs, manufacturers are beginning to allow outside software developers to create applications that will provide content on their displays.[60]

➡ **Despite a slower start than some analysts expected, sales of 3D TVs are expected to increase.** In 2010, only an estimated 4% of all large TVs sold, or 3.2 million units, were 3D-capable.[61] Barriers to 3D television adoption include a lack of 3D content, the price premium of the 3D TV and glasses, and the need for a 3D-capable DVD player.[62] Nonetheless, analysts anticipate competition in the TV industry will decrease costs and predict that nearly 18 million 3D-capable TVs will ship in 2011, a more-than five-fold increase over 2010.[63]

➡ **Competing formats have the potential to slow 3D TV adoption.** Two 3D formats – one using active shutters glasses and the other passive polarized glasses – are currently available and manufacturers are developing a third format that would not require glasses. Manufacturers believe that "At some point, a standard will emerge," and one suggested the current competition could limit consumer acceptance of 3D TVs, as some consumers may wait to purchase a 3D TV until a single technology gains widespread acceptance.[64]

Energy Efficiency

➡ **TV technology has evolved rapidly and, as it has evolved, energy efficiency has increased.** According to one manufacturer, the shift away from CRT displays and the increasing dominance of LCD technology have brought about increases in the efficiency of televisions, and ENERGY STAR has driven further efficiency gains. The ENERGY STAR program notes that TVs have rapidly become more energy-efficient since it

---

[59]   Patel. "LED Backlights Used."

[60]   Grobart. "A Bonanza In TV Sales Fades Away."

[61]   DisplaySearch. January 4, 2011. "3D TV Forecast to Reach 3.2 Million Global Shipments in 2010 and 91 Million in 2014." Press release. Retrieved from *http://www.displaysearch.com/cps/rde/xchg/displaysearch/ hs.xsl/110104_3d_tv_forecast_to_reach_3_2_million_global_shipments_in_2010_and_91_million_in_2014. asp.*

[62]   Grobart. "A Bonanza In TV Sales Fades Away."

[63]   DisplaySearch. "3D TV Forecast."

[64]   Erica Ogg. January 10, 2011. "At CES, New 3D TV Tech Emerges.*" CNet.* Retrieved from *http://news.cnet.com/8301-31021_3-20027925-260.html.*

developed its Version 3 specification in 2007 and 2008, and anticipates that television efficiency will continue to increase.[65]

➡ **While manufacturers consider energy use in their product design, factors like cost and picture quality typically take precedence**. Manufacturers promote energy efficiency as a way to differentiate their products and a 2009 market characterization found that retailers increasingly request that manufacturers supply efficient TVs.[66] However, analysts note that consumers seem to lack awareness of the amount of energy TVs consume and do not consider energy use in TV purchasing decisions, as they do for other large appliances.[67] Similarly, according to a manufacturer, while efficiency may sway consumers deciding between otherwise equivalent products, consumers do not appear willing to pay more or sacrifice functionality to reduce energy use. As a result, manufacturers may opt to lower costs or improve picture quality at the expense of energy efficiency.

➡ **TV efficiency is improving faster than the EPA anticipated when developing ENERGY STAR standards.** Through ENERGY STAR, the EPA aims to qualify the top 25% of products available. However, according to the EPA, industry sources estimate 60% to 90% penetration of ENERGY STAR-qualified TVs under the current (Version 4.2) specification and a major retailer estimates 70% of the TVs it currently offers are ENERGY STAR-qualified.[68] As a result, the EPA moved up the effective date of the next TV specification (Version 5.3) by seven months – from May 1, 2012, to September 30, 2011. Even so, 26% of TVs qualified under the current specification *already* meet Version 5.3 requirements.[69]

➡ **Manufacturers' perception of their ability to meet a voluntary efficiency specification influences the extent to which they invest in energy efficiency**. Manufacturers who do not anticipate they will meet an efficiency specification have little incentive to take steps that would reduce a TV's energy use. While this has traditionally impacted products at the low end of the TV market, manufacturers asserted that

---

[65] Katharine Kaplan and Bijit Kundu. July 28, 2009. *ENERGY STAR TV Stakeholder Webinar: Final Draft Versions 4.0 and 5.0 Specifications*. EPA ENERGY STAR: Washington, D.C. Retrieved from *http://www.energystar.gov/ia/partners/prod_development/revisions/downloads/television/ENERGY_STAR_TV_Stakeholder_Webinar_Presentation_72809.pdf*.

[66] Opinion Dynamics Corporation. 2009. *Statewide Business and Consumer Electronics Baseline Study: Final Report*. Volume I of II: Main Report. Study ID: PGE0283.01. Prepared by for Pacific Gas & Electirc Company, Southern California Edison, San Diego Gas & Electric; Donelan. "Do Consumers Really Go For Green." 3.

[67] Jenny Donelan. 2010. "Do Consumers Really Go For Green." *Information Display*, November-December 2010: 28-30.

[68] Katharine Kaplan. November 23, 2010. "EPA ENERGY STAR Televisions." Memo. Retrieved from *http://www.energystar.gov/ia/partners/prod_development/revisions/downloads/television/Televisions_Memo.pdf*.

[69] Ibid.

qualifying for ENERGY STAR's Version 5.3 requirement "is going to be impossible for bigger screens and plasma." As a result, manufacturers stated that the requirement may limit their ability to justify investment in efficiency in larger, high-end models in addition to the low-cost models that have traditionally sacrificed efficient features. However, the high penetration of TVs over 50-inches that already meet ENERGY STAR Version 5.3 requirements (36% in July 2011) casts some doubt on this claim.

➡ **There is increasing interest in regulation and labeling of TV energy consumption.** Mandatory energy efficiency standards for TVs took effect in California on January 1, 2011. Since then, four additional states (Massachusetts, New York, Washington, and Wisconsin) have proposed similar standards. In addition, beginning May 10, 2011, the Federal Trade Commission requires that TVs display an *Energy Guide* sticker that lists the device's energy use and compares it to other models.

➡ **More than half, and potentially as many as 90%, of TVs on the market already meet California's 2013 standards.** Beginning in 2013, California's mandatory *on* mode power standards for TVs will parallel those of the current ENERGY STAR Version 4.2 specification for screen sizes between 32 and 50 inches (Table 16). Given ENERGY STAR's current estimates of 60% to 90% penetration under the Version 4.2 specification, 10% to 40% of TVs currently on the market would not meet California's 2013 standards.

Table 16: On Mode Power Limits (Watts) for ENERGY STAR & California TV Standards, 2010-2013

SCREEN SIZE	2010	2011		2013
	ENERGY STAR Version 4.2	California Tier 1	ENERGY STAR Version 5.3	California Tier 2
20-inch	37	66	27	45
32-inch	78	120	55	78
42-inch	115	183	81	115
50-inch	153	246	108	153
60-inch	209	Not Regulated	108	Not Regulated

➡ **Statewide energy use standards have impacts beyond the state that enforces them.** Because manufacturers design products for national markets, manufacturers reported that efficiency standards like those in effect in California will impact products available nationally.

➡ **Manufacturers seek consistency and predictability in efficiency specifications – both mandatory and voluntary.** Manufacturers would like assurance that specifications will remain constant for at least 18 months. However, they may be able to adapt to standards that change as frequently as every year, given sufficient advanced notice of planned changes.

4 DESKTOP PCS

This chapter leads with descriptions of the four high confidence desktop PC opportunities. The market characteristics follow and are important reading for program administrators and designers. The contents are more nuanced than the opportunity descriptions below and they provide context, and hopefully an understanding, of the markets in which programs seek to intervene.

HIGH CONFIDENCE DESKTOP PC OPPORTUNITIES

Installed Base Power Management: Increase the penetration of power management on the residential installed base

A recent study designated PC power management as "the single most important opportunity" it identified among the residential installed base plug load. Eighty percent of desktop PCs monitored did not have power management enabled (although most *did* have power management enabled for monitors). Homeowners were both unaware that their power management settings were not optimally configured and were willing to change them.[70] For most desktop PCs, enabling power management takes only a few clicks and does not affect the user's experience. This measure could be implemented in several ways and has the potential to save **21 GWh** (2.4 aMW) in NEEA territory in 2012-2014.

Energy Savings Calculation and Key Assumptions

Table 17 shows the calculation method for this opportunity. The key assumption for this is:

➡ **Achievable opportunity penetration potential (AOPP).** The number of reachable households is a key determinant of projected energy savings. The more households a program reaches, the higher the savings. Two key inputs to AOPP are household penetration and the willingness of owners to change their power management settings:

> We estimated penetration at 5% of households annually. Program administrators should adjust this input based on the selected implementation method.

> We estimated 75% of users will be willing to change their settings. We base our estimate on a recent study that found PC users had "a high level of willingness" to implement aggressive power management.[71]

---

[70]   Energy Center of Wisconsin. *Electricity Savings Opportunities.*

[71]   Ibid.

Table 17: Installed Base Power Management Opportunity Calculation

INPUT	2012	2013	2014	NOTES / SOURCES
Percent of installed base currently employing measure	30%	35%	40%	Energy Center of Wisconsin, 2010, estimated 5% growth in measure implementation annually due to default settings in new operating systems
Percent of installed base that cannot employ measure	20%	20%	20%	*Estimate:* 10% of computers require network and 10% have windows XP glitches that do not allow the PC to wake up from sleep.
Technical Opportunity Penetration Potential (TOPP): percent of PCs	**50%**	**45%**	**40%**	*Calculation:* 100% – (Percent of installed base currently employing) – (Percent of installed base that cannot employ)
Technical Opportunity Penetration Potential (TOPP): number of PCs	**1,647,620**	**1,377,658**	**1,122,585**	*Calculation:* (TOPP percent) * (Installed base in NEEA territory)
Technical Opportunity Penetration Potential (TOPP): number of PCs per household	**0.31**	**0.26**	**0.21**	*Calculation:* (TOPP number) / (Number of NEEA households)
Percent NEEA households the program can reach annually	5%	5%	5%	Estimate
Percent computer owners willing to change power management settings	75%	75%	75%	Constant
Persistence of measure over 3 years	90%	90%	90%	Estimate
Achievable Opportunity Penetration Potential (AOPP): percent of households	**3%**	**3%**	**3%**	*Calculation:* (Percent NEEA households the program can reach annually) * (Percent willing to change) * (Persistence)
Achievable Opportunity Penetration Potential (AOPP): percent of households	**176,914**	**178,683**	**180,469**	*Calculation:* (AOPP percent) * (Number of NEEA households)
Achievable Opportunity Penetration Potential (AOPP): number of PCs	**55,607**	**46,496**	**37,887**	*Calculation:* (AOPP number of households) * (TOPP number of PCs per household)
Average unit energy consumption (UEC) per PC (kWh/year)	160	152	144	Estimated based on Energy Center of Wisconsin 2010; Assumes savings decrease 5% each year due to product retirement.
Annual Achievable Savings (GWh/yr)	**9**	**7**	**5**	*Calculation:* ((AOPP number) * (Average annual UEC savings per TV)) / 1,000,000
TOTAL Achievable Savings: 2012-2014		**21 GWh**		

Key Program Design Considerations

➡ **A program designed to increase adoption of power management settings on the desktop PC installed base could be implemented in at least two ways**:

> **Direct install approach using in-home implementers.** There are many professionals who could implement this program, singly or in combination.

> **End-user educational program**. An end-user educational program could provide PC users with step-by-step instructions, in hard copy or online, for activating power management.

➡ **Enable the implementer to adjust power management settings *quickly* and *accurately*.** There is little published data on the market share of the three major desktop PC operating systems (Windows, Apple, and Linux). However, industry data suggests about 80% of desktops operate a version of Microsoft's Windows (most likely Windows XP, Vista, and 7), with most of the remainder going to Apple Macintosh OSX.[72] Implementers must be taught to navigate these systems to quickly and accurately activate the most aggressive power management settings possible (and tolerable to users). This means different things depending on the implementation model:

> **Direct install.** All in-home implementers must be trained to quickly and accurately adjust settings on all relevant PC operating systems.

> **Educational program.** Provide PC users clear directions with screenshots, how-to videos, or live support via phone or web. Step-by-step directions can be modeled on those provided by software companies and websites. Programs can consider offering a nominal incentive to end-users to track participation, and would need to develop a validation approach (for example, having the user send a screenshot of their adjusted power management settings).

➡ **Enable the implementer to activate the most *aggressive* power management settings practical.** Most operating systems offer multiple time delay options for sleep and hibernation. Program administrators should determine the minimum delay users will tolerate.

➡ **Explain the benefits of power management to the PC user.** Program administrators will need to sell the measure's benefits. Programs can use the same messages and language used for other efficiency programs. The ability of the program to sell the measure will have a direct impact on the program's energy savings.

---

[72] Wikipedia. July 28, 2011. "Usage share of operating systems." Retrieved from *http://en.wikipedia.org/wiki/Usage_share_of_operating_systems.*

➡ **Collect information on the duty cycle of the PC, and pre- and post-measure energy use.** The program will improve the accuracy of the impact evaluation if it collects data from all or a sample of implemented measures. This should include the PC duty cycle (the number of hours the PC spends in *on*, *sleep*, and *off* modes, preferably over a week or more), and energy consumption pre- and post-measure.

➡ **Collect participant contact information (email and phone number) and consider conducting a follow-up persistence study.** The persistence of measures that are easy to change is uncertain. This is particularly true of measures like this one, in which PC settings can be easily modified by the user. Programs should thus consider a follow-up participant survey to improve the accuracy of the impact evaluation.

Barriers

➡ **Users may be unwilling to modify their PC settings**. Education on the benefits of the measure will likely overcome this barrier for some (if not most) users.

➡ **The technical potential is huge, but dispersed.** We estimate over 1.5 million desktop PCs in NEEA territory (in 2012) are candidates for this measure. But they are likely distributed over as many households.

Leverage Points

➡ **A direct install approach using in-home implementers could be implemented by many types of professionals**, singly or in combination. A non-exhaustive list includes:

Pay-TV service providers

Third-party program implementers, in combination with other in-home energy efficiency program(s)

Existing trade allies, in combination with other in-home energy efficiency program(s)

Consumer electronics installation and/or IT service installation professionals, employed by retailers, service providers, or independent consultants

Other technically skilled in-home service professionals

➡ **An end-user educational program could also be implemented in several ways.** Hard copy information could be distributed by:

Any of the professionals listed above as candidates for implementing a direct install program

Retailers, at the point-of-sale

Utilities, in any communications to customers

➡ **Instructional materials could also be made available online** (and marketed using traditional and social media) via:

A program-specific website

Utility website(s)

How-to articles on leading technology websites like *CNET* and *PCWorld* that provide step-by-step instructions

How-to videos on *YouTube*

Other Implementation Options

➡ **Increase the stringency of default power management settings**. New unit sales of both desktop PCs and laptops likely do not have the most aggressive power management settings enabled by default. A program could work directly with the major brands, as they configure the operating system settings, to optimize these defaults.

➡ **Add a feature to the PC operating system alerting the user to energy implications of changing power management settings**. A feature on the device menu could indicate (in numbers, charts, or arrows) how changes to settings affect energy consumption.

Power Supply: Improve the efficiency of the internal power supply

The power supply converts AC power at the outlet to the DC power required by the computer. Most standard residential desktop PCs do not incorporate the most efficient power supply available due to its higher cost – about $5 to $15 per PC. A typical desktop PC power supply is 70% to 75% efficient, compared to 80% to 90% for the most efficient products. Replacing a typical PC power supply with a more efficient product has the potential to save **7 GWh** (0.8 aMW) in NEEA territory in 2012-2014.

Energy Savings Calculation and Key Assumptions

Table 18 shows the calculation method for this opportunity.

Table 18: Power Supply Opportunity Calculation

INPUT	2012	2013	2014	NOTES / SOURCES
Percent of new unit sales currently employing measure	8%	9%	10%	Estimate based on ODC 2010 baseline study of ENERGY STAR market penetration in the Pacific Northwest and interviews with manufacturers. Assumes 1% growth/year.

Continued

INPUT	2012	2013	2014	NOTES / SOURCES
Percent of new unit sales that cannot employ measure	0%	0%	0%	
Technical Opportunity Penetration Potential (TOPP): percent of units	**92%**	**91%**	**90%**	*Calculation:* 100% – (Percent of new unit sales currently employing) – (Percent of new unit sales that cannot employ)
Technical Opportunity Penetration Potential (TOPP): number of units	**100,406**	**64,635**	**39,040**	*Calculation:* (TOPP percent) * (Projected annual unit sales in NEEA territory)
Market share of top 4 standard desktop brands	88%	88%	88%	Constant
Achievable Opportunity Penetration Potential (AOPP): percent of units	**81%**	**80%**	**79%**	*Calculation:* (TOPP percent) * (Market share of top 4 brands)
Achievable Opportunity Penetration Potential (AOPP): number of units	**88,357**	**56,879**	**34,355**	*Calculation:* (AOPP percent) * (Projected annual unit sales in NEEA territory)
Efficiency of typical power supply	73%	74%	75%	Estimate from Ecos internal email survey of 10 manufacturers; assumes efficiency growth of 1% per year over estimated 72% in 2011
Efficiency of 80 PLUS Bronze power supply (at 20% load)	82%	82%	82%	*Plugloadsolutions.com*
Typical power supply unit wattage	350	350	350	Estimate based on market data
Average power load	20%	20%	20%	Estimate, 20% load is typical idle
Typical PC wattage (output)	70	70	70	*Calculation:* (PC power supply unit wattage) * (Average power load)
Typical PC wattage (input)	96	95	93	*Calculation:* ((Typical PC wattage (output)) / (Efficiency of typical power supply)
80 PLUS Bronze power supply PC wattage (input)	85	85	85	*Calculation:* ((Typical PC wattage (output)) / (Efficiency of 80 PLUS Bronze power supply)
Savings from more efficient power supply (watts)	11	9	8	*Calculation:* ((Typical PC wattage (input)) – ((80 PLUS Bronze power supply PC wattage (input))
Average unit energy consumption (UEC) savings per PC (kWh/yr)	41	36	31	*Calculation:* ((Savings from more efficient power supply) * (24 * 0.45 * 365)) / 1000
Annual Achievable Savings (GWh/yr)	**4**	**2**	**1**	*Calculation:* ((AOPP number) * (Average annual UEC savings per PC)) / 1,000,000
TOTAL Achievable Savings: 2012-2014		**7 GWh**		

The key assumptions for this calculation are:

➡ **Percent of new unit sales currently employing measure**. There are no market data on the penetration of efficient power supplies. A recent Pacific Northwest baseline study estimated the market penetration of ENERGY STAR desktop PCs (which have power supplies at least 82% efficient) on retail store shelves might be as low as 1%.[73] However, representation on the retail shelf may not be proportionate to market penetration because unit sales differ across product models. For this calculation, we estimate market penetration at 8% (in 2012) based on the baseline study and interviews with market analysts and manufacturers.

Key Program Design Considerations

➡ **The program may be more effective at convincing brands to incorporate the measure if it coordinates a nation-wide effort**. It seems unlikely that brands will be willing to alter product designs/feature sets on PCs sold only into some regions of the U.S.

➡ **Programs must engage with the top PC brands to identify the appropriate incentive structure and amount.** This opportunity is premised on an upstream implementation model in which programs work directly with top brands to increase penetration of more efficient power supplies.

➡ **Programs should combine an upstream approach with education for end-users.** Consumer demand is an important influence on a brand's product design decisions, so long-term market transformation depends on building demand for efficiency.

➡ **Programs may want to differentiate the goal of increasing power supply efficiency from increasing penetration of ENERGY STAR-qualified products**. A program may be more successful in incenting a brand to increase the efficiency of the power supply if it does not require ENERGY STAR qualification. ENERGY STAR requirements impose time and dollar costs on a brand that may exceed the incentive offered by a program, or impose complications that a brand is unwilling to tackle.

➡ **Targeting ODMs and/or power supply manufacturers in addition to major PC brands**. Because many (if not most) standard residential desktop PCs are designed by oversees ODMs and purchased "off-the-shelf" by the brands, a multi-pronged program design approach may be required. A program could target multiple players in the PC channel to identify where there is the most traction.

---

[73] ODC. "The Market for Energy Efficient Electronics." ENERGY STAR requires a power supply at the 80 PLUS Bronze level or above. Representation on the retail shelf is not the same as unit sales, so this figure must be used with caution.

Barriers

➡ **Programs may need to be national in scope** to convince PC brands to incorporate the measure on a greater number of product models.

➡ **PC brands control product specifications, but not product design**. The program will need to work closely with top brands to convince them to incorporate the measure in products that might not otherwise employ it, as well as ODMs and possibly power supply manufacturers.

➡ **ODMs are behind-the-scenes players and are not easy to identify**. Major PC brands do not publicize the fact that they no longer design or manufacture the majority of residential desktop PCs. As a result, the ODMs that do this work are hard to identify, and tracing the connections between specific ODMs and brands using publicly available data is nearly impossible. ODMs thought to supply the top brands include Wistron, Flextronics, ECS and Inventac.

Leverage Points

➡ **ODMs.** ODMs design and manufacture most desktop PCs. They make most decisions about which components to include and are primarily concerned with producing low-cost products.

➡ **Power supply manufacturers**. Five manufacturers account for 80% of the power supply market: Delta, Light-On, Chicony Power, and AcBel Polytech, Inc. A program could target these manufacturers to increase cost-effectiveness, but would need to resolve the attribution and evaluation issues of a (way) upstream program design.

➡ **Top PC brands**. Three brands account for nearly 90% of all residential standard desktop PCs sold in the U.S.: HP, Acer, and Dell. The top brand, HP, accounts for over 40% of the market.

➡ **80 PLUS Program**. The 80 PLUS program has been successful in transforming the market for business PC power supplies through its certification and incentive program. A program could leverage the existing 80 PLUS program infrastructure and knowledge in developing a strategy for the residential market.

Voltage Regulator: Improve efficiency of voltage regulator

The voltage regulator ensures the various PC components (for example, the processor) receive power at a constant voltage level. A typical desktop PC may incorporate between five and nine voltage regulators. Few, if any, standard residential desktop PCs incorporate the most efficient voltage regulators available due to their higher cost – about $5 per PC. A typical *linear* voltage regulator is 60% to 70% efficient, compared to 80% to 90% for the most efficient *switching* voltage regulators. Replacing the typical linear PC voltage regulators with the more efficient switching types has the potential to save **6 GWh** (0.6 aMW) in NEEA territory in 2012-2014.

Energy Savings Calculation

Table 19 shows the calculation method for this opportunity.

Table 19: Voltage Regulator Opportunity Calculation

INPUT	2012	2013	2014	NOTES / SOURCES
Percent of new unit sales currently employing measure	1%	1%	1%	Estimate based on interviews with manufacturers
Percent of new unit sales that cannot employ measure	0%	0%	0%	
Technical Opportunity Penetration Potential (TOPP): percent of PCs	**99%**	**99%**	**99%**	*Calculation:* 100% – (Percent of new units currently employing) – (Percent of new units that cannot employ)
Technical Opportunity Penetration Potential (TOPP): number of PCs	**108,045**	**70,317**	**42,944**	*Calculation:* (TOPP percent) * (Projected annual unit sales in NEEA territory)
Market share of top 4 standard desktop brands	88%	88%	88%	Constant
Achievable Opportunity Penetration Potential (AOPP): percent of PCs	**87%**	**87%**	**87%**	*Calculation:* (TOPP percent) * (Market share of top 4 brands)
Achievable Opportunity Penetration Potential (AOPP): number of PCs	**95,080**	**61,879**	**37,790**	*Calculation:* (AOPP percent) * (Projected annual unit sales in NEEA territory)
Efficiency of typical linear voltage regulator	65%	65%	65%	Estimate based on interviews with manufacturers
Efficiency of typical switching voltage regulator	85%	85%	85%	Estimate based on interviews with manufacturers
Typical linear switching voltage regulator output, per PC (watts)	20	20	20	Estimate based on interviews with manufacturers
Typical linear switching voltage regulator input, per PC (watts)	31	31	31	*Calculation:* (Typical linear voltage regulator output) * (Efficiency of typical linear voltage regulator)
Typical switching voltage regulator input, per PC (watts)	24	24	24	*Calculation:* (Typical switching voltage regulator output) * (Efficiency of typical switching voltage regulator)
Savings from more efficient switching voltage regulators, per PC (watts)	7	7	7	*Calculation:* (Typical linear voltage regulator input) – (Typical switching voltage regulator input)
Average unit energy consumption (UEC) savings per PC (kWh/yr)	29	29	29	*Calculation:* ((Savings from more efficient power supply) * (24 * 0.45 * 365)) / 1000
Annual Achievable Savings (GWh/yr)	**3**	**2**	**1**	*Calculation:* ((AOPP number) * (Average annual UEC savings per TV)) / 1,000,000
TOTAL Achievable Savings: 2012-2014		**6 GWh**		

Key Program Design Considerations

➡ **Before pursuing this opportunity, the program would need to characterize the market for voltage regulators**, including documenting the current and projected market penetration of the two component types.

➡ **Before pursuing this opportunity, the program would also need to test the measure to more accurately estimate the per-unit energy savings potential**.

➡ **The program may be more effective at convincing brands to incorporate the measure if it coordinates a nation-wide effort**. It seems unlikely that brands will be willing to alter product designs/feature sets on PCs sold only into some regions of the U.S.

➡ **Programs must engage with the top PC brands to identify the appropriate incentive structure and amount.** This opportunity is premised on an upstream implementation model in which programs work directly with top brands to increase penetration of more efficient power supplies.

➡ **The PC design cycle is about nine months** from product conception to store shelves. The program should reevaluate its efforts every design cycle to gauge market movement in order to lower free-ridership. It is also important to consider that any program activities will take at least this long to impact the market.

Barriers

➡ **Programs may need to be national in scope** to convince PC brands to incorporate the measure on a greater number of product models.

➡ **PC brands control product specifications, but not product design**. The program will need to work closely with top brands to convince them to incorporate the measure in products that might not otherwise employ it, as well as ODMs and possibly retailers.

➡ **ODMs are behind-the-scenes players and not easy to identify**. Major PC brands do not publicize the fact that they no longer design or manufacture the majority of residential desktop PCs. As a result, the ODMs that do this work are hard to identify, and tracing the connections between specific ODMs and brands using publicly available data is nearly impossible. ODMs thought to supply the top brands include Wistron, Flextronics, ECS, and Inventac.

➡ **Switching voltage regulators are slightly larger than linear voltage regulators**. The program will need to ascertain whether the difference in form factor presents a barrier to measure adoption.

Leverage Points

➡ **Top PC brands**. Three brands account for nearly 90% of all residential standard desktop PCs sold in the U.S.: HP, Acer, and Dell. The top brand, HP, accounts for over 40% of the market.

➡ **Retailers**. Retailers have the ability to request specific feature sets from brands. In particular, Best Buy and Walmart are known to negotiate with brands in this regard. The program could incentivize retailers to stock PCs with the desired measures.

Hard Drive: Reduce the size of the hard disk drive from 3.5" to 2.5"

A hard drive (or *hard disk*, *hard disk drive*, or *HDD*) is a PC component that provides long-term data storage. Typical hard drives magnetically read and write data onto magnetized disks. They resemble record players, with a moveable arm and a circular spinning disk. Reducing the size (measured in inches) and rotational speed (measured in rpm) of a hard drive are two ways to lower its energy consumption. Replacing the 3.5" hard drive found in most desktop PCs with a 2.5" hard drive more typically found in laptops has the potential to save **3.4 GWh** (0.4 aMW) in NEEA territory in 2012-2014.

Energy Savings Calculation and Key Assumptions

Table 20 shows the calculation method for this opportunity. The key assumptions for this calculation are:

➡ **Percent of new unit sales currently employing measure**. There are no data on the penetration of 2.5" hard drives in desktop PCs. We estimate penetration to be very low (5% in 2012) due to the higher cost of the measure and lack of observable benefits to the user.

➡ **Savings from a smaller hard drive**. The most recent data comparing energy consumption of 3.5" and 2.5" hard drives is from 2008.[74] In this fast-paced market, it is recommended that this assumption be tested before making program savings projections.

---

[74]   Ecos Consulting. 2008. "How Low Can We Go? A White Paper on Cutting Edge Efficiency in Commercial Desktop Computers" See *http://www.efficientproducts.org/product.php?productID=1.*

Table 20: Hard Drive Opportunity Calculation

INPUT	2012	2013	2014	NOTES / SOURCES
Percent of new unit sales currently employing measure	3%	3%	3%	Estimate based on manufacturer interviews
Percent of new unit sales that cannot employ measure	10%	10%	10%	Estimated percent of users that still need HDD with capacity >1TB
Technical Opportunity Penetration Potential (TOPP): percent of units	**87%**	**87%**	**87%**	*Calculation:* 100% – (Percent of new unit sales currently employing) – (Percent of new unit sales that cannot employ)
Technical Opportunity Penetration Potential (TOPP): number of units	**94,949**	**61,794**	**37,738**	*Calculation:* (TOPP percent) * (Projected annual unit sales in NEEA territory)
Market share of top 4 standard desktop brands	88%	88%	88%	Constant
Achievable Opportunity Penetration Potential (AOPP): percent of units	**77%**	**77%**	**77%**	*Calculation:* (TOPP percent) * (Market share of 4 top brands)
Achievable Opportunity Penetration Potential (AOPP): number of units	**83,555**	**54,378**	**33,210**	*Calculation:* (AOPP percent) * (Projected annual unit sales in NEEA territory)
Savings from smaller hard drive (watts)	5	5	5	Ecos Consulting, "How Low Can We Go?" 2008
Average unit energy consumption (UEC) savings per PC (kWh/yr)	20	20	20	*Calculation:* (Average UEC) * (Savings from smaller hard drive). Caveat: Savings estimates are from 2008. The baseline market has changed dramatically since then and achievable savings may be considerable lower. Assumes HDD spins 45% when PC is on.
Annual Achievable Savings (GWh/yr)	**2**	**1**	**1**	*Calculation:* ((AOPP number) * (Average annual UEC savings per PC)) / 1,000,000
TOTAL Achievable Savings: 2012-2014		**3.4 GWh**		

Key Program Design Considerations

➡ **The program may be more effective at convincing brands to incorporate the measure if it coordinates a nation-wide effort**. It seems unlikely that brands will be willing to alter product designs/feature sets on PCs sold only into some regions of the U.S.

➡ **Programs must engage with the top PC brands to identify the appropriate incentive structure and amount.** This opportunity is premised on an upstream implementation model in which programs work directly with top brands to increase penetration of smaller

and/or solid state hard drives. Costs change quickly and a program will need to assess the incremental cost continuously throughout the program. One source estimated that, as of February 2011, a 2.5" drive costs twice as much as a 3.5" drive, and a solid state drive costs 24 times as much as a 3.5".[75] Programs will also need to ascertain what type of incentive brands will require to adjust their product designs for incentives offered in only a limited geographic area.

Barriers

➡ **Programs may need to be national in scope** to convince PC brands to incorporate the measure on a greater number of product models.

➡ **PC brands control product specifications**. The program will need to work closely with these brands to both convince them to incorporate the measure in products that might not otherwise employ it.

➡ **The measure requires brands to redesign their products**. Smaller hard drives (and solid state drives) have a different form factor than the typical 3.5" hard drive: they are a different size and/or shape. Unlike a more efficient power supply, which *is* the same size and shape as its less efficient counterpart, substituting a more efficient hard drive requires a brand to redesign the product. This imposes a cost on the brand and will extend the time between program implementation and impact.

Leverage Points

➡ **Top PC brands**. Three brands account for nearly 90% of all residential standard desktop PCs sold in the U.S.: HP, Acer, and Dell. The top brand, HP, accounts for over 40% of the market. By targeting the top brands, programs can affect a large share of units sold. In addition, brands control feature selection and the incremental costs tend to be lower at this point in the supply chain.

➡ **Hard drive manufacturers**. After a series of recent acquisitions and mergers, three companies manufacture nearly all hard drives: Western Digital (50%), Seagate (40%), and Toshiba (10%).[76] A program could target these manufacturers to increase cost-effectiveness, but would need to resolve the attribution and evaluation issues of a (way) upstream program design.

---

[75]   Wikipedia. "Solid state drives." Retrieved from *http://en.wikipedia.org/wiki/SSD#Comparison_of_SSD_with_hard_disk_drives.*

[76]   Anton Shilov. May 9, 2011. "TDK predicts increase of Toshiba's hard drive market share." *Xbit Laboratories.* Retrieved from *http://www.xbitlabs.com/news/storage/display/20110509223715_TDK_Predicts_Increase_ of_Toshiba_s_Hard_Drive_Market_Share.html.*

Other Implementation Options

➡ **A solid state drive (SSD) is another type of long term storage device.** A solid state drive uses a microchip instead of a spinning magnetic disk to store data. It is more energy-efficient than a hard drive because it has no moving parts and produces less heat. Most analysts expect solid state drives to be the next dominant technology in long-term storage once the cost declines.

MARKET CHARACTERISTICS

Product Types

Table 21 describes four types of desktop PCs. The standard, or tower, PC is the most common in the residential market (68%). The all-in-one, which combines PC and monitor in a single desktop unit has the next largest market share (25%) and is growing in popularity. The mini PC, the smallest desktop, has the least market penetration (7%) and the lowest energy consumption.

Supply Chain

There are four key actors in the desktop PC supply chain:

➡ **Component manufactures** design and manufacture the many PC components, including the motherboard, CPU, graphics card, power supply, and cooling elements.

➡ **Original design manufacturers (ODMs)** are typically Asia-based companies that design and manufacture PCs and sell them to brands. They tend to remain behind the scenes and do not market themselves to end-users.

➡ **Brands** market PCs to end-users and are the household names associated with today's PCs. A brand may design the product in-house or outsource this function to an ODM.

➡ **Retailers** sell PCs or components to end-users.

Table 21: Four Types of Desktop PCs

CHARACTERISTIC	STANDARD	ALL-IN-ONE	MINI	PERFORMANCE
Residential Market Share *	68%	25%	7%	N/A
Description	Also called a *tower*, typically the least expensive desktop, sold separately or bundled with monitor and accessories	Desktop and monitor in one device, bridge between standard desktop and mobile device; high-end units may include screens > 23", touch screens, HD displays, Blu-ray drives	Also called a "compact PC," this smallest desktop sacrifices power to save space	Similar in appearance to a standard desktop but much more powerful and expensive, typically includes a powerful processor, lots of memory and storage, multiple graphics cards
Typical Uses	Home office, file server, storage	Home office, media center, kitchen, dorm or kids' room	Home office, media server (when connected to a TV)	Gaming, graphic design
Sample Products	Acer Aspire M3400 (pictured above)	HP All-in-One 200 (pictured above)	Dell InspironZino HD (pictured above)	Maingear Shift Super Stock (pictured above)
	HP Inspiron 580s	Acer AZ5700-U2112	Asus EeeBox 1501	Origin Genesis 2011
	Gateway SX2840-01	Lenovo IdeaCenter B500	Acer Veriton N282G	V3 Convoy
Example Power Supply	200-750 W	90-200 W	30-90 W	500–1,500 W
Cost	$250 -$1,000	$500-$1,600	$300-$600	$500+

Picture credits: Standard and Performance: *www.pcworld.com*; All-in-One: *www.logicbuy.com*; Compact: *www.dell.com*

* Mikako Kitagawa and Angela McIntyre. 2010. *Gartner Market Statistics: Personal Computers by Channel, United States, 4Q10 Update, (Final Statistics).* *Gartner.* Market share reflects sales in Q1 and Q2 of 2010.

Original Design Manufacturers (ODMS)

ODMs are the primary decision-makers determining which components to include in a PC (Table 22). While ODMs are responsive to brands' requests, PC brands typically provide the ODM with a desired feature set, but do not specify the individual components a device will contain. ODMs compete with one another on price and therefore have an incentive to use the cheapest (and usually least efficient) components while still meeting product specifications.

Table 22: PC ODMs

ODM	HP	DELL	ACER	APPLE
Wistron	X	X	X	
Flextronics	X	X		
Pegatron (Asus)				X
ECS		X		
Inventac	X			
Lanix				
First International Computer (FIC)				
Jabil				

Brands

The market for desktops is highly consolidated (Table 23).

Table 23: Brand Market Share for U.S. Residential Desktop Shipments, 2010

RANK	BRAND	MARKET SHARE			
		Overall	Standard	All-In-One	Mini
1	HP	**37%**	**43%**	19%	**44%**
2	Acer Group	17%	22%	9%	4%
3	Dell	17%	20%	7%	16%
4	Apple Computer	12%	<1%	**46%**	8%
5	Lenovo	3%	3%	1%	<1%
6	ASUS	3%	—	4%	25%
7	Sony	2%	—	10%	—
8	MSI	1%	—	5%	<1%
—	Other PC vendors	4%	5%	<1%	3%
—	Self-assembled PCs	4%	5%	—	—

Source: Mikako Kitagawa and Angela McIntyre. September 1, 2010. "Personal Computer Quarterly Statistics United States: Final Database." *Gartner Dataquest Market Statistics.*

Three or four brands hold 80% of the desktop market overall and in each product type.

Retailers

Bricks-and-mortar retailers lead online-only retailers in the PC space. Among the top 25 PC retailers, the U.S. dollar sales of the top three (Best Buy, Apple Retail Stores, and Walmart) account for more than 50% of total sales among the top PC retailers, and all have bricks-and-mortar stores. The U.S. dollar sales of the top 12 retailers account for 80% of the group's total sales, only three of which are online-only. Table 24 lists the top PC retailers in the U.S. in 2010.

Table 24: Top PC Retailers in the US (2010)

RANK	COMPANY	TOTAL PC SALES MILLION U.S. $	NUMBER OF U.S. STORES
1	Best Buy	$12,745	1,099
2	Apple Retail Stores	$7,426	238
3	Walmart	$5,104	3,616
4	Dell.com	$3,909	Online & Select Retail Stores
5	Newegg.com	$1,814	Online Only
6	Staples	$1,415	1,575
7	Micro Center	$1,414	23
8	Amazon.com	$1,396	Online Only
9	Office Depot	$1,373	1,125
10	Systemax	$1,356	35
11	Target	$988	1,752
12	Fry's Electronics	$904	34

Source: *TWICE.* "Top 25 PC Retailers." Volume 26, Number 12. June 6, 2011: 40-46.

The prevalence of bricks-and-mortar retailers indicated in Table 24 is in accordance with a 2010 survey of U.S. and Canadian consumers, which found that two-thirds of the respondents who planned to buy a computer said they would buy from a bricks-and-mortar retailer rather than online. This is comparable to a 2010 survey of Pacific Northwest desktop PC owners, two-thirds of whom also stated they would be most likely to buy their next PC or monitor in a bricks-and-mortar store. It is important to note that one-quarter (27%) of respondents stated they would be

likely to make their next PC purchase online, a much higher percentage than would purchase a TV online.[77]

Respondents to a 2010 survey who planned to buy from a bricks-and-mortar retailer most often reported they would buy from an electronics specialty store (32%). A smaller portion of respondents would buy from office supply stores (11%) and mass merchandisers (11%).[78] Sales data from the top PC retailers support these findings (Figure 4).

Figure 4: PC Sales by Retailer Type
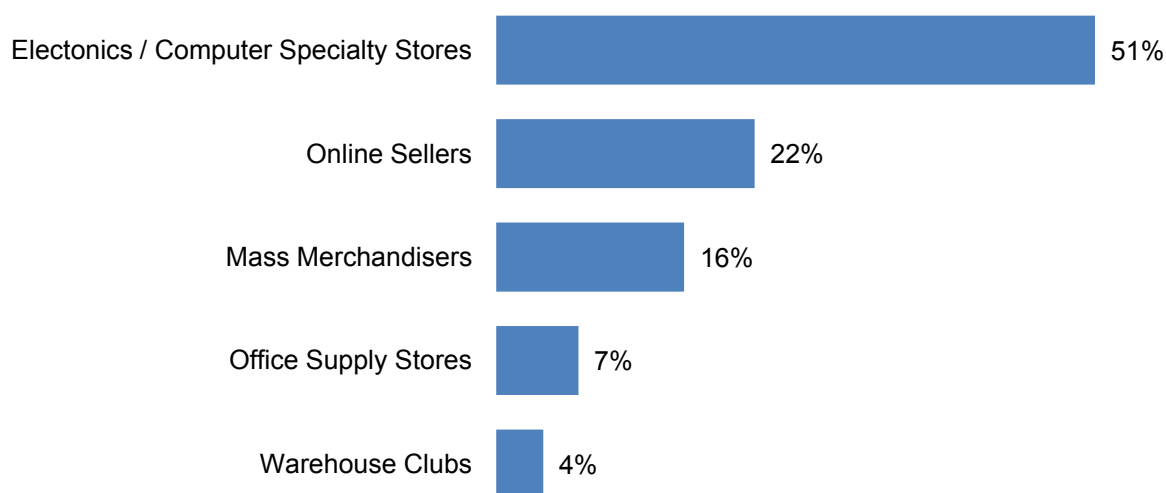
Source: Doug Olenick. (June 7, 2010). Top 25 PC Retailers. TWICE.

KEY TRENDS

User Demographics and Overall Trends

➡ **Overall, U.S. desktop PC sales rose slightly in 2010, but are expected to gradually decline through 2014.** The increase in sales in 2010 follows two years of declines as a

---

[77] ODC. "The Market for Energy Efficient Electronics." Only 91% of respondents stated they would purchase a new TV in a bricks-and-mortar store.

[78] Market Force. "Market Force Survey."

result of the recession. Analysts expect sales to remain relatively flat through 2011 and decline gradually from 2012 to 2014.[79]

➡ **Sales of *residential* desktop PCs have been falling since 2005.** Sales of laptops surpassed desktops in 2006 and have driven the consumer PC market over the past five years (Figure 5).[80]

Figure 5: U.S. Residential PC Sales by Device Category
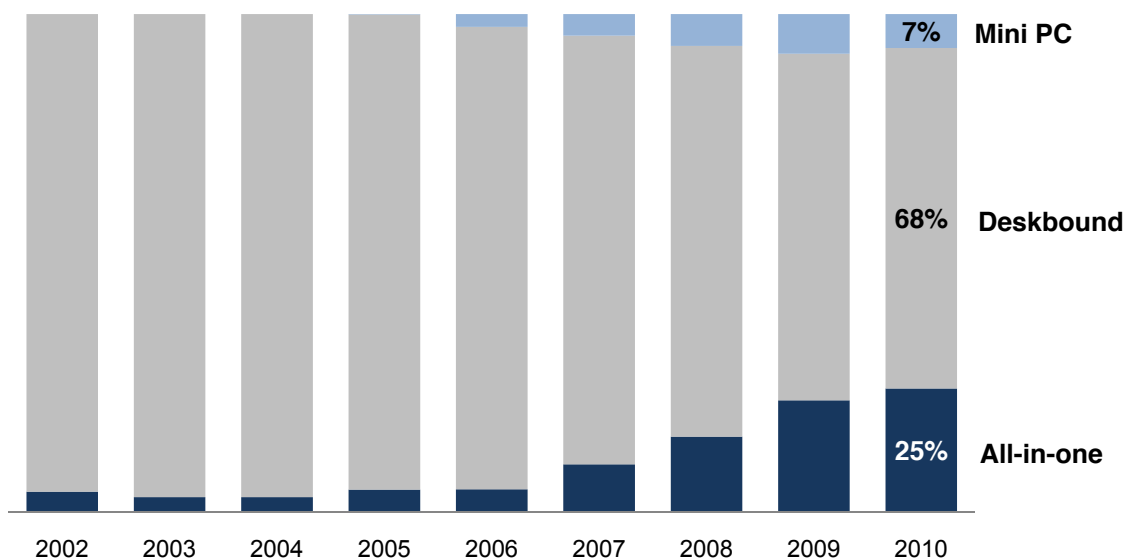
Source: Gartner.

➡ **Despite falling sales, more U.S. adults own desktop PCs than laptops**, and the growing penetration of laptops has only partially displaced desktops. In September 2010, 59% of U.S. adults owned a desktop PC, while 52% owned a laptop. These figures reflect a rapid increase in penetration for laptops, up from 30% in April 2006, but a much slower decrease in penetration for desktops, down from 68% over the same period.[81]

➡ **Older computer users are more likely to own desktop PCs.** As of September 2010, more than 80% of U.S. computer users over the age of 30 owned a desktop PC (Figure 6).

---

[79] IDC. September 2, 2010. "Business PC Buying Expected to Partially Offset Slower Consumer Sales in the Second Half of 2010, According to IDC." Press release. Retrieved from *http://www.idc.com/about/ viewpressrelease.jsp?containerId=prUS22480610&sectionId=null&elementId=null&pageType=SYNOPSIS*.

[80] Gartner. March 3, 2011. "Gartner lowers PC Forecast as Consumers Diversify Computing Needs Across Devices." Press release. Retrieved from *http://www.gartner.com/it/page.jsp?id=1570714*.

[81] Aaron Smith. October 14, 2010. "Americans and Their Gadgets*." Pew Internet and American Life Project*. Retrieved from *http://pewinternet.org/Reports/2010/Gadgets/Report/Desktop-and-Laptop-Computers.aspx*.

Eighteen to 29-year-olds were the only age group more likely to own a laptop than a desktop.[82]

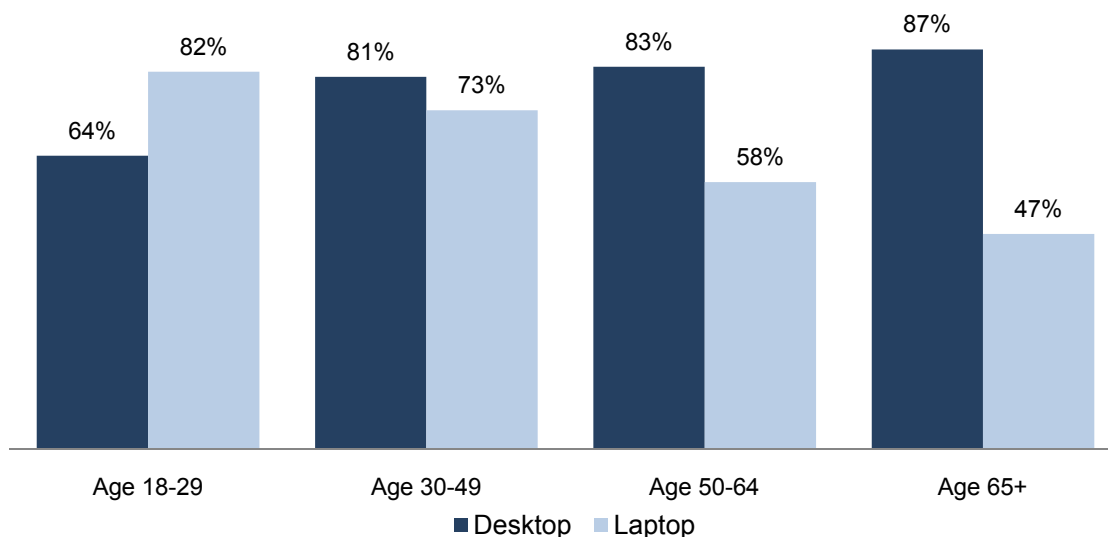**Figure 6: Proportion of U.S. Computer Owners Who Own Desktop PCs by Age Group**

Source: Aaron Smith. (October 14, 2010). Americans and Their Gadgets. Pew Internet and American Life Project. Retrieved from *http://pewInternet.org/Reports/2010/Gadgets/Report/Desktop-and-Laptop-Computers.aspx*.

➡ **Energy efficiency may not be a high priority for consumers in selecting a PC.** Interviewees at leading brands stated that energy efficiency is not a primary concern for residential PC buyers. A survey of U.S. and Canadian consumers conducted in December 2010 supports their assessment. In purchasing a PC, respondents were primarily concerned with reliability and product life, followed by value and the features and functions a device offers.[83]

➡ **Because they perceive little consumer demand for energy efficiency, brands are reluctant to include it in specifications or promotions**. A brand's marketing organization defines a product's feature set based on its assessment of customer preferences. Because brands perceive energy efficiency as unimportant to consumers, it does not rank highly among the features they specify for residential desktop PCs. In addition, brands may not promote the efficiency of desktop PCs in order to avoid

---

82   Ibid.

83   Market Force. March 22, 2011. "Market Force Survey Reveals Nearly Everyone Owns a Computer, Printer and Digital Camera." Press release. Retrieved from *http://www.marketforce.com/2011/03/market-force-survey-reveals-nearly-everyone-owns/#more-4591*.

complicating messages that focus on factors perceived to be of higher-priority to consumers.

Product Types and Components

➡ **Desktop PCs vary in cost, computing power, and energy use, and are increasingly customizable.** The category of "desktop PC" covers a diverse range of products, from mini PCs designed primarily to provide users with access to websites to high-performance PCs with the capacity to support graphics-intensive video games. Some manufacturers allow customers to order PCs with feature sets customized to the user's specifications.

Figure 7: Residential Market Penetration by Device Type
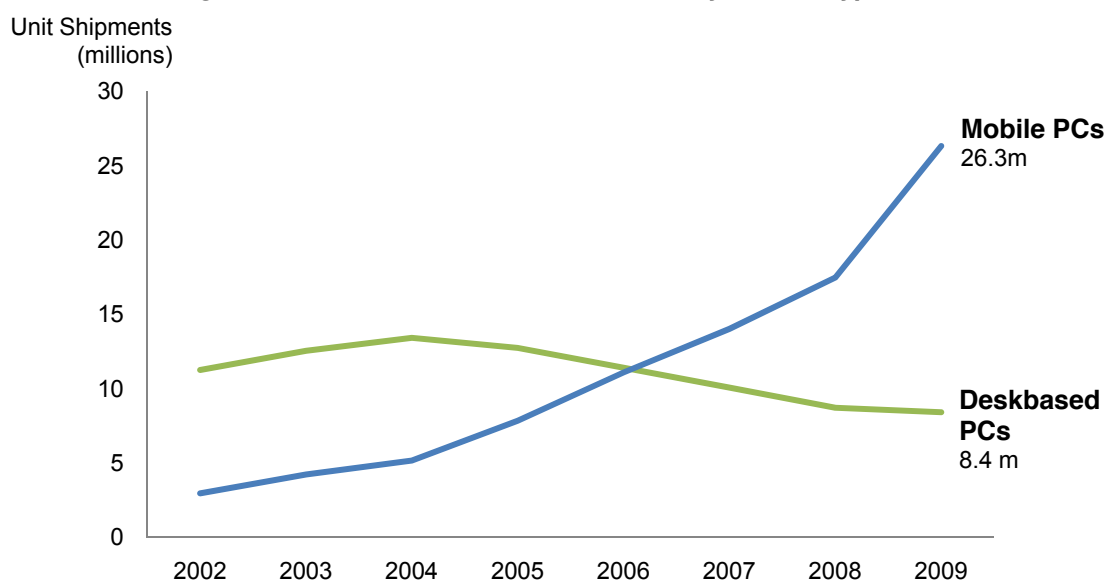
Source: Gartner.

➡ **Original design manufacturers (ODMs) are the primary decision-makers regarding the components included in standard desktop PC designs**. Brands typically provide desired feature sets to an ODM, which then offers the brand a reference design, a product the ODM has already designed that provides as many of the desired features as possible. Reflecting the role of ODMs in PC design, component manufacturers like Intel have begun marketing new products to ODMs rather than brands, because components that are included in ODMs' reference designs can gain market share quickly.[84]

---

[84] Tim Bajarin. July 6, 2009. "ODMs Are Helping to Drive the PC Market." *PC Magazine*. Retrieved from *http://www.pcmag.com/article2/0,2817,2349739,00.asp#*.

➡ **All-in-one and mini PCs are growing market segments.** In 2009, manufacturers released a range of new all-in-one PC models. Some models incorporated features like touch-screens and sought to take advantage of features that the newly-released Windows 7 offered, while other manufacturers sought to make them available at low prices.[85] Strong sales of all-in-one PCs appear to have continued through 2010, with analysts crediting Apple's all-in-one *iMac* with approximately 25% of the year-over-year growth in overall desktop PC shipments that occurred in 2010.[86]

Efficiency Standards

➡ **Desktop PCs have a lower ENERGY STAR penetration than laptops.** In 2009, ENERGY STAR desktop PCs had a market penetration of 27%, while laptops had a penetration nearly three times higher (74%).[87] Although brands stated that residential customers are less interested in PC efficiency than businesses, data from Q1 and Q2 2010 indicates the penetration of ENERGY STAR desktops has remained constant (26%) and varies little between home (25%) and business (23%) users.[88]

➡ **PC brands believe that ENERGY STAR penetration for residential PCs is low because consumers are unwilling to pay the added cost for efficient power supplies**. Brands argue that continuously increasing power supply efficiency requirements in ENERGY STAR specifications limits the penetration of qualified PCs in the consumer market. Manufacturers expect prices of power supplies that meet the current specification to fall and argue that ENERGY STAR penetration in the consumer market could increase if power supply requirements remain constant.[89] The cost premium of an efficient power supply to brands is $8 to $15.

➡ **ENERGY STAR specifications form the basis for mandatory efficiency standards in markets outside the U.S.** As a result, manufacturers would like new ENERGY STAR specifications, which are currently under development, to include a broad range of

---

[85] DisplaySearch. October 21, 2009. "All-in-One PCs Moving to Capitalize on Windows 7, Including Touch Interfaces." Press release. Retrieved from *http://www.displaysearch.com/cps/rde/xchg/displaysearch/ hs.xsl/091021_all_in_one_pcs_moving_to_capitalize_on_windows_7_including_touch_interfaces.asp*.

[86] Trefis Team. January 6, 2011. "Dell Drives to $20 Just By Maintaining Market Share in Recovering Desktop PC Biz." *Forbes*. Retrieved from *http://blogs.forbes.com/greatspeculations/2011/01/06/dell-drives-to-20-just-by-maintaining-market-share-in-recovering-desktop-pc-biz/*.

[87] U.S. Environmental Protection Agency. 2009. *ENERGY STAR Unit Shipment and Market Penetration Report Calendar Year 2009 Summary*. Retrieved from *http://www.energystar.gov/ia/partners/downloads/2009_USD_Summary.pdf*.

[88] Gartner. "Gartner Lowers PC Forecast."

[89] Information Technology Industry Council. March 10, 2011. *ENERGY STAR Computers (Ver. 6) Product Specification Discussion*. Retrieved from *http://www.energystar.gov/ia/partners/prod_development/ revisions/downloads/computer/Stakeholder_Computers_V6_0_Presentation.pdf*.

devices and clearly articulate which devices are outside the specifications' scope. Brands are lobbying for ENERGY STAR specifications to include higher allowances for discreet graphics, as well as for allowances for TV tuners and discreet audio devices.[90]

PC Energy Use

➡ **Seventy-five percent of desktop energy consumption occurs when no one is using the computer.**[91] A recent in-home metering study found that a majority of desktop owners leave their device on nearly all the time: 20% of the metered computers were never turned off and 40% were left on for long periods in which they were idle.[92] Similarly, a study that used software to monitor user activity found that the monitored computers were being actively used only 22% of the time they were on.[93]

➡ **Users may not view utility bill savings as sufficient motivation to alter the way they use their computers.** The majority of participants in a study of residential PC energy use estimated that the amount of energy and cost savings they could achieve by turning off their computers would not be enough to justify changing their behavior. The participants were reluctant to turn off their computers because they wanted the computers to be immediately available and because they feared turning off a shared computer would inconvenience other users.[94]

➡ **Lack of awareness among computer users is another key barrier to increased use of PC power management settings.** While power management settings have the potential to reduce the amount of time PCs spend in *on* mode when not in use, a recent study found that 80% of the PCs monitored had power management features disabled. However, the majority of the households that had been operating the PCs turned power management back on voluntarily after researchers informed them of its benefits.[95]

---

[90] Ibid.

[91] Energy Center of Wisconsin. *Electricity Savings Opportunities.*

[92] Ibid.

[93] Marshini Chetty, A.J. Bernheim Brush, Brian R. Meyers, and Paul Johns. April 2009. "It's Not Easy Being Green: Understanding Home Computer Power Management." *Microsoft Research.* Retrieved from *http://research.microsoft.com/pubs/79362/chiHomePowerManagementchetty.pdf.*

[94] Ibid.

[95] Energy Center of Wisconsin. *Electricity Savings Opportunities.*

5 | GAME CONSOLES

This chapter leads with descriptions of the one high confidence game console opportunity. The market characteristics follow and are important reading for program administrators and designers. The contents are more nuanced than the opportunity descriptions below and they provide context, and hopefully an understanding, of the markets in which programs seek to intervene.

This chapter can be read as a complement to a previous characterization of game consoles, completed in January 2010, and included in *Electronics and Energy Efficiency: A Plug Load Characterization Study*.[96]

HIGH CONFIDENCE GAME CONSOLE OPPORTUNITY

Game Console APD: Increase the penetration of consoles shipped with auto-power-down (APD) enabled by default (set to 1 hour)

Auto-power-down (APD) is a feature that enables a game console to turn itself off after a specified period of inactivity. APD has the potential to reduce the game console duty cycle by preventing unused consoles from remaining in *on-mode* unnecessarily. There are no data on the percent of the console owners that activate APD voluntarily or the length of time delay selected, nor on the percent of players for whom APD would produce significant savings (those whose consoles are typically left on and placed in *home menu*). Given these uncertainties, we estimate greater adoption of a 1-hour default APD has the potential to save **17 GWh** (2.0 aMW) in NEEA territory in 2012-2014.

Energy Savings Calculation and Key Assumptions

Table 25 shows the calculation method for this opportunity. The key assumptions for this calculation are:

→ **Percent of new unit sales currently employing measure**. There are no market data on the penetration of APD for any of the three major consoles; each the three consoles ships with different default APD settings (PS3: 2 hours, Xbox: none, Wii: unknown). All offer a 1-hour time delay option, but there are no data on the percent of users who manually select this option. We estimate 20% of Xbox 360 users manually selected *1-hour APD* (corresponding to our estimate of 80% penetration of default settings more generally).

---

[96]   Peters, et al. *Electronics and Energy Efficiency.*

Table 25: Game Console APD Opportunity Calculation

INPUT	2012	2013	2014	NOTES / SOURCES
Percent PS3 employing measure	0%	0%	0%	
Technical Opportunity Penetration Potential (TOPP): percent of units	**100%**	**100%**	**100%**	*Calculation:* 100% - (Percent PS3 employing measure)
Technical Opportunity Penetration Potential (TOPP): number of units	**107,909**	**53,955**	**26,977**	*Calculation:* (TOPP percent) * (Projected annual PS3 sales in NEEA territory)
Achievable Opportunity Penetration Potential (AOPP) : percent of PS3 units	**10%**	**10%**	**10%**	*Calculation:* (TOPP percent) * (Percent of players with *always-on* console) * (Percent of players with *always-on* console left in *home menu* when idle)
Achievable Opportunity Penetration Potential (AOPP): number of PS3 units	**10,791**	**5,395**	**2,697**	*Calculation:* (AOPP percent) * (Projected annual PS3 sales in NEEA territory)
Delta between current PS3 default APD and 1 hour (hours)	1	1	1	PS3 default APD as of July 1, 2011, is 2 hours
Delta between *idle* power and *off-mode* power for PS3 (watts)	83	83	83	Calculation from constants
Average unit energy consumption (UEC) of new unit sales savings per PS3 (kWh/year)	9	9	9	*Calculation:* ((Delta between current) * (Gaming sessions per week) * (Delta between idle) * *52) / 1000
Annual Achievable PS3 Savings (GWh/yr)	**0.09**	**0.05**	**0.02**	*Calculation:* (Average UEC savings) * (AOPP number)
Percent Xbox 360 employing measure	20%	20%	20%	Estimate
TOPP for Xbox 360: percent of units	**80%**	**80%**	**80%**	*Calculation:* 100% - (Percent of Xbox employing measure)
TOPP for Xbox 360: number of units	**134,961**	**67,480**	**33,740**	*Calculation:* (TOPP percent) * (Projected annual Xbox sales in NEEA territory)
AOPP for Xbox 360: percent of units	**8%**	**8%**	**8%**	*Calculation:* (TOPP percent) * (Percent of players with *always-on* console) * (Percent of players with *always-on* console left in *home menu* when idle)
AOPP for Xbox 360: number of units	**13,496**	**6,748**	**3,374**	*Calculation:* (AOPP percent) * (Projected annual Xbox sales in NEEA territory)
Delta between i*dle* power and *off-mode* power for Xbox 360 (watts)	83	83	83	Calculation from constants
Average UEC savings per Xbox 360 (kWh/year)	706	706	706	*Calculation:* ((Delta between current) * (Gaming sessions per week) * (Delta between idle) * 52) / 1000
Annual Achievable Xbox 360 Savings (GWh/yr)	**10**	**5**	**2**	*Calculation:* (Average UEC savings) * (AOPP number)

INPUT	2012	2013	2014	NOTES / SOURCES
Percent Wii employing measure	0%	0%	0%	
TOPP for Wii: percent of units	**100%**	**100%**	**100%**	*Calculation:* 100% - (Percent Wii employing measure)
TOPP for Wii: number of units	**25,316**	**12,658**	**6,329**	*Calculation:* (TOPP percent) * (Projected annual Wii sales in NEEA territory)
AOPP for Wii: percent of units	**8%**	**8%**	**8%**	*Calculation:* (TOPP percent) * (Percent of players with *always-on* console) * (Percent of players with *always-on* console left in *home menu* when idle)
AOPP for Wii: number of units	**2,025**	**1,013**	**506**	*Calculation:* (AOPP percent) * (Projected annual Wii sales in NEEA territory)
Default time to APD (hours)	1	1	1	
Average UEC savings per Wii (kWh/year)	76	76	76	*Calculation:* ((Delta between current) * (Gaming sessions per week) * (Delta between idle) * 52) / 1000
Annual Achievable Wii Savings (GWh/yr)	**0.15**	**0.08**	**0.04**	*Calculation:* (Average UEC savings) * (AOPP number)
Annual Achievable Savings all consoles (GWh/yr)	**10**	**5**	**2**	
TOTAL Achievable Savings all consoles: 2012-2014		**17 GWh**		

Key Program Design Considerations

➡ **In order to affect game console design, the program will need to work closely with the three major console manufacturers.** Sony, Microsoft, and Nintendo dominate the console market. They are secretive about their product design process, which is costly and of long duration (at least five years) compared to other electronics products. The program will need to cultivate relationships with these manufacturers. One recent effort, by ENERGY STAR, was unsuccessful in developing a specification in which these manufacturers would agree to participate.

➡ **Per-unit incentives are unlikely to sway game console manufacturers.** Console manufacturers spend the better part of a decade and *billions* of dollars to bring each new console generation to market. Any per-unit incentive that is cost-effective for a program is unlikely to affect a manufacturer's design decisions.

➡ **Allowing APD to turn off a console during game play or movie mode will increase savings.** Current APD functionality only turns off the game console if it is left idle in

home menu mode. It seems likely that many users leave consoles on, unattended, in other modes. In this case, APD will not take effect. Sony is currently the only console that allows users to designate that APD take effect in multiple modes.

Barriers

➡ **Game console generations are released infrequently and stay on the market for five to ten years**, so program impacts are unlikely to occur in the typical three-year program cycle.

➡ **Game console manufacturers privilege the quality of play above all else, and will likely be unmoved by energy efficiency funders' typical approaches**. The efficiency funders' bag-of-tricks, like per-unit incentives and marketing support, do not offer substantial benefits to game console manufacturers. Programs will need an entirely new approach to entice these players.

Leverage Points

➡ **Coordinate with other energy efficiency efforts.** The Natural Resources Defense Council is working with game console manufacturers to raise awareness of energy efficiency for the next generation of consoles. The program should coordinate with this effort.

➡ **Negative publicity**. The program will not have many resources at its disposal that will be appealing to game console manufacturers. However, the potential for negative publicity related to the energy consumption of the console, particularly if it cannot scale power, may be one potential leverage point.

➡ **Game developers**. Game console manufacturers depend on the sale of games for a large share of revenue. In fact, the consoles themselves are often sold at a loss in the first few years after their release. The program could work with game developers to both ensure the games accommodate efficiency features and/or tips, and for assistance putting pressure on console manufacturers.

MARKET CHARACTERISTICS

Product Types and Key Manufacturers

Table 26 describes the four major game consoles in use today. Of those currently on the market, the PS3 and Xbox 360 use a similar architecture (and exhibit similar energy-consumption levels), while the Wii differs significantly in construction, processing power, and function (and uses much less energy).

Table 26: Game Console Data

CHARACTERISTIC	NINTENDO WII	MICROSOFT XBOX 360	SONY PLAYSTATION 3	SONY PLAYSTATION 2
Installed base [1]	26%	19%	12%	43%
2010 market share [2]	36%	37%	24%	3%
Units sold to-date, in the U.S. (millions) [3]	31.8	23.5	14.3	52.3
Active play energy consumption, 2010(W) [4]	13.7	87.9	84.8	—
Active play energy consumption, 2006 (W) [5]	16.4	118.8	150.1	35 [6]
Change in active play energy consumption, 2006 to 2010 (W)	(2.7)	(30.9)	(65.3)	—
Retail price	$222.22 [7]	$299.99 [8]	$349.99 [9]	$99.99 [10]
Supports high definition (HD)	No	Yes	Yes	No
DVD functionality	None	Standard	Standard and Blu-ray	Standard
Online functionality	Stream only	Stream and save content	Stream and save content	Online gaming only
Motion gaming functionality	Integrated with console	Sold separately (Kinect)	Sold separately (Move)	Sold separately (Eye Toy)
Company website	www.nintendo.com/wii	www.xbox.com/en-US/	us.playstation.com/ps3	us.playstation.com/ps2/

Continued

[1] Wikia. "Video Game Sales Wiki.NPD Seventh Generation." Data retrieved from http://vgsales.wikia.com/wiki/NPD_Seventh_generation. Calculation of cumulative unit sales to-date as a percent of total sales to-date of the four consoles.

[2] Ibid. Console sales from January-November 2010 (excluding December 2010).

[3] Ibid.

[4] Electric Power Research Institute. December 16, 2010. "Power Play: EPRI Analysis Reveals that Video Game Consoles Differ In Energy Consumption." News Release from *Lowering the Cost of Play.* Retrieved from *http://my.epri.com/portal/server.pt/gateway/PTARGS_0_230564_317_205_776_43/http%3B/uspalecp604%3B7087/publishedcontent/publish/power_play___epri_analysis_ reveals_that_video_game_consoles_differ_in_energy_consumption_da_753432.html.PS2 energy use.*

[5] Ibid.

[6] The Energy Saving Blog. January 31, 2008. "How Much Electricity Does A Sony PS2 Use?" Retrieved from *http://www.energy.gs/2008/01/how-much-electricity-does-sony-ps2-use.html.*

[7] Amazon.com. February 24, 2011. Retrieved from *http://www.amazon.com/Wii-Nintendo/dp/B0009VXBAQ/ref=sr_1_1?ie=UTF8.*

[8] 250 GB model. Microsoft .com. February 24, 2011. Retrieved from *http://www.xbox.com/en-US/xbox360/consoles.*

[9] Sony. February 24, 2011. "250 GB model." Retrieved from *http://us.playstation.com/ps3/systems/250gb.html.*

[10] Sony. February 24, 2011. Retrieved from *http://us.playstation.com/ps2/systems/.*

## *Sales Trends*

Figure 8 and Figure 9 show sales trends for the four currently-available consoles. Figure 8 shows that the PS2 is still the best-selling console, far out-selling all others on the market today. While sales of all consoles have climbed steadily, sales of the Wii have grown faster than the others. Overall sales of video games (not consoles) fell slightly in 2010 and gamers appear to be directing more of their funds towards other forms of entertainment.[97]

Figure 8: Cumulative Sales of Game Consoles in the U.S. Since Launch (2005-2010)
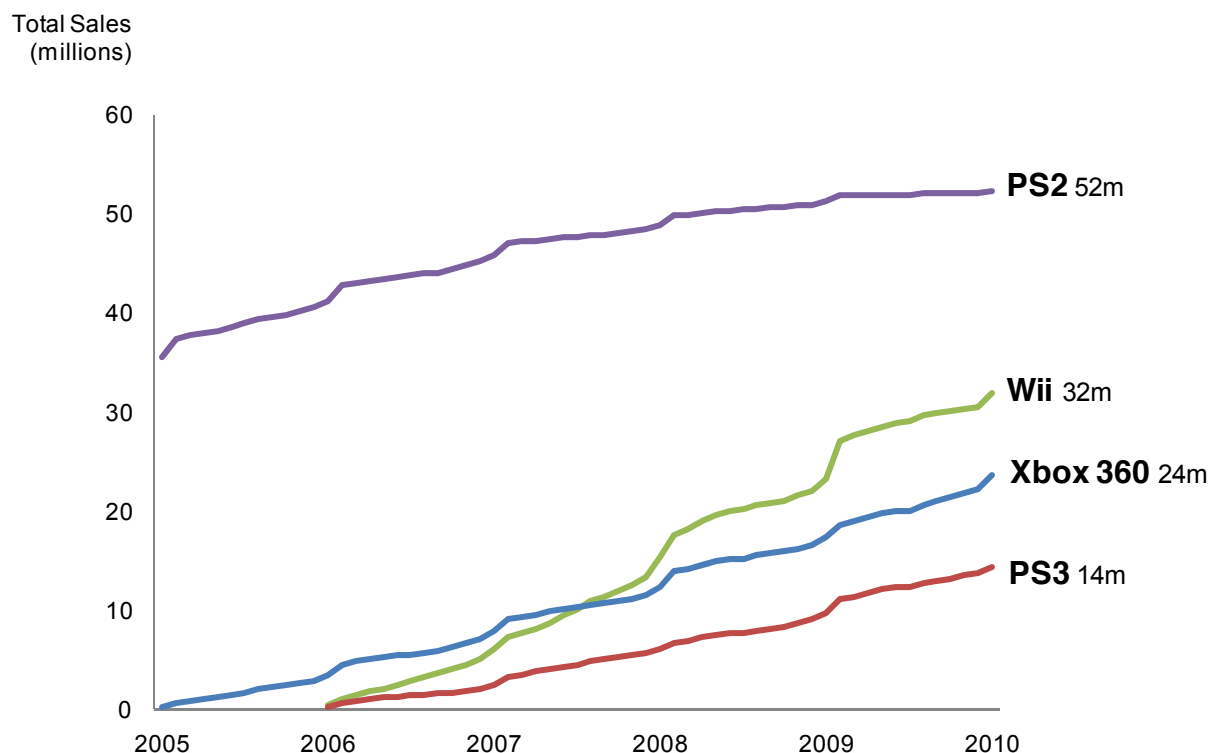
Source: VGChartz. NPD seventh generation. VGChartz - hardware comparison table. Retrieved from *http://www.vgchartz.com/interstitial2.php?url=http://www.vgchartz.com/hwtable.php*

Figure 9 shows that, in 2010, new unit sales of the Wii and Xbox 360 were nearly equal, though travelling in opposite directions – Wii sales have dropped steadily since 2008 and Xbox 360 sales have risen slightly. Sales of the PS3 lag the leaders by about 35% and the PS2, the only sixth generation console, sold only one-tenth as many consoles as the Wii and Xbox 360.

---

[97] Media Daily News. February 21, 2011. "Video Games, Entertainment Purchases Slower in 2010." Retrieved from *http://www.mediapost.com/publications/?fa=Articles.showArticle&art_aid=145313&nid=123980*.

Figure 9: Annual Sales by Console Type (2005-2010)

Total Sales
(millions)

Source: VGChartz. NPD seventh generation. VGChartz - hardware comparison table. Retrieved from
http://www.vgchartz.com/interstitial2.php?url=http://www.vgchartz.com/hwtable.php
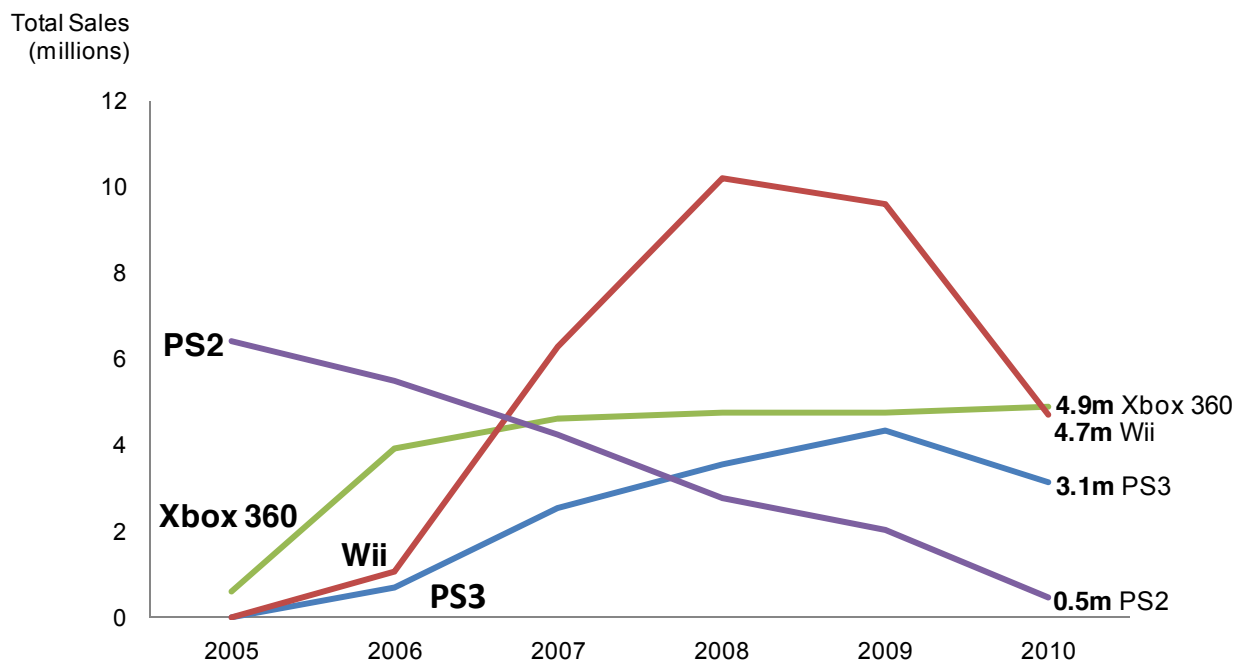
Time Played

Despite a lack of consistent information about the amount of time users spend on their game
consoles, there are some findings of note:

➡ **Users spend more hours on the Xbox 360 and the PS3 than on the Wii**. The most
   recent metered study found players spend about three times as many hours per week on
   the Xbox 360 and PS3 as on the Wii (4.9 and 4.1 hours on the Xbox and PS3, 1.4 hours
   on the Wii).

➡ **The reported number of hours played per week varies considerably**. Reports of hours
   played per week range from 1.4 (metered data) to 13 (user survey).

➡ **Men spend more time playing game consoles than women, and disproportionately
   more time on the Xbox 360 and PS3**. Men play more than twice as many hours per
   week as women on these consoles, compared to 50% more on the Wii.[98]

---

[98] NPD Group. May 27, 2010. "Extreme Gamers Spend Two Full Days Per Week Playing Video Games." NPD
      press release. Retrieved from *http://www.npd.com/press/releases/press_100527b.html*; NeilsenWire.
      December 15, 2010. "Game Consoles Edge Closer to Serving as Entertainment Hubs." Retrieved from
   *continued…*

Other Console Uses

Game console owners are increasingly using their devices to do things *other* than playing games: to stream media; to view DVDs, Blu-ray discs, and downloaded content; and to surf the web. Figure 10 shows the percent of time an average user spends doing three main activities: playing video games (offline and online), watching discs or downloaded media, and streaming content and using the Internet (which includes content from video-on-demand and third-party providers like *Netflix*). The use of game consoles to watch DVD and Blu-ray discs impacts energy consumption significantly. Game consoles typically use about five times as much power to play a disc as a stand-alone DVD or Blu-ray player.[99]

Figure 10: Percent of Time Spent Using Game Consoles for Various Activities, U.S. Users Age 13+ (2010)
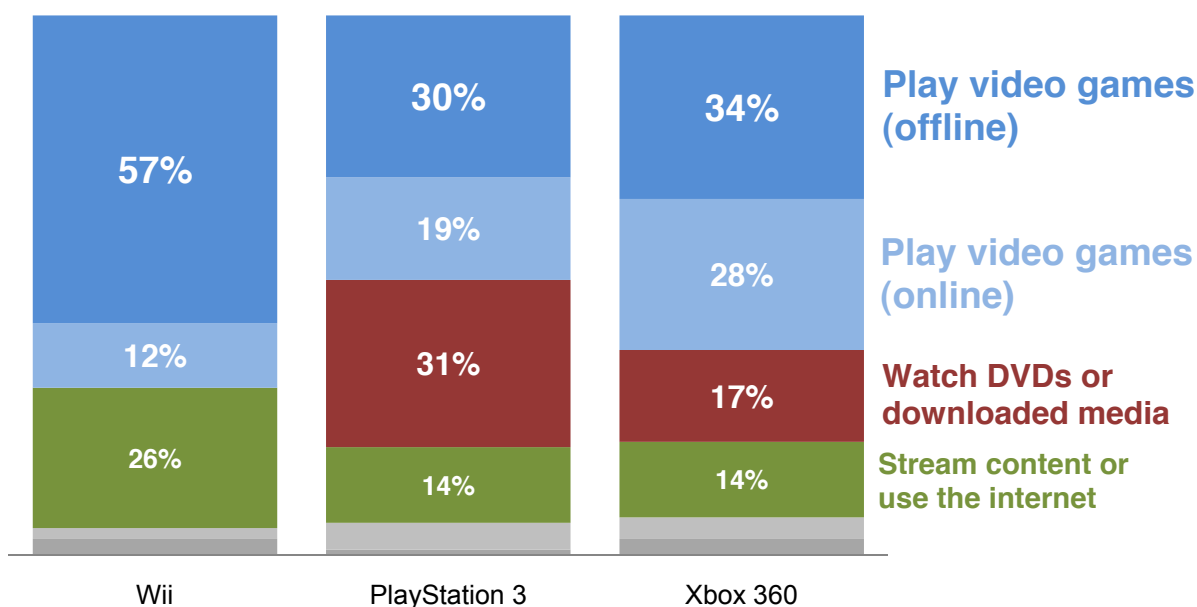
Source: NeilsenWire. December 15, 2010. "Game Consoles Edge Closer to Serving as Entertainment Hubs." Retrieved from *http://blog.nielsen.com/nielsenwire/online_mobile/game-consoles-edge-closer-to-serving-as-entertainment-hubs/*. Breakdown based on consumer-reported data from a survey conducted in October 2010 among "a general population sample in the United States." Additional categories not labeled above and represented at bottom of bars are *listening to music* (CDs, downloaded and streaming) and *other*"

---

http://blog. nielsen.com/nielsenwire/online_mobile/game-consoles-edge-closer-to-serving-as-entertainment-hubs/.

[99] National Resources Defense Council. November 2008. "Lowering the Cost of Play, Improving Energy Efficiency of Video Game Consoles.". *NRDC Issue Paper*. Retrieved from *http://www.nrdc.org/energy/consoles/files/consoles.pdf.*

A few notable findings:

➡ **PS3 users spend the *least* amount of time playing games and the most time watching discs or downloaded media**, likely reflecting the console's ability to play Blu-ray discs and its marketing as an all-around home entertainment device.

➡ **Wii users spend the most time playing games and no time watching discs and downloaded media**, as the Wii does not include DVD functionality.

➡ **Xbox 360 users spend the most time playing online games**.

Marketing Added Functionality

Although manufacturers view game play as the primary purpose of their consoles and note their profits are still driven by game sales, they nonetheless emphasize their console's other capabilities in marketing materials – a clear indication that these features have value to consumers and increase sales. One manufacturer argued a game console's additional functionality makes it a "safer household purchase" and helps users justify the price.

Among the three manufacturers, Sony has made a point of marketing the PS3's breadth of functionality, in particular its Blu-ray capability. Figure 11 shows an image from a Sony marketing campaign, *It Only Does Everything*.[100]

Figure 11: Image from Sony's *It Only Does Everything* Campaign

Image: *Playstationlifestyle.net*. Accessed January 13, 2010.

---

[100]   NeilsenWire. "Game Consoles Edge Closer."

Third-party content providers like *Netflix* are also actively marketing the ability of game consoles to stream content. Figure 12 shows an image from a *Netflix* marketing campaign highlighting the streaming functionality of all three consoles.

Figure 12: Image from a *Netflix* Cross-Promotion with Game Consoles

Image: Netflix. Accessed January 13,2010: *http://www.netflix.com/*.

Supply Chain

A detailed explanation of game console development, manufacturing, and distribution can be found in *Electronics and Energy Efficiency*.[101]

Product Development

Game consoles are different from other consumer electronics in three important ways. Game consoles have:

➡ **Only a few manufacturers and models**. A game console buyer must select from among four models from three manufacturers. A buyer of a DVD player at Best Buy, in contrast, can choose from 40 models by 10 manufacturers.[102] Sony alone currently sells more than 60 models of DVD players.[103]

---

[101]   Jane Peters, Marti Frank, Joe Van Clock, and April Armstrong. January 29, 2010. *Electronics and Energy Efficiency: A Plug Load Characterization Study*. Southern California Edison: Rosemead, Calif.

[102]   Best Buy. January 15, 2010. Retrieved from *http://www.bestbuy.com*.

[103]   Sony. January 13th, 2011. Retrieved from *http://esupport.sony.com/US/perl/select-system.pl?PRODTYPE=41*.

➥ **Longer lifecycles than other consumer electronics products**. Manufacturers release new TV models every year and new PC models two or three times per year – and once new models come to market, the old models are phased out. In comparison, new game console generations have only been released every five years in the past and manufacturers expect to extend their lifecycles to six-to-ten years in the future.[104] Also, many older game console generations continue to sell, even after the next generation is introduced. Sony's PS2, on the market since 1999, sells millions of units every year, a phenomenon unimaginable in the TV or PC marketplace.[105]

➥ **A complex architecture that is expensive to develop**. Game console manufacturers spend billions of dollars designing and developing each new generation of products. The investment required is likely one reason for the small number of manufacturers and also motivates the device's long lifecycle. Extending a console's time on the shelf has two practical benefits for a manufacturer. First, it allows a greater opportunity to recoup development costs. For example, the first releases of both the PS3 and Xbox sold at a loss (-$300 for the PS3 and -$126 for the Xbox) and took more than three years to become profitable.[106] (Here again the Wii differs – its first release sold at a $40 profit.[107]) Second, the long lifecycle also guarantees game developers a market for their products and a consistent revenue stream for manufacturers, whose revenue depends in part on game sales.

---

[104]   There is some disagreement over whether the Wii is of the same generation as the current Xbox and PlayStation models due to its less powerful processor and other differences in architecture. ENERGY STAR® considered the most recent versions of the three major consoles to be part of the same generation when developing its v5.1 computer specification.

[105]   Sony Computer Entertainment Inc. *Unit Sales of Hardware (Since April 2006)*. Retrieved from *http://www.scei.co.jp/corporate/data/bizdataps2_sale_e.html*. Unit sales of PlayStation 2 were 3.1 million worldwide in the first half of 2010.

[106]   Martyn Williams. May 13, 2010. "Sony's Playstation 3 Turns Profitable." *PCWorld*. Retrieved from *http://www.pcworld.com/article/196214/sonys_playstation_3_turns_profitable.html*; Andrew Rassweiler. December 11, 2009."Sony Gets One Step Closer to Breakeven Point with Latest Playstation 3 Design." iSupply press release. Retrieved from *http://www.isuppli.com/Teardowns/News/Pages/Sony-Gets-One-Step-Closer-to-Breakeven-Point-with-Latest-PlayStation-3-Design.aspx*; Leigh Alexander. December 14, 2009.*iSuppli*: "PS3 Rapidly Approaching Profitability As Costs Decline." Gamastura. Retrieved from *http://www.gamasutra.com/view/news/26498/iSuppli_PS3_Rapidly_Approaching_Profitability_As_Costs_Decline.php*; Tor Thorsen. November 23, 2005. "Microsoft taking $126 hit per Xbox 360." *GameSpot.* Retrieved from*http://www.gamespot.com/news/6140383.html*; iSuppli Data available for purchase at *http://www.isuppli.com.*

[107]   Luke Plunkett. December 14, 2006."Wii Autopsy Discovers Manufacturing Cost." Kotaku. Retrieved from *http://kotaku.com/gaming/wii/wii-autopsy-discovers-manufacturing-cost-221736.php*.

Incremental Energy Efficiency Improvements

Although game consoles have long lifecycles, manufacturers continue to make improvements to the models within each generation and these improvements typically decrease energy consumption. The use of smaller CPUs, for example, reduces the manufacturer's cost of materials, increases hard drive capacity, and reduces energy consumption. Since 2006, the typical PS3 power consumption has fallen just over 40%, from 150W to 85W. Similarly, the Xbox 360 has fallen 26%, from 119W to 88W.[108] The Wii has always been the miser of the group, using only 16W in 2006 and 14W in 2010.

Distribution

Distribution of games at various bricks-and-mortar and online retailers is described in *Electronics and Energy Efficiency*.

Retailers suggest local economic conditions have a large impact on game console sales. They noted that sales in Texas and the Northeast seem to have rebounded from the recent recession better than sales in California.

Key Trends

➡ **Microsoft, Nintendo, and Sony continue to dominate the game console industry.**
There are only four game consoles on the market today: the Nintendo Wii, the Microsoft Xbox 360, and Sony's PlayStation 2 (PS2) and PlayStation 3 (PS3). The Wii, Xbox 360, and PS3 are considered to be seventh generation consoles, a grouping defined by their release dates. The PS2 is the only sixth generation console still being manufactured. The Wii and the Xbox 360 make up nearly equal proportions of 2010 unit sales (37% to 38% each), but the PS2 has the largest installed base (43%).[109] Among seventh generation consoles, the Wii is the best-selling (31.8 million units sold to-date), and almost half of Xbox and PlayStation owners also own a Wii.[110] There are several reasons for this. Wii is

---

[108] Electric Power Research Institute. December 16, 2010. "Power Play: EPRI Analysis Reveals That Video Game Consoles Differ In Energy Consumption." News release. Retrieved from *http://my.epri.com/portal/server.pt/gateway/PTARGS_0_2_317_205_776_43/http%3B/uspalecp604%3B7087/publishedcontent/publish/power_play__epri_analysis_reveals_that_video_game_consoles_differ_in_energy_consumption_da_753432.html.*

[109] P.J. Hruschak. October 28, 2009. "PS2 Turns Nine, Sony Says System's 'Life Cycle Will Continue.'" *GamerTell*. Retrieved from *http://www.gamertell.com/gaming/comment/ps2-turns-nine-sony-says-systems-life-cycle-will-continue/.* The PS2 is not part of the current console generation, but it is still available for purchase because of the large number of available games (10,828 as of February 2011) and continued demand from users. Sony has stated that the lifecycle of the PS2 will continue until demand decreases.

[110] NPD Group. September 14, 2009. "Majority of Gamers Rely on Word of Mouth and Hands-On Play at Friends' and Relatives' Homes to Obtain Information on Video Games." NPD press release. Retrieved from

continued…

the least expensive, appeals to families as well as traditional gamers, and, until recently, was the only motion gaming platform.[111] (See Table 26 and Figure 8 for more details.)

➡ **Manufacturers have continuously improved console efficiency** – without incentive or intervention from energy efficiency programs. The central processing unit (CPU) or chip accounts for a majority of game console *on* mode power consumption. Near-constant improvements in the semiconductor industry have resulted in a continuous decrease in chip size and energy use. Sony and Microsoft have incorporated newer and smaller chips into each successive version of their consoles, which has, in turn, reduced console energy consumption. For example, the PS3 on the market today uses about 60% less energy than the initial version, released in 2006.[112]

➡ **Consumers use game consoles for more than playing video games.** Console owners are increasingly likely to use their consoles to watch a DVD, stream a TV show, or surf the web. All three consoles can stream media from third-party online providers like *Netflix*. The PS3 and Xbox 360 can download content and play DVDs, and the PS3 plays Blu-ray discs. (See Figure 10 for a breakdown of console use.)

➡ **Manufacturers are currently making critical decisions about the next generation of game consoles, and energy efficiency is a high priority**. Microsoft and Sony are currently developing their next generation game consoles. Critical choices that will influence the energy consumption of these devices are currently being made. Manufacturers are extremely secretive about the nature of this process and the timing of new console releases, making more detailed information difficult to obtain. However, one manufacturer noted that energy efficiency is a high priority and has numerous benefits, including lower manufacturing costs.

➡ **Motion gaming is the next trend in game console functionality**. Motion gaming allows a user's physical movement to control game play, rather than (or in addition to) the use buttons on a handheld remote control. Nintendo was the first to introduce motion gaming, in November 2006. Motion-sensing capability is integrated into all Wii handheld controllers. Sony released its motion gaming platform, the PS3 Move, in September 2010, followed shortly by the Microsoft Kinect. Users must purchase separate accessories to gain motion gaming functionality for both. The Move (PS3) is a handheld controller

---

http://www.npd.com/press/releases/press_090914.html. Cross-ownership among console models is high. One-third of PS3 owners also have an Xbox 360 and nearly 20% of Xbox 360 owners also have a PS3.

[111] Musa Aykac. October 11, 2008. "Why the Wii Is So Popular?" *Articlesbase*. Retrieved from *http://www.articlesbase.com/art-and-entertainment-articles/why-the-wii-is-so-popular-598548.html*.

[112] Wikipedia January 19, 2010. "PlayStation 3 Hardware." Retrieved from *http://en.wikipedia.org/wiki/PlayStation_3_Hardware. Power consumption of the PS3 at launch (2006) was about 180 W. Today's 3rd generation PS3 consumes about 110 W. The size of the CPU has shrunk from 95 nm to 65 nm. CPU size and power consumption is even lower in the "slim" models (60-73 W and 40-65 nm).*

wand that is "seen" by a peripheral "eye" or camera connected to the console. The Kinect (Xbox 360) relies solely on the user's physical motion, detected by a peripheral device attached to the console. There are no official reports on the energy use of the motion gaming equipment, but based on the technical specifications, it appears that they will use minimal energy.

➡ **There is a lack of data on the total time game consoles spend in *active* or *on* mode, and a lack of *consistent* data on the time they are actually in use**. Estimates of the amount of time gamers spend playing vary widely and are largely based on user surveys. Findings range from 8 to 48 hours per month, depending on the console and the data source.[113] All sources agree that users spend the fewest hours on the Wii. Only one recent study includes metered data of in-home game console use and its sample size is too small and variable to be of use in making generalizations.[114] No user surveys or metering studies provide data on the amount of time game consoles are left on (in *active* or *on* mode) while not in use.

➡ **U.S. energy efficiency standards do not address game consoles**. There are no state or federal energy efficiency standards targeting game consoles. The California Energy Commission has recently included game consoles as a product of interest in preliminary policy discussions, but considered it low priority.

➡ **International energy efficiency standards may address game consoles in the future**. Sony recently proposed a new game console standard for consideration in Europe as part of the EU Lot 6 requirements. The proposal focused on the current generation of products (those available for purchase today) and on auto-power-down modes. Any standard adopted in the EU or elsewhere will affect U.S. products because game consoles are, as most electronics products, manufactured for international markets.

---

[113] NPD Group. "Extreme Gamers Spend Two Full Days."

[114] Energy Center of Wisconsin. *Electricity Savings Opportunities*. Metered data reflects only seven consoles: five Wii consoles and two Xbox 360 consoles. No PS2s or PS3s were metered. In addition, active wattage data varies between systems, a fact that is hard to explain and lessens the credibility the data.

6 | STREAMING MEDIA

This chapter leads with descriptions of the one high confidence streaming media opportunity. The market characteristics follow and are important reading for program administrators and designers. The contents are more nuanced than the opportunity descriptions below and they provide context, and hopefully an understanding, of the markets in which programs seek to intervene.

A note about terminology: The market for streaming content is relatively new and lacks commonly accepted terminology. In this report, we use the following terms:

- **Pay-TV** is any multi-channel TV service that viewers receive through a monthly subscription. It includes cable, satellite, and multi-channel services offered by telecom companies like AT&T and Verizon.

- **Scheduled programming** is TV content delivered by a pay-TV service or over-the-air by a network that determines when it will be broadcast.

- **Time-shifted programming** is TV content that viewers access at a time that is convenient for them. Viewers may access time-shifted programming through a digital video recorder (DVR), a pay-TV provider's on-demand service, or over the Internet.

- **Streaming content** is content that viewers access over the Internet and watch without downloading the content to a local drive.

- **Over-the-top (OTT) devices** allow viewers to stream content on a TV.

- **Cutting the cord** is the act of cancelling or unsubscribing from pay-TV service.

- **Content providers** make streaming content available over the Internet.

- **Content producers** are the TV networks and studios that create TV and movie content. They may distribute the content themselves or license it to other content providers.

HIGH CONFIDENCE STREAMING MEDIA OPPORTUNITY

Eliminate Multi-room DVRs: Increase the replacement of multi-room DVR set-top boxes with thin client set-top boxes

Set-top boxes with digital video recording (DVR) capability are among the biggest energy consumers of all the consumer electronics devices. At least two new technologies may enable users to eliminate a DVR without sacrificing the ability to record and play back TV content. *Thin client* set-top boxes are boxes that stream TV content from a different location, typically another

DVR set-top box in the household. The replacement of multi-room DVRs (more than one DVR per household) with thin client set-top boxes has the potential to save **6.7 GWh** (0.8 aMW) in NEEA territory in 2012-2014.

Energy Savings Calculation and Key Assumptions

Table 27 shows the calculation method for this opportunity.

Table 27: Eliminate Multi-room DVRs Opportunity Calculation

INPUT	2012	2013	2014	NOTES / SOURCES
Given the household has pay-TV, percent that have > 1 set-top box (STB)	50%	50%	50%	Estimate
Percent of NEEA households subscribing to DIRECTV	16%	16%	16%	*Calculation:* 19.4 million * (NEEA population as a percent of U.S.) / (NEEA number of households)
Technical Opportunity Penetration Potential (TOPP): percent of households	**8%**	**8%**	**8%**	*Calculation:* (Percent of NEEA households subscribing to DIRECTV) * (HH with >1 STB)
Technical Opportunity Penetration Potential (TOPP): number of households	**417,100**	**421,271**	**425,484**	*Calculation*: (TOPP percent) * (Number of NEEA households)
Annual STB replacement rate	33%	33%	33%	Estimate
Percent STBs replaced with thin clients, as a result of program	25%	25%	25%	Estimate
Achievable Opportunity Penetration Potential (AOPP): percent of households	**0.66%**	**0.66%**	**0.66%**	*Calculation:* (TOPP percent) * (Annual STB replacement rate) * (Percent annual replacements with thin clients)
Achievable Opportunity Penetration Potential (AOPP): number of households	**34,758**	**35,106**	**35,457**	*Calculation:* (AOPP percent) * (Number of NEEA households)
High definition STB energy use (kWh/year)	124	124	124	Assumes HH have the older DIRECTV STB model #H24-700 instead of the H25-500
Thin client energy use (kWh/year)	60	60	60	Assumed to be comparable to the DIRECTV STB model #D12-300
Energy savings per replaced STB (kWh/year)	64	64	64	*Calculation:* (HD STB energy use) – (Thin client energy use)
Annual Achievable Savings (GWh/yr)	**2**	**2**	**2**	*Calculation:* (Energy savings per replaced STB) * (AOPP number)
TOTAL Achievable Savings: 2012-2014		**6.7 GWh**		

The key assumptions for this calculation are:

➡ **Percent of households with more than one set-top box**. There are no market data on the number of households with multiple DVR set-top boxes. We estimate a 50% penetration of households with pay-TV have more than one DVR box.

➡ **Percent STBs replaced with thin clients as a result of the program.** The program's ability to affect the replacement of DVR boxes with thin clients is uncertain. We estimate the program could lead to the replacement of 25% of the boxes replaced annually with thin clients.

Key Program Design Considerations

➡ **Pay-TV service providers control which box a subscriber receives.** A program will need to work closely with these providers to find an incentive structure and amount that motivates action.

➡ **A program must track market movement to gauge free-ridership.** The pay-TV market is moving to adopt thin clients without program intervention. A program will need to develop a protocol for measuring baseline adoption to avoid high free-ridership levels.

Barriers

➡ **Replacing an STB is expensive.** Pay-TV service providers may be resistant to replacing STBs unless they are broken or specifically requested by the customer.

Leverage Points

➡ **Thin client manufacturers**. A program could work with manufacturers of the device to decrease the incremental cost and increase penetration. See *Electronics and Energy Efficiency* for a complete list of top STB manufacturers.

➡ **Thin clients produce less waste heat than typical STBs** and may last longer and generate fewer customer complaints, reducing costs for pay-TV service providers.

➡ **Consumer demand.** A program could educate pay-TV subscribers about the benefits of thin clients to grow demand.

Other Implementation Options

➡ **Other technologies that support streaming.** RVU is a proprietary technology embedded in a TV that allows the TV to act as the set-top box client, receiving content from another location. RVU-enabled TVs could also serve as "client" STBs, eliminating the need for a DVR box.

MARKET CHARACTERISTICS

Product Types

In 2011, TV viewers have more choice in how they obtain and view TV content than ever before. Broadcast and pay-TV, formerly the only two options, are now supplemented by multiple streaming services that deliver video content over the Internet to many types of devices, including smart phones, tablets, PCs and TVs.

As the availability of and demand for streaming content has increased, a variety of devices have emerged to allow users to view it on their TVs. Devices offering connected TV functionality include computers, game consoles, Internet-enabled Blu-ray players, stand-alone OTT devices, and Internet-enabled TVs (IETVs).

➡ **Computers:** An estimated 22% of U.S. households (one-third of high speed Internet users) have connected a computer to a TV in order to watch streaming content.[115] PC manufacturers offer lines of desktop computers designed specifically to provide access to streaming content. (For additional detail on PC usage and market trends, see Chapter 4.)

➡ **Game consoles:** An estimated 17% of U.S. households (one-third of game console owners) have used a game console to watch streaming content.[116] (Chapter 5 provides additional information on game consoles.)

➡ **Internet-enabled Blu-ray players:** Internet connectivity is becoming an increasingly common feature of Blu-ray players.[117] In 2009, two major manufacturers began offering streaming content through *Netflix* on all of the Blu-ray players they produce.[118]

➡ **Internet-enabled TVs (IETVs):** An estimated 12% of U.S. households have viewed streaming content on an IETV (half of all TV owners who have viewed streaming

---

[115] The Diffusion Group. March 1, 2011. "PC-to-TV Connectivity More Widespread than Percieved.*"* Retrieved from *http://tdgresearch.com/blogs/press-releases/archive/2011/03/01/pc-to-tv-connectivity-more-widespread-than-perceived.aspx.U.S.*household figure adjusted from source statistic.

[116] Janko Roettgers. May 18, 2011. "Netflix Data: AT&T Caps Not That Generous After All." *GigaOM*. Retrieved from: *http://gigaom.com/broadband/netflix-data-caps/.* U.S. household figure adjusted from source statistic.

[117] In-Stat. April 7, 2010. "Shipments of Network-Enabled Blu-Ray Players/Recorders Will Approach 80 Million Units by 2013." Retrieved from *http://www.instat.com/press.asp?Sku=IN1004547ME&ID=2769*.

[118] Matthew Moskovciak. November 23, 2009. "Blu-Ray Players with Built-in Netflix Streaming." *CNET*. Retrieved from *http://reviews.cnet.com/4321-6463_7-6646260.html*. U.S. household figure adjusted from source statistic.

content).[119] Chapter 3 provides a more detailed examination of IETVs, as well as trends in the TV market generally.

➡ **Stand-alone OTT devices:** OTT devices, like the Apple TV, differ from other delivery devices in that their sole function is to bring streaming content to users' TVs. Stand-alone OTT devices are discussed further below.

A survey of U.S. TV viewers in Q1 2010 found that 24% of respondents had a TV connected to the Internet.[120] Figure 13 provides an estimate of the proportion of U.S. households that have used each device type to view streaming content on a TV screen.

Figure 13: Percent of U.S. Households That Have Used Each Device to Stream Content to a TV, 2010-2011
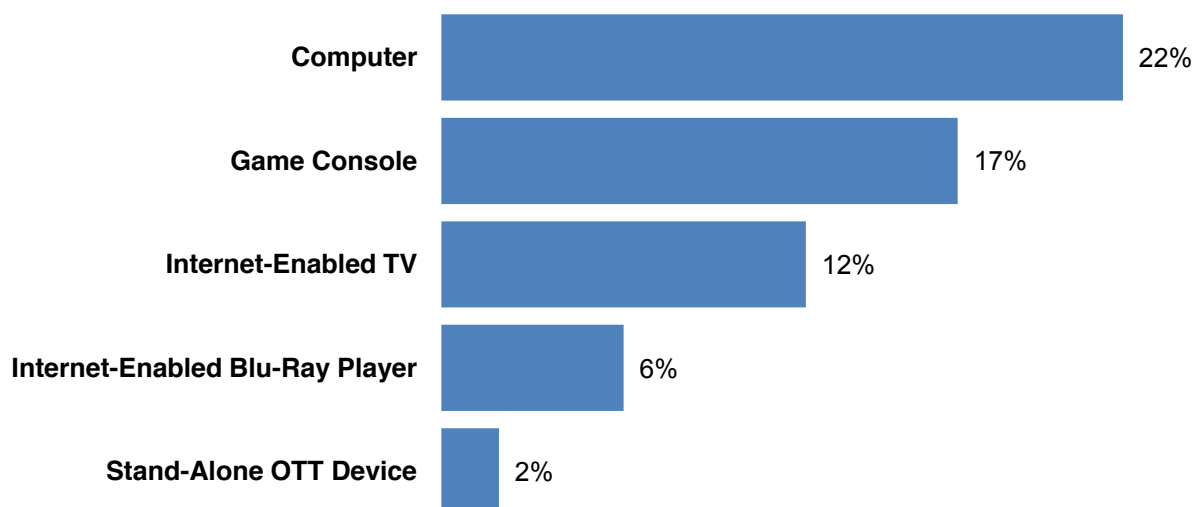
Note: Figures were compiled from multiple sources and adjusted to reflect the proportion of all households, rather than the proportion of households with broadband Internet access. *Stand-Alone OTT Devices* based on unit sales of Apple TV and Roku devices (Table 28:). *Blu-Ray Players*, *IETVs*, and *Game Consoles* are from Leichtman Research Group. Q1 2010."New Ways to Watch Video Increasing" Research Notes. Retrieved from *http://www.leichtmanresearch.com/research/notes03_2010.pdf. Computers* from The Diffusion Group. "PC-to-TV Connectivity More Widespread than Perceived."

---

[119]   Riddhi Patel. December 17, 2010. "LED Backlights Used in 20 Percent of LCD TVs Sold in U.S. During Q3."*iSuppli.* Retrieved from *http://www.isuppli.com/Display-Materials-and-Systems/News/Pages/LED-Backlights-Used-in-20-Percent-of-LCD-TVs-Sold-in-US-During-Q3.aspx.*

[120]   Leichtman Research Group. Q1 2010. "New Ways to Watch Video Increasing." *Research Notes.* Retrieved from *http://www.leichtmanresearch.com/research/notes03_2010.pdf.*

OTT Devices

Table 28: provides detail about four of the stand-alone OTT devices on the market today.

Table 28: Popular Stand-Alone OTT Device Types

	APPLE TV	**ROKU**	**LOGITECH REVUE (GOOGLE TV)**	**BOXEE BOX**
Release date	October 1, 2010	May 20, 2008	November 10, 2010	October 21, 2010
Units sold as of Dec 31, 2010	1,000,000	1,000,000	100,000	Not Available
Price	$99	$60-$100	$299	$199
Content delivery methods	Applications	Applications	Applications	Applications
	Proprietary pay-per-view service (*iTunes*)		Internet search	Internet search
Unique features	Can stream content from and be controlled by other Apple devices	120 content provider applications available as of March 2011	Integrates with pay-TV services to search pay-TV as well as Internet content	Originally a provider of software for TV-connected PCs, includes social media elements
Market characteristics	Rapid adoption compared to other devices; analysts speculate a wider range of applications will become available[1]	The attention Apple TV brought to OTT devices boosted Roku sales, which doubled over the course of 2010[2]	Limited sales as a result of content producers blocking access to content; high video processing and memory requirements increase device cost[1]	Expects to sell 100,000 units by end of 2011; software is available for download on TV-connected PCs independent of Boxee box and is more widespread; some content producers have blocked access[3]

[1] Source: Paul Sweeting. November 8, 2010. "The Connected TV Marketplace." *GigaOM Pro*. Retrieved from *http://pro.gigaom.com/2010/11/report-the-connected-tv-marketplace/#briefing*.

[2] *Source:* Devindra Hardawar. December 21, 2010. "New Apple TV Sales Nearing 1M, But Rival Roku Is Keeping Up." *MediaBeat*. Retrieved from *http://venturebeat.com/2010/12/21/apple-tv-1m-sales-roku/#*.

[3] *Source:* Irene Chen. December 28, 2010. "D-Link Sees Better than Expected Boxee Box Sales." *DigiTimes Systems*. Retrieved from *http://www.digitimes.com/news/a20101227PD222.html*.

Stand-alone OTT devices provide access to content in three ways:

➡ **Applications** created by content providers give users an interface that allows them to access content from a content provider without using a web browser. Examples include the *Netflix* and *Hulu* applications available on a variety of devices.

➡ **Internet search**, as on a computer, provides access to streaming content from a variety of providers, typically through a web browser.

➡ **Proprietary services**, like Apple's *iTunes*, are similar to applications, but are associated with a device manufacturer and are not available on other manufacturers' devices.

Content Providers

Content providers make streaming content available over the Internet. While content providers vary in their approach to content delivery, they share four key characteristics:

➡ **They may or may not be content *producers*.** Most major content producers act as content providers, making at least some of their content available directly for streaming. For example, major TV networks make recent shows available for streaming through their websites. However, some of the biggest content providers, like *Netflix* and *iTunes*, are not content producers. Rather, these providers license content from producers.

➡ **They make content available across multiple device types.** With the exception of Apple's *iTunes* service, most of the top content providers make streaming content available to users on a variety of devices. For example, *Netflix* is available on all of the devices listed in Table 28.

➡ **They may offer content both on a website and through applications.** Content providers typically operate websites that allow users to stream content through a web browser.[121] Many content providers also offer applications that allow users to access content on devices that do not offer a web browser or do not support Adobe's *Flash* video format. For example, *Netflix*, *Hulu*, and Major League Baseball's *MLB.TV* all offer applications for Internet-connected TV devices.

➡ **They have developed three methods to generate revenue**:

Subscription services offer content to subscribers who pay a monthly or annual fee. Examples include *Netflix*, *MLB.TV*, and *Amazon Prime*.

Pay-per-view services charge subscribers for each TV episode or movie they view. These services rent content by making it available to users for a set time period or sell it for unlimited use. Examples include *iTunes*, *Vudu* (a content provider owned by Walmart), and *CinemaNow* (owned by Best Buy).

---

[121] Apple's *iTunes* service is, again, a notable exception.

Advertising-supported services display paid advertisements interspersed with content. These services typically do not charge users for access. The most prominent advertising-supported content providers, including *Hulu* and major TV networks, have blocked access to their "free" content on some Internet-connected TV devices.

➡ **Some content providers may use more than one method to generate revenue**. For example, *Hulu* offers a subscription *Plus* service that provides additional content and is available on a wider range of devices than its advertising-supported basic service. Amazon offers content on a pay-per-view basis that is available without additional fees to its *Prime* subscribers. Table 29 lists examples of streaming content providers.

Table 29: Example Content Providers Streaming TV and Movie Content

	CONTENT TYPE(S)	REVENUE SOURCE		
		Subscription	**Pay-Per-View**	**Advertising**
Amazon Prime	Past season TV shows, movies	X	X	
TV network websites (ABC, CBS, Fox, NBC, ESPN, Comedy Central)	Current TV shows and sports			X
Hulu	Current and last season TV shows, movies	X		X
iTunes	Current and past season TV shows, movies		X	
Mlb.tv/NHL Gamecenter Live/NBA Gametime	Live sporting events	X		
Netflix	Past season TV shows, movies	X		
Pay-TV providers	Live and current TV shows	X		X
VEVO	Music videos			X
Vudu	Movies		X	

There is no single ranking of content providers' popularity. Table 30 lists the top providers of advertising-supported online video content based on total unique viewers.

Table 30: Top 10 Advertising-Supported Streaming Content Providers, January 2011

	TOTAL UNIQUE VIEWERS (MILLIONS)	VIEWING SESSIONS (MILLIONS)	MINUTES PER VIEWER
Google Sites (including YouTube)	144.0	1,912.5	283.4
VEVO	51.0	121.0	91.9
Yahoo! Sites	48.7	193.0	38.0
Viacom Digital	48.1	119.6	61.1
AOL, Inc.	44.5	167.8	22.5
Facebook.com	42.0	122.6	15.4
Microsoft Sites	38.1	149.6	62.0
Turner Digital	28.2	88.7	26.6
Fox Interactive Media	25.4	57.6	18.2
Hulu	25.0	127.0	236.4

Source: comScore. February 15, 2011. "comScore Releases January 2011 U.S. Online Video Rankings." Retrieved from http://www.comscore.com/Press_Events/Press_Releases/2011/2/comScore_Releases_January_2011_U.S._Online_Video_Ra nkings.

Note: Netflix might not be on the list because it trails in total unique viewers. As of Q4, 2010, Netflix had just over 20 million subscribers. A LRG survey in Q1, 2010, found that 55% of Netflix subscribers had used the *watch instantly* feature in the past month. Given those figures, Netflix should have about 11 million viewers/month. It is worth noting that as advertisers are the intended audience, the methodology for the research might not include pay-per-view and subscription-based services.

The dominance of Google's video sites, which include *YouTube*, suggests that a notable portion of the ad-supported steaming content consists of short clips and user-produced videos rather than long-form movies and TV shows. However, the presence of *Hulu* and major content producers among the top streaming content providers indicates a strong demand for streaming more typical TV content.

Web Browsers

Web browsers used with connected TV devices provide access to streaming content from providers who have not developed applications. As noted, however, some content producers have blocked access to their content through these browsers. Browsers for connected TV devices include *Google TV*, *Kylo*, and Boxee's software, which users can run through the *Boxee Box* or download to a TV-connected PC. Some of these devices, like *Google TV*, provide users with the ability to search both for online content and for content available through their pay-TV service.

Key Trends

Time Shifting

➡ **Americans are increasingly watching time-shifted TV.** In Q1 2010, nearly 95 million Americans watched time-shifted TV, an increase of 18.1% over the previous year. These

viewers watched an average of 9.5 hours of time-shifted TV per month.[122] Overall, more than 60% of digital cable subscribers have used time-shifting technologies and a study in September 2010 found that 52% had done so during the past month.[123] Viewers report they time-shift TV content for convenience and because it allows them to see TV programs they were unable to watch when they originally aired.[124]

➡ **Most viewers watch time-shifted content from a DVR rather than the Internet or a pay-TV provider's on-demand service.** Forty-one percent of U.S. viewers planned to use a DVR to watch time-shifted primetime television content during the 2010-2011 television season, more than double the proportion that planned to watch online (17%) or through pay-TV service providers' on-demand services (16%).[125] Since viewers typically use DVRs in conjunction with a pay-TV service, the prevalence of DVRs as time-shifting technologies may be a barrier to viewers' willingness to give up pay-TV service for online viewing.

Streaming Content

➡ While estimates of the proportion of U.S. households that currently watch streaming content vary, demand for online video will continue to grow. Reports of the percent of U.S. adults in households with broadband Internet access who regularly stream long-form video vary from as few as 11% to as many as 40%.[126] Analysts predict the number of U.S.

---

122   The Nielsen Company. *Three Screen Report*.

123   Comcast. August 17, 2010. "Comcast's Annual 'TV Pulse Survey' Shows the Drama Genre and New Hawaii Five-O Are the Most-Anticipated 'What to Watch' This Fall TV Season." Press release. Retrieved from *http://www.comcast.com/About/PressRelease/PressReleaseDetail.ashx?PRID=1000* ; Leichtman Research Group. Q3 2010. "DVRs Now in 40% of U.S. TV Households." *Research Notes.* Retrieved from *http://www.leichtmanresearch.com/research/notes09_2010.pdf*.

124   Tania Yuki. June 17, 2010. "Blurring the Landscape: How TV is Merging Digital and Traditional Media." *comScore*. Retrieved from *http://www2.comscore.com/l/1552/BlurringtheLandscapeJune17-pdf/PHU2B*.

125   Comcast. "Comcast's Annual 'TV Pulse Survey." Leichtman. "DVRs Now in 40% of U.S. TV Households."

126   Estimates include: 3% of adults watch full-length TV shows online daily and 11% do so weekly; 17% of viewers were planning to watch primetime TV online during the 2010-2011 broadcast season; 18% watched free, full episodes of TV online in 2010; 29% are watching scripted TV content both online and on TV and 6% are watching online only; and 40% of U.S. homes with broadband access regularly watch "long form video" on a computer. Sources: Leichtman Research Group. 2010. "Emerging Video Services IV." Retrieved from *.http://www.leichtmanresearch.com/research/emerging_vid_brochure.pdf*; Comcast. "Comcast's Annual 'TV Pulse Survey."; Convergence Consulting Group. *The Battle for the North American (US/Canada) Couch Potato*"; Yuki. "Blurring the Landscape." Parks & Associates. August 17, 2010. "Consumption of PC Video Is Still Increasing, but TV Still Main Video Source for Households." *Marketwire*. Retrieved from *http://www.marketwire.com/press-release/Consumption-of-PC-Video-Is-Increasing-but-TV-Still-Main-Video-Source-for-Households-1305766.htm*.

households that access streaming content will more than double by 2014 and revenue will triple.[127]

➜ **Nearly a quarter of U.S. households can access streaming content through their TV.** Game consoles most often provide TV Internet connectivity (20% of households), followed by Internet-enabled TVs (8%) and Blu-ray players (6%). Figure 13 provides additional information on devices used to access streaming content. Overall, 1% of adults use these devices to watch streaming content daily and 5% do so weekly.[128]

➜ **Streaming content accounts for a significant portion of home Internet use.** During peak evening hours, *Netflix* users account for more than 20% of all Internet download traffic.[129] In addition, estimates of the proportion of homes that have broadband Internet access but do not subscribe to a pay-TV service (5%) parallel estimates of the proportion of viewers who exclusively consume content over the Internet (6%).[130]

➜ **The number of providers offering streaming content is growing quickly.** There is no definitive source for the number of content providers, but a single device, the Roku set-top box, lists 120 content providers available to users, offering content ranging from Irish sports, to Buddhist teachings, to programming "for the aviation enthusiast." While *Hulu* and *Netflix* were early entrants to the streaming market and continue to lead, new and sometimes unexpected providers continue to enter the market. Recent entrants include companies whose primary business lies in other areas, including *Amazon.com*, *Redbox*, and Walmart.

Pay-TV versus Streaming Content

➜ **Pay-TV remains the dominant form of home entertainment.** Although the total number of pay-TV subscribers declined for the first time in Q2 and Q3 2010, subscriptions for the year were up. As of the end of Q3 2010, 89% of U.S. households subscribed to a pay-TV service.[131]

---

[127] Rick Vogelei. June 25, 2010. "OTT Video Providers Jockeying for Position as Market Heats Up." *In-Stat.* Retrieved from *http://www.in-stat.com/press.asp?ID=2803&sku=IN1004653CM*.

[128] Leichtman. "New Ways to Watch Video Increasing."

[129] Tim Arango and David Carr. November 24, 2010. "Netflix's Move Onto the Web Stirs Rivalries." *New York Times.* Citing study by Sandvine: *http://www.sandvine.com/news/pr_detail.asp?ID=288.*

[130] Wayne Friedman. December 30, 2010. "TV Dominates As Live Medium, Cord-Cutting Disputed." *MediaDailyNews.* Retrieved from: *http://www.mediapost.com/publications/?fa=Articles.showArticle&art_* aid=141576. Citing study by Turner Broadcasting., (Yuki 2010).

[131] Leichtman Research Group. Q4 2010. "Few Don't Get It." *Research Notes.* Retrieved from *http://www.leichtmanresearch.com/research/notes12_2010.pdf*; SNL Kagan. November 17, 2010. "SNL Kagan Analysis Shows U.S. Multichannel Video Subscribers Drop for Second Straight Quarter." Retrived from *http://www.snl.com/InTheMedia.aspx#.*

➡ **Some pay-TV subscribers are cutting the cord, but there is no clear data on how many.** Recent studies provide conflicting information on how many people have cancelled pay-TV service in the last few years, and one analyst called the existing data "muddy." Two studies of TV viewer behavior in Q3 2010 found that: in one, 0.3% of people reported replacing pay-TV with streaming content; and, in the other, about the same percent of respondents cancelled pay-TV, but maintained a high-speed Internet connection. A more recent survey reported that 5.5% of respondents cancelled pay-TV service in the past year and 4.4% planned to do so.[132] While only a small fraction of households have cancelled their pay-TV service over the last year, the majority of those that did likely replaced pay-TV with online content.[133] These households account for two-thirds of the net loss in pay-TV subscribers over the same period.[134]

➡ **At least 13 and as many as 50 times more viewers have *considered* cord-cutting than have actually done so.** A study conducted in Q4 2009 and Q1 2010 found that 4% of respondents had considered canceling their pay-TV subscription and watching streaming content, more than 13 times the proportion of respondents who reported having done so (0.3%).[135] That number may be even higher now. A study conducted in Q3 2010 found that 15% of respondents had considered cutting the cord.[136] Subscribers to *Netflix*'s streaming video service are more likely to consider cord-cutting than other viewers.[137]

➡ **Limited availability of streaming content is a significant barrier to cord-cutting.** Between 13% and 25% of respondents, depending on race, reported they would cancel their pay-TV service if more of "their favorite content" were available for streaming.[138]

---

[132] Matt Carmichael. April 18, 2011. "Consumers Aren't so Keen on Cutting the Cord After All, Survey Finds." *Ad Age Mediaworks.* Retrieved from *http://adage.com/article/mediaworks/television-consumers-keen-cutting-cord/227014/.*

[133] Leichtman. "New Ways to Watch Video Increasing." ESPN. "First Nationally Projectable Study Shows Multichannel Loss to 'Cord Cutters' Just 0.1% of U.S. Households." *ESPN MediaZone.* Retrieved from *http://www.espnmediazone3.com/us/2010/12/06/study-on-cord-cutting/.*

[134] Nielsen data suggests that 0.17% of viewers began a new pay-TV subscription during the period analyzed, offsetting the 0.28% decline in subscribership among viewers who maintained high-speed Internet connections, for a net decline of 0.11% (ESPN. "First Nationally Projectable Study."). In Q3, 2010 total pay-TV subscribership declined by 0.15% (Leichtman Research Group. "New Ways to Watch Video Increasing.").

[135] Ibid.

[136] Matt Richtel and Brian Stelter. August 23, 2010. "In the Living Room, Hooked on Pay TV." *The New York Times.* Retrieved from *http://www.nytimes.com/2010/08/23/business/media/23couch.html.*

[137] Erick Schonfeld. January 5, 2011. "Netflix Streaming Is the Gateway Drug to Internet TV." *TechCrunch*. Retrieved from *http://techcrunch.com/2011/01/05/netflix-streaming-internet-tv/#.*

[138] Erik Sass. December 27, 2010. "Minorities Over-Index in Multiplatform TV Viewing." *MediaDailyNews*. Retrieved from: *http://www.mediapost.com/publications/?fa=Articles.showArticle&art_aid=141970*. Citing study by Horowitz Associates, "Multiplatform Content and Services: Multicultural Edition."

Anecdotal accounts in the popular press support this finding, quoting consumers who expressed a desire to cancel their pay-TV subscriptions if more content from premium channels like HBO were available for streaming.[139]

➡ **Younger viewers are more likely to view streaming content and to cut the cord.** Viewers ages 18-24 are more likely to watch streaming content and more likely to access streaming content through their TVs than the population as a whole.[140] Consistent with these findings, one study found that viewers under 45 were significantly more likely to consider cutting the cord and another reported that its cell-phone-only sample, which disproportionately represents young people, was five times as likely as the population as a whole to cut the cord.[141]

➡ **At the moment, and for the vast majority of viewers, streaming content complements, but does not replace, pay-TV.** A recent survey found that, in 2010, the 18% of viewers who accessed streaming content streamed, on average, one to two full-episode TV shows per week. Those one to two episodes account for only 5% of the average viewer's weekly viewing time.[142] Consistent with these findings, viewers report that accessing streaming content has not reduced the frequency with which they watch scheduled programming.[143] Rather, people who access both scheduled and streaming content consume more TV content than viewers who watch only scheduled programming.[144]

➡ **Viewers prefer to access most types of TV content through scheduled programming rather than streaming.**[145] While streaming allows for the increased convenience of time-shifting, viewers stated that watching scheduled programming allows for better picture quality, higher sound quality, and provides access to content immediately when it is

---

[139]   Richtel and Stelter. "In the Living Room, Hooked on Pay TV." David Lieberman. January 6, 2011. "Web and Other Options Are Shaking Up How We Watch TV." *USA Today.* Retrieved from *http://www.usatoday.com/tech/news/2011-01-04-1Acable04_CV_N.htm.*

[140]   Vogelei. "OTT Video Providers Jockeying for Position." Yuki. "Blurring the Landscape."; Leichtman. "New Ways to Watch Video Increasing."

[141]   Richtel and Stelter. "In the Living Room, Hooked on Pay TV." Leichtman. "New Ways to Watch Video Increasing."

[142]   Convergence Consulting Group Ltd. 2011. *The Battle for the North American (US/Canada) Couch Potato: Online and Traditional TV, and Movie Distribution.* Retrieved from *http://www.convergenceonline.com/downloads/NewContent2011.pdf.*

[143]   Yuki. "Blurring the Landscape."; Leichtman. "Emerging Video Services IV."

[144]   Yuki. "Blurring the Landscape."

[145]   Yuki. "Blurring the Landscape." Exceptions include lifestyle/home, celebrity/entertainment, and reality TV programming. Pluralities of viewers who access content both online and on TV had no preference regarding the source of these programming types.

broadcast.[146] While the differences in quality between streaming content and scheduled programming are most pronounced when viewers use a computer or mobile device to access the content, streaming content may provide inferior picture and sound quality, even when viewed on a TV.

➡ **Content production is a consolidated market.** Seven companies (CBS, Disney, Discovery, Fox, NBC Universal, Time Warner, and Viacom) create approximately 90% of all professionally produced video content in the U.S.[147] These vertically-integrated companies profit from pay-TV services.

➡ **Some content producers have taken steps to ensure that pay-TV remains the dominant source of content viewers access on their TVs.** Content producers have blocked access to their content on devices that display the content on a TV, even when the same content is available for streaming on other devices. In addition, content producers have declined to make some high-demand TV shows and sporting events legally available online. For example, in 2011, the Versus cable network (which is part of NBC, a subsidiary of Comcast) will no longer provide live streaming of IndyCar auto races in an effort to raise the Nielsen ratings of the races' TV broadcasts.[148]

➡ **Consumers may be reluctant to pay to view streaming content on a TV when that content is available free on other screens**, like a computer or mobile device. More than 80% of survey respondents said they would not be willing to pay $9.95 per month to watch streaming content from an online service like *Hulu*.[149] The relatively low subscribership of *Hulu*'s premium *Plus* service appears to support this finding. Although users must subscribe to *Hulu Plus* in order to view *Hulu* content on a TV or tablet, only approximately 4% of *Hulu* users subscribe to the *Plus* service.[150] User reviews of *Hulu*'s iPad application, which requires a subscription to *Hulu Plus*, expressed dissatisfaction with the requirement to pay for content that users could view for free on other screens.

➡ **Pay-TV service providers are beginning to provide streaming content and seeking to integrate online features with TV viewing.** Cable, IPTV, and satellite service providers

---

[146]   Ibid.

[147]   Lieberman. "Web and Other Options Are Shaking Up How We Watch TV." Richtel and Stelter. "In the Living Room, Hooked on Pay TV."

[148]   Marshall Pruett. March 12, 2011. "IndyCar: Changes to Streaming video for 2011." *Speed.* Retrieved from *http://auto-racing.speedtv.com/article/indycar-changes-to-streaming-video-for-2011/.*

[149]   Leichtman. "New Ways to Watch Video Increasing."

[150]   Industry newsletter *Fierce IPTV* reports that Hulu expects to pass 1 million+ subscribers in 2011; in January 2011, *comScore* reported that Hulu had just under 25 million unique viewers. Jim O'Neill. February 3, 2011. "Hulu CEO Kilar Raps Traditional TV's Model, Lays Out 'Future of TV.'" *Fierce IPTV*. Retrieved from *http://www.fierceiptv.com/story/hulu-ceo-kilar-raps-traditional-tvs-model-lays-out-future-tv/2011-02-03. Yuki. "Blurring the Landscape."*

are responding to competition from streaming content providers with a "TV everywhere" strategy, making pay-TV content available to stream on multiple devices.[151] However, some content producers have resisted pay-TV providers efforts to stream their content.[152] Service providers are also providing online functionality to allow subscribers to change channels and program DVRs over the Internet.[153]

---

[151]   Matthew Huntington. March, 2011. "Taking Multi-Screen TV to the Next Level." *Videonet*. Retrieved from *http://viewer.zmags.com/publication/5abf8aec#/5abf8aec/26*.

[152]   Wayne Friedman. April 4, 2011. "Cablevision Debuts iPad App, Users Access 300 Channels." *MediaDailyNews*. Retrieved from *http://www.mediapost.com/publications/?fa=Articles.showArticle&art_aid=147944&nid=125394*.

[153]   David Pogue. March 2, 2011. "Cable TV In Pursuit of Mobility." *The New York Times.* Retrieved from *http://www.nytimes.com/2011/03/03/tech nology/personaltech/03pogue.html.*

APPENDICES
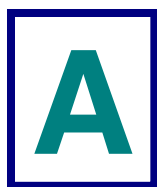
A METHODOLOGY

This study was composed of three distinct phases, each with its own research approach and deliverables. Each phase was expected to provide the foundation for its successor (Table 31).

Table 31: Consumer Electronics Project Structure

OBJECTIVE	RESEARCH APPROACH	DELIVERABLE
Market Characterization	Literature review and in-depth interviews	Market characterization chapters on each product type, list of opportunities
Opportunity Identification	Vet opportunities identified during market characterization research, supplement with research team's industry knowledge	List of vetted opportunities
Opportunity Assessment	Estimate potential energy savings for each opportunity achievable in NEEA territory 2012-2014	Ranked list of opportunities by potential energy savings, in-depth write-ups of selected opportunities

MARKET CHARACTERIZATION

The first objective of this study was to characterize the market for TVs, desktop PCs, game consoles, and a fourth product category, referred to in the scope of work as *set-top box alternatives*. The latter quickly resolved into a broader treatment of pay-TV versus streaming media, of which alternatives to the pay-TV set-top box are but one element in a much larger landscape. As a result, the chapter is called *Streaming Media*.

Data for the market characterization came from a literature review and interviews with market actors.

Literature Review

The literature review covered published reports, news releases, articles in online and print publications and a limited amount of purchased market research data. Key sources for each chapter included:

➡ **TVs**: *CNet*, Consumer Electronics Association, *DisplaySearch*, ENERGY STAR, *Information Display*, *iSuppli*, *The New York Times*, The Nielsen Company, NPD Group

➡ **Desktop PCs:** Energy Center of Wisconsin, Gartner, NPD Group, *PCWorld*, Pew Internet & American Life Project, The Nielsen Company, *TWICE*

➡ **Game Consoles**: Energy Center of Wisconsin, EPRI, *iSuppli*, NPD Group, *PCWorld*, The Nielsen Company,*VGSales.com*

➡ **Streaming Media**: comScore, iSuppli, MediaDailyNews, PC Magazine, The New York Times, The Nielsen Company,

Interviews

Interviews with industry actors focused on identifying energy efficiency opportunities. Each interview lasted 30 to 90 minutes with some follow-up conversations by phone and/or email. Interview questions can be found in Appendix B. Interviews were sought with top manufacturers and candidates were identified based on Ecos' and Research Into Action's market knowledge, as well as Internet searches.

Table 32 lists the organizations we consulted and their area(s) of expertise.

Table 32: Completed Interviewees by Type

	INTERVIEWS
BRAND REPRESENTATIVES	
TVs	6
Desktop PCs	3
Game consoles	1
Over-the-top set-top boxes	3
Total Interviews	13
ENERGY EFFICIENCY ORGANIZATIONS	
Consortium for Energy Efficiency (CEE)	2
ENERGY STAR	2
Energy Trust of Oregon (ETO)	1
Lawrence Berkeley National Laboratory (LBNL)	1
Northeast Energy Efficiency Partnerships (NEEP)	1
Total Interviews	7
OTHER	
Retailers	2

OPPORTUNITY IDENTIFICATION

A total of 34 opportunities were identified from the following sources:

➡ Interviews with market actors

➡ Secondary literature review

➡ Ecos' and Research Into Action's industry knowledge

The opportunities were placed in an *Excel* table that included a shortened name for the opportunity, description, origin and whether the technology was sufficiently developed to allow the opportunity to be implemented in a programmatic context by 2014.

It is important to note that *all* opportunities were included in the initial list, regardless of whether the team had confidence in their potential to produce savings. For example, even though the team doubted that a TV's download acquisition mode could replace a pay-TV set-top box, the opportunity was included in the list because it was suggested by an interviewee.

OPPORTUNITY ASSESSMENT AND PRIORITIZATION

Assessment

Once the team finalized the list of opportunities, we vetted them according to whether they did in fact have the potential for savings and whether those savings were achievable by 2014. After the vetting was complete, we began the quantification process. We specified constant values and developed a template that would allow us to quantify a large number of opportunities using the same set of constants. Some constants applied to opportunities in every device type (for example, households in NEEA territory), others applied to only one device type (for example, projected TV screen-size distribution of new-unit sales). The team used the template and constants to calculate technical and achievable savings for each opportunity for which sufficient data were available and which was estimated to have the potential to be implemented by 2014.

The team defined the inputs required and the methodology for calculating technical vs. achievable energy savings as follows.

Inputs

➡ **Technical opportunity penetration potential (TOPP):** the total percent of units not employing the opportunity (the baseline).

100% – (percent employing) – (percent that can't employ)

➡ **Achievable opportunity penetration potential (AOPP)**: the percent of units that could be reached by a program

TOPP * (percent of units estimated to be reachable)

Calculation Methodology

➡ **Technical potential (annual):** energy savings potential if all units not previously employing the opportunity are affected

（Number of units) * TOPP * (Annual UEC savings)

➡ **Achievable potential (annual):** energy savings potential if only units reachable by a program are affected

(Number of units) * AOPP * (Annual UEC savings)

Prioritization

The team selected 13 opportunities to investigate in further detail. The selection was based on energy savings potential (as projected in this report) and the level of engagement required from a program perspective (as estimated by NEEA).

B INTERVIEW GUIDE

The questions in this guide were used in telephone interviews with product manufacturers. Words in CAPS are placeholders for the relevant proper noun(s).

1.   What are the top features you use to promote your PRODUCTS today – what features do you see as the most important to consumers today?

2.   What new features, or improvements to existing features, will be important in the next wave of PRODUCTS that will come to market in the next two to three years?

3.   Compared to other features being improved or developed for new products, how would you rate the importance of qualifying for ENERGY STAR? Would you say it's a high, medium, or low priority, or not a priority at all?

4.   Is there anything that discourages COMPANY from making your PRODUCTS even more energy efficient – for example, products that exceed ENERGY STAR standards?

      4a.   What could an organization like NEEA do to encourage you to do so?

5.   If, tomorrow, you could change anything about your PRODUCTS, what would you do to make them as energy efficient as possible – and by that I mean: using as little energy as possible while maintaining all their current functionality?

6.   What about changes you couldn't necessarily make tomorrow, but could imagine making a little farther in the future?

7.   We've identified COMPONENTS as the biggest energy users in PRODUCTS. Does that seem correct to you? [If no, which COMPONENTS are bigger users?]

8.   What are the most important technologies or features coming down the road that NEEA needs to be aware of? These can be things that are going to increase or decrease the energy used by PRODUCTS.

9.   I'm familiar with the typical electronics product design process – a requirements document with desired features, a technical spec that defines how the product will be

built, possibly a test run and then full manufacturing. Is there any aspect of that process that differs for your PRODUCTS?

10.   How long is the product development timeline today – from initial design to when the product hits the shelf? [Follow up: what do you think will happen in the next few years, as far as development timelines?]

11.   How do you expect the number of ENERGY STAR models that you manufacture to change over the next 3 to 5 years? [Probes: increase, decrease, stay the same]

12.   Is there anything that discourages COMPANY from making more of your PRODUCTS ENERGY STAR-qualified? [Prompts: cost, availability of components/technologies, other technical issues, ENERGY STAR testing guidelines/spec levels]

      12a.   What could an organization like NEEA do to encourage you to do so?

13.   Finally, is there anyone else you think I should speak with, either at COMPANY or elsewhere?
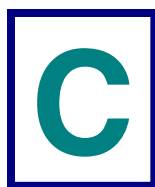
C OPPORTUNITY CALCULATION CONSTANTS

TV CONSTANTS

Calculations for the TV opportunities make use of the constant values in Table 33, below.

Table 33: Constant Values for TV Opportunities

INPUT	2012	2013	2014	NOTES / SOURCES
INSTALLED BASE (NEEA TERRITORY)				
Number of units < 32"	5,138,665	4,761,632	4,474,106	Shift to large models affected by annual unit sales assumption below
Number of units 32" to 46"	5,608,304	6,038,757	6,455,059	
Number of units > 46"	2,996,181	3,239,497	3,472,941	Assumes units retire after 10 years
Total Number of Units	**13,743,150**	**14,039,885**	**14,402,107**	
INSTALLED BASE UNIT ELECTRIC CONSUMPTION (UEC) (KWH/YEAR)				
Units < 32"	167	158	148	Assumes units retire after 10 years. Based on Ecos's unit installed base & UEC calculations.
Units 32" to 46"	270	259	247	
Units > 46"	438	426	413	
Weighted Average	**268**	**263**	**256**	Weighted on estimated percent market share of size bins over the course of the lifecycle
PROJECTED ANNUAL UNIT SALES (NEEA TERRITORY)				
Number of units < 32"	339,105	347,012	355,118	Screen size distribution projected to increase at constant rate from 2010 actual data (Source: NEEA) to estimated 2020 distribution of 10%-30%-60%.
Number of units 32" to 46"	715,977	732,672	749,787	
Number of units > 46"	381,245	390,135	399,248	
Total Number of Units	**1,632,831**	**1,670,904**	**1,709,936**	
				Actual 2009 CEA data; estimated no change to 2010 and 2% growth from 2011-2014.

Continued

INPUT	2012	2013	2014	NOTES / SOURCES
ANNUAL UNIT SALES UEC (KWH/YEAR)				
Units < 32"	66	59	54	Based on ENERGY STAR spec level minimums, Ecos calculations from EPA formula. Screen size "bin" UEC from weighted average of ENERGY STAR model offerings at each size.
Units 32" to 46"	137	134	93	
Units > 46"	222	198	182	
Weighted Average	**151**	**143**	**121**	Weighted on estimated % market share of size bins.
PENETRATION OF ENERGY STAR TIER				
Not qualified	5%	5%	5%	Assumptions provided by NEEA
Tier 4.0	40%	19%	7%	
Tier 5.0	45%	52%	40%	
Tier 5.0 + 20%	10%	24%	48%	
Total	**100%**	**100%**	**100%**	
OTHER				
Unit lifespan (years)	10	10	10	Estimate
NEEA territory population as a percent of U.S. population	4.3%	4.3%	4.3%	6th Power Plan
U.S. number of households	121,904,233	123,123,276	124,354,508	U.S. Census Bureau, Current Population Reports. From Statistical Abstract of the United States, 2008.
NEEA number of households	5,241,882	5,294,301	5,347,244	Calculated
TVs per U.S. household	2.62	2.65	2.69	Calculated
Percent of U.S. households with pay-TV	83%	83%	83%	Roth and Urban 2009
Number of NEEA households with pay-TV	4,350,762	4,394,270	4,438,212	Calculated
Market share of 7 top brands	79%	80%	81%	iSuppli
TV daily duty cycle	5.42	5.53	5.64	Nielsen Three Screen Report v8
LCD market share	85%	85%	85%	Assumes growth over plasma is counterbalanced by loss from OLED
Percent of models that do not have enough memory for a forced menu	8%	8%	8%	Estimate

Continued

research/into/action inc

INPUT	2012	2013	2014	NOTES / SOURCES
OTHER (CONT.)				
Percent of people willing to implement power management/ efficiency tips	50%	50%	50%	Based on findings in Energy Center of Wisconsin 2010.
Average unit energy consumption (UEC) for a STB (kWh/year)	219	219	219	Calculation
Market share of ENERGY STAR partners	97%	97%	97%	ENERGY STAR
Entry- level TV market share	40%	40%	40%	Estimate

PC CONSTANTS

Calculations for the PC opportunities make use of the constant values in Table 34, below.

Table 34: Constant Values for PC Opportunities

INPUT	2012	2013	2014	NOTES / SOURCES
INSTALLED BASE (NEEA TERRITORY)				
Total number of units	3,295,239	3,061,463	2,806,464	
PROJECTED ANNUAL MARKET SHARE BY PRODUCT TYPE				
Mini PCs	14%	16%	18%	Actual 2010 Gartner data; projected penetration change based on actual change 2007-2009
All-in-one PCs	49%	56%	62%	
Standard/performance PCs (desktop PCs)	37%	28%	20%	
PROJECTED ANNUAL UNIT SALES (NEEA TERRITORY)				
Mini PCs	41,295	40,587	39,040	
All-in-one PCs	144,532	142,055	134,470	
Standard/performance PCs (desktop PCs)	109,137	71,027	43,377	
Total Number of Units	**294,964**	**253,669**	**216,887**	
PROJECTED PENETRATION OF ENERGY STAR V5.X				
Percent of standard residential desktop new unit sales	8%	9%	10%	Estimate based on ODC 2010 baseline study of ENERGY STAR market penetration in the Pacific Northwest and interviews with manufacturers. Assumes 1% growth/year.

Continued

research/into/action inc

INPUT	2012	2013	2014	NOTES / SOURCES
OTHER				
Projected U.S. desk-bound PC sales (includes mini, desktop, and all-in-one PCs)	6,859,622	5,899,275	5,043,880	Gartner
Projected NEEA desk-bound PC sales	294,964	253,669	216,887	Calculation
U.S. installed base of desk-bound PCs (includes minis, desktops, and all-in-ones)	76,633,471	71,196,812	65,266,598	Gartner
HP residential market share for standard desktops	43%	43%	43%	Gartner 2010 data; assumed to stay constant
Acer residential market share for standard desktops	22%	22%	22%	
Dell residential market share for standard desktops	20%	20%	20%	
Lenovo residential market share for standard desktops	3%	3%	3%	
Average unit energy consumption (UEC) savings as a result of optimum power management on installed base (kWh/year)	160	152	144	Based on findings in Energy Center of Wisconsin, 2010; decreased 5% per year
Percent of computer owners willing to change power management settings	75%	75%	75%	Based on findings in Energy Center of Wisconsin, 2010

GAME CONSOLE CONSTANTS

Calculations for the game console opportunities make use of the constant values in Table 35, below.

Table 35: Constant Values for Game Console Opportunities

INPUT	2012	2013	2014	NOTES / SOURCES
ESTIMATED ALWAYS-ON UEC (KWH/YEAR)				
PS3	733	733	733	Calculation
Xbox 360	758	758	758	Calculation
Wii	77	77	77	Calculation
ESTIMATED ON-WHILE-PLAYING UEC (KWH/YEAR)				
PS3 (2011)	29	29	29	Calculation
Xbox 360 (2011)	44	44	44	Calculation
Wii (2011)	12	12	12	Calculation

Continued

research/into/action inc

INPUT	2012	2013	2014	NOTES / SOURCES
PROJECTED ANNUAL UNIT SALES (NEEA TERRITORY)				
PS3	107,909	53,955	26,977	*Source:* 2010 NPD data from *http://vgsales.wikia.com/wiki/NPD_Seventh_generation.* Xbox 360 and PS3 sales are assumed to stay constant 2010-2011 as consumers adopt motion gaming. Sales are projected to decrease 20% in 2012 as market becomes saturated. Demand is projected to decrease 50% year-over-year in 2013 and 2014 as current-generation consoles become increasingly saturated and consumers begin to expect new consoles to launch. Assumes the consoles do not release new features. Projections do not include future console generations.
Xbox 360	168,701	84,351	42,175	
Wii	25,316	12,658	6,329	*Source:* 2010 NPD data from *http://vgsales.wikia.com/wiki/NPD_Seventh_generation.* Wii sales are assumed to decrease 50% in 2011, continuing a trend begun in 2008 and resulting from rumors of a 2nd generation Wii release in Christmas 2011. Sales are projected to drop 75% in 2012 after release of the next-generation console. Sales are projected to drop 50% year-over-year in 2013 and 2014, as the system is not the most current available, but sought out as a replacement product or by extremely budget conscious buyers. Projections do not include future console generations.
PROJECTED INSTALLED BASE (NEEA TERRITORY)				
PS3	716,501	618,025	458,615	Accounts for all units sold in the U.S. from inception through November 2010. Future estimates are shown in *Projected annual unit sale*s. Does not account for broken, defective units. Assumes consoles averages assumed duty cycle for 5 years, after which it is retired.
Xbox 360	999,182	879,944	716,979	
Wii	1,128,368	703,673	297,460	

Continued

| INPUT	2012	2013	2014	NOTES / SOURCES
				GAME CONSOLE CONSTANTS
PS3				
Duty cycle for PS3 (hrs/week)	4.1	4.1	4.1	Nielsen
Active-mode power for PS3 (watts)	84.8	84.8	84.8	EPRI. December 16, 2010. "Power Play: EPRI Analysis Reveals That Video Game Consoles Differ in Energy Consumption." News Release. *www.epri.com.*
Idle-mode power for PS3 (watts)	83.9	83.9	83.9	Assumed to be 99% of active-mode power, per previously tested model revision from Ecos research conducted for *Lowering the Cost of Play*
Off-mode power for PS3 (watts)	1.3	1.3	1.3	*http://www.hardcoreware.net/reviews/review-356-4.htm*
XBOX 360				
Duty cycle for Xbox 360 (hrs/week)	4.9	4.9	4.9	Nielsen
Active-mode power for Xbox 360 (watts)	87.9	87.9	87.9	EPRI 2010
Idle-mode power for Xbox 360 (watts)	86.8	86.8	86.8	Assumed to be 99% of active-mode power, per previously tested model revision from Ecos research conducted for Lowering the Cost of Play
Off-mode power for Xbox 360 (watts)	2.5	2.5	2.5	*http://www.hardcoreware.net/reviews/review-356-4.htm*
Xbox 360 owners who don't turn on the 6-hour APD	90%	90%	90%	Estimate
WII				
Duty cycle for Wii (hrs/week)	1.4	1.4	1.4	Nielsen
Active-mode power for Wii (watts)	13.7	13.7	13.7	EPRI 2010
Idle-mode power for Wii (watts)	8.8	8.8	8.8	Assumed to be 60% of active-mode power, per previously tested model revision from Ecos research conducted for *Lowering the Cost of Play*
Off-mode power for Wii (watts)	1.3	1.3	1.3	*http://www.hardcoreware.net/reviews/review-356-4.htm*

Continued

research/into/action inc

INPUT	2012	2013	2014	NOTES / SOURCES
		OTHER		
Gaming sessions per week	2	2	2	Estimate
Percent of players with "always-on" console (console in active or idle mode 24/7)	20%	20%	20%	Estimate
Percent of players with "always-on" console who place console in "home menu" when idle (in which console will APD, if appropriate)	50%	50%	50%	Estimate
Percent of players with console "on-while-playing" (player turns console off when not playing)	80%	80%	80%	Estimate
Percent of households with one or more game consoles	40%	40%	40%	NRDC. *Lowering the Cost of Play*.
Percent of Wii owners that also own an Xbox 360	26%	26%	26%	NPD. September 14, 2009. "Majority of Gamers Rely on Word of Mouth and Hands-On Play at Friends' and Relatives' Homes to Obtain Information on Video Games."
Percent of Wii owners that also own a PS3	14%	14%	14%	NPD. "Majority of Gamers."
Persistence of APD measure	80%	80%	80%	Estimate
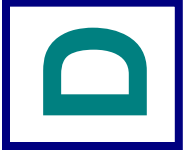
D OTHER OPPORTUNITIES AND REASONS FOR LOWER CONFIDENCE

Table 36 below lists other energy efficiency opportunities identified during this project. These opportunities were not selected as having a high confidence of success, for the reasons listed.

Table 36: Other Opportunities

PRODUCT TYPE	OPPORTUNITY	TOTAL ACHIEVABLE POTENTIAL SAVINGS 2012-2014		REASON FOR LOWER CONFIDENCE
		GWh	aMW	
TVs	Increase penetration of LED backlighting on entry-level LCD models LED backlights are least likely to be found on entry-level models due to their cost premium.	3	0.4	Savings estimated to be relatively small due to small screen size and thus low energy consumption of most entry-level TVs
	Increase penetration of digital CMOS tuners Some tuners consume more energy than others. Digital CMOS/ICE technology is the most efficient currently available. Ecos research suggests the majority of TVs have already begun incorporating this technology.	3	0.4	Although an interviewee suggested this as an opportunity, market appears to have moved such that > 80% of new units employ digital tuners; as a result, potential savings are small
	Increase number of cable TV subscribers who use the TV's download acquisition mode (DAM) in place of a cable set-top box DAM allows a user to view basic cable TV content without the use of an external set-top box. DAM does not allow users to access premium or on-demand content.	0	—	Although an interviewee suggested this as an opportunity to reduce set-top box energy use, further investigation revealed that few pay-TV subscribers to basic channels would be provided a set-top box, and that DAM cannot be used to access any premium channels
	Increase penetration of TVs with forced menu functionality (FMF) AND standard/home mode brightness as default The forced menu is a menu which requires the selection of a display mode by a user upon their first use after the manufacture of a television: "bright" or "retail" mode v. "standard" or "home" mode. A recent study estimated 17% energy savings per unit in standard v. bright mode.	0	—	No projected savings; since publication of referenced study, 92% of new units are estimated to have a forced menu, and the remaining 8% of new units are estimated to be too small or entry-level to include one

APPENDIX D: OTHER OPPORTUNITIES AND REASONS FOR LOWER CONFIDENCE

PRODUCT TYPE	OPPORTUNITY	TOTAL ACHIEVABLE POTENTIAL SAVINGS 2012-2014		REASON FOR LOWER CONFIDENCE
		GWh	aMW	
TVs (cont.)	Increase penetration 2D dimming in LCD TVs Local or backlight dimming reduces lighting in inactive or dark areas of the screen.	0	—	There is no conclusive evidence that 2D dimming provides energy savings
	Increase penetration of TVs >50" that meet ENERGY STAR v5.3	Not quantified	—	Penetration of large TVs is already high; as of July 2011, 36% of all ENERGY STAR qualified TVs > 50" meet the version 5.3 specification
	Engage with manufacturers to promote NEEA's energy efficiency goals	Not quantified	—	Program strategy, not selected as a measure-level opportunity
	Include RVU software in new TVs With RVU software, any IETV can serve as a client STB. This eliminates the need for an STB for each TV and lets all TVs use one DVR.	Not quantified	—	RVU software is not yet widely introduced to the market and it is unclear whether it will become a dominant technology
	Improve efficiency of TV power supply	Not quantified	—	No data available on baseline power supply efficiency
	Improve luminance efficiency for plasma TVs Efficiency of plasma TVs in 2009 was 0.5% (light output/power input). Industry estimates suggest at least a 50% improvement in efficiency is feasible.	Not quantified	—	Insufficient market data to calculate potential savings
	Increase penetration of dim room viewing conditions Dim room viewing conditions combined with ABCs has the potential to reduce on-mode power consumption.	Not quantified	—	Insufficient market data to calculate potential savings; high barriers to evaluating behavior change and persistence
	Increase penetration of OLED TVs OLED is a display technology in which individual OLEDs form pixels within the display. Energy savings come from the ability to turn on only those LEDs needed to display the image.	Not quantified	—	In R&D phase and not expected to enter the market until after 2014
	Field sequential color Eliminates need for color filters by quickly cycling through red, green and blue LED backlights.	Not quantified	—	In R&D phase and not expected to enter the market until after 2014

PRODUCT TYPE	OPPORTUNITY	TOTAL ACHIEVABLE POTENTIAL SAVINGS 2012-2014		REASON FOR LOWER CONFIDENCE
		GWh	aMW	
PCs	Shift new standard desktop PC purchases from standard/tower products to mini/compact products Mini PCs are only 7% of the residential desktop market, but use 2 to 8 times less power.	11	1.3	Focus group results indicate that energy savings are not decisive factor for consumers in selecting between similar models; judged to be too difficult to influence customers to select one product size/ design over another
	Increase penetration of PC power management on new unit sales A recent study by the Energy Center of Wisconsin found the majority of desktop PCs did not have power management settings enabled.	0	—	Top brands indicated they now ship PCs with power management enabled
	Increase number of qualified models by working with "consumer marketing organizations" at top brands Consumer marketing organizations control product features and their relative priority. To-date, these groups have been skeptical about the demand for energy efficiency and thus have not prioritized it when specifying products to ODMs. Apple is a notable exception.	Not quantified	—	Program strategy, not selected as a measure-level opportunity
	Increase number of qualified models by working with ODMs ODMs design desktop PCs that brands buy "off the shelf" for sale in the U.S. market. ODMs compete on price while trying to meet as many of the brand's desired features as possible. Because energy efficiency is a low priority, it is often not included in the final product.	Not quantified	—	Program strategy, not selected as a measure-level opportunity

research/into/action℠

ENERGY SAVINGS OPPORTUNITIES IN CONSUMER ELECTRONICS

APPENDIX D: OTHER OPPORTUNITIES AND REASONS FOR LOWER CONFIDENCE

PRODUCT TYPE	OPPORTUNITY	TOTAL ACHIEVABLE POTENTIAL SAVINGS 2012-2014		REASON FOR LOWER CONFIDENCE
		GWh	aMW	
Game Consoles	Educate console owners to turn on APD Some users (there is no precise measure of how many) leave their consoles on, even when not in use. Users could be educated to turn on the console's "auto-power-down" feature, which will automatically turn the console off after a specified number of hours in idle mode.	5	0.6	Implementation and attribution challenges
	Educate console owners to turn consoles off when not in use Some users (there is no precise measure of how many) leave their consoles on even when not in use. Users could be educated to turn their console off.	1.4	0.2	Implementation and attribution challenges
	Work in collaboration with other efficiency organizations, like NRDC, to encourage manufacturers to make next-generation consoles more efficient Game consoles are a difficult device to reach because of the small number of manufacturers and models. NRDC is currently engaging manufacturers to discuss efficiency.	Not quantified	—	Program strategy, not selected as a measure-level opportunity
Streaming Media	Increase the number of pay-TV subscribers that "cut the cord" and thus no longer require a set-top box (or multiple boxes) Up to 15% of pay-TV subscribers have considered dropping their service in the recent past. Every household that "cuts the cord" eliminates the operation of at least one and likely two or more set-top boxes.	12	1.3	Requires program to interfere with consumer relationship with pay-TV service provider