# Taming the Beast: 13 Savings Opportunities for Next Generation Consumer Electronics Programs

*Marti Frank and Jane Peters, Research Into Action, Inc.*
*Stephanie Fleming, Northwest Energy Efficiency Alliance*
*Gregg Hardy and Matt Krick, Ecova*

## ABSTRACT

Plug load energy consumption is growing and efficiency programs have only just begun to address it. First generation programs focus on TVs and desktop PCs and have been in the field only a few years. Their number is small compared to appliance or lighting programs and nearly all aim to increase sales of ENERGY STAR®-qualified products. In late 2009, one efficiency funder, seeking additional opportunities for the 2012-2014 timeframe, commissioned a research project to identify other energy savings opportunities in consumer electronics.

The resulting study provides a foundation for new program designs that will be useful to funders, implementers, and researchers. It identified and quantified 13 "high confidence" opportunities for energy savings in TVs, desktop PCs, game consoles, and streaming media. The opportunities address new and existing products and are implementable through upstream, midstream, and downstream program designs. In addition to describing each opportunity, the study recommended implementation strategies, provided Excel savings calculation workbooks that program administrators can customize to project savings in their territories, and characterized the market for each product.

The study methodology was innovative in its systematic and multi-modal approach. This paper describes each of the opportunities in detail and the recommended strategies for electronics program design. The study and the editable MS Excel workbooks for the opportunity calculations can be downloaded from Northwest Energy Efficiency Alliance (NEEA) website: http://neea.org/research/reportdetail.aspx?ID=1474

## Why Did We Need This Study?

In early 2009, the Northwest Energy Efficiency Alliance (NEEA) piloted a consumer electronics program in tandem with California utilities to encourage electronics retailers to increase the number of energy efficient digital TVs, desktop computers, and computer monitors in their "assortment" – the products a retail store carries. The program, often referred to as the Business and Consumer Electronics (BCE) program, provided per-unit incentive payments to electronics retailers for every qualifying product sold. Incentive levels were set differently by each funding entity; however, the participants in BCE aligned on product specification levels. NEEA's first TV measure qualification, effective from September 2009 to December 31, 2009, included TVs at least 30% more efficient than those meeting ENERGY STAR version 3. The BCE's measure qualifications became more stringent on January 1 of 2010 and 2011, targeting TVs at or above ENERGY STAR version 4 and ENERGY STAR version 5 respectively.

Although NEEA continued funding the program in 2010, program managers wanted more detailed information about the energy efficiency opportunities available to them for future program designs. The current programs were centered on ENERGY STAR and focused on TVs.

Program managers wanted to enhance their ability to act in the market, particularly with mid- and upstream supply chain partners. To do so successfully, they needed to understand the technical potential of TVs and other electronics products. NEEA was particularly motived by the Northwest Power and Conservation Council's 6th Power Plan, a guiding document for efficiency funding the Northwest Region, which specifically called out TVs, computers and set-top boxes as three products with energy saving potential.

The dearth of efficiency research in the consumer electronics space led NEEA to commission a first phase of the study, in which they tasked Ecos, an energy-efficiency consulting firm, now known as Ecova, with using their depth of technical and market expertise to identify top opportunities in consumer electronics. The results of this phase of the research indicated that there were many opportunities to improve efficiency at the component level – either by substituting more efficient components or by altering product design to include efficiency features. The study also pointed to the efficiency potential of game consoles.

NEEA commissioned a second phase of research, from Ecos and Research into Action, Inc., to follow-up on these findings and push the exploration further, and help program managers prepare for other program opportunities that could be executed within the organization's five-year funding cycle that would conclude in 2014.

### Study Goals

NEEA had several goals for the study, all of which were intended to contribute to their effort to think strategically in planning their next-generation consumer electronics program. First, NEEA wanted to understand what the technical opportunities were for improving efficiency in energy-intensive electronics products. Second, NEEA wanted to better understand the potential leverage points in the supply chain for these products. For example, NEEA's use of retailer incentives had not had the desired effect on sales of efficient desktop computers and monitors, and NEEA wanted to understand why.

NEEA decided to focus the study on four product categories: TVs, desktop PCs, game consoles, and streaming media. TVs were an obvious choice because they were the focus of the BCE program already in the field. Desktop PCs had been included in the BCE program at the outset, but were later dropped due to low uptake. Game consoles and streaming media devices were also products of interest, the former due to high energy consumption and the latter because it was presumed to be a substitution for pay-TV set-top boxes, another energy-intensive product.

NEEA's goals for the study were to enhance its understanding of the market for each product, including key trends and technologies, supply chain players, and product development practices; expand its knowledge of energy-saving measures that would allow it to move its program design beyond ENERGY STAR, with a specific focus on component-level opportunities for savings; and achieve the market and energy-savings goals using a systematic process.

## Innovative Approach: Bringing Systematic Inquiry to Seat-Of-The-Pants Practices

There is no standard practice in program design around selecting energy efficiency measures, and probably as many different approaches as there are program designers. In this

project, NEEA and the consultants wanted a systematic way to identify, quantify, and prioritize energy-saving opportunities.

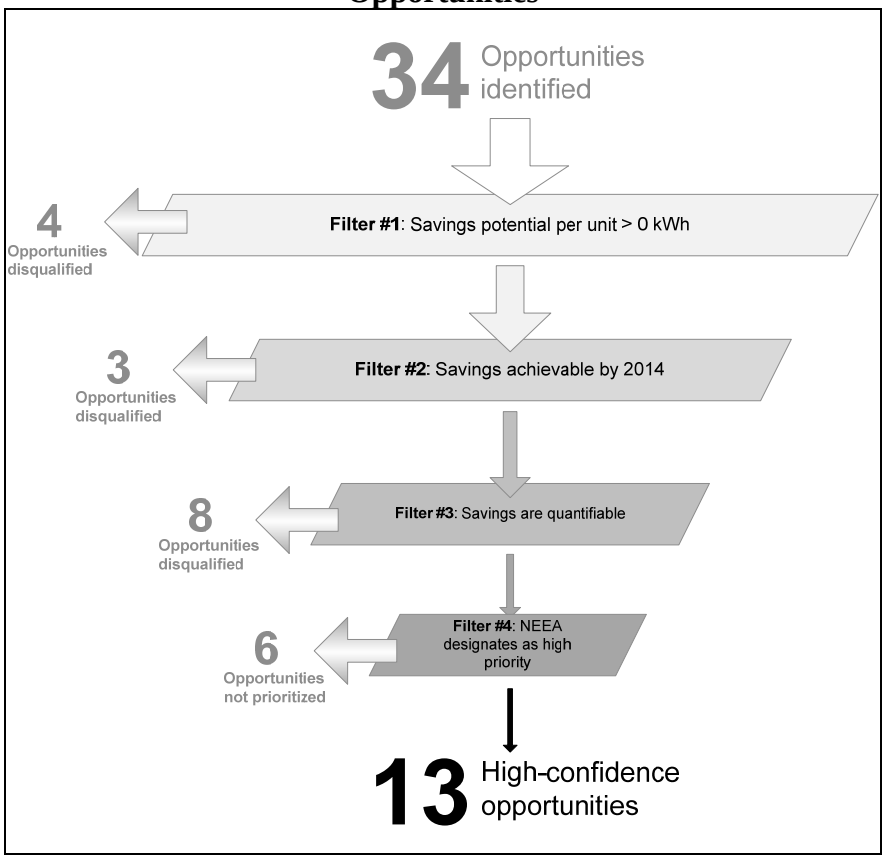
The research team took several steps to achieve the goal of systematic inquiry and evaluation. First, they created a "brainstorm" list of potential opportunities on which every identified opportunity was placed, without critique or comment. The opportunities were identified during a thorough qualitative research process that included in-depth interviews with market actors and technical experts, and a secondary literature review. The researchers also relied on their own market and product knowledge, gained through past projects, to place potential opportunities on the list. The complete list included 34 potential opportunities for energy savings in TVs, desktop PCs, game consoles, and streaming media.

Next, the team vetted the list. They made a binary judgment as to the technical validity of each opportunity, asking whether it did or did not have the potential to reduce energy consumption. Opportunities judged in the affirmative were passed through a second binary filter regarding whether they did or did not have the potential to be implemented by 2014, the year NEEA specified as the latest possible implementation date of its yet-to-be-designed program. Of the original 34 potential opportunities, four failed to pass the first filter (they were judged not to have energy-saving potential) and three failed to pass the second filter (they were judged not to have implementation potential until after 2014).

The team then attempted to quantify, at the program level, the potential savings of the remaining 27 opportunities that had passed both of the first two filters. MS Excel was the tool of choice, and the team developed workbooks for each product category that included a set of standardized inputs and estimation approaches to ensure the savings estimates would be both consistent and transparent.

Finally, the team worked closely with NEEA program managers to review the savings estimates of each of the opportunities, and together selected thirteen opportunities as having a high confidence of success based on their energy savings potential and the level of engagement required from a program perspective, for example, the administrative costs and time required. Figure 1 depicts this methodology.

**Figure 1: Systematic Process for Identifying, Quantifying, and Evaluation Energy-Saving Opportunities**




## An Overview of the 34 Opportunities

Among all 34 opportunities identified, a few common themes emerged. More than half of all opportunities applied to TVs (58% or 20 of 34) as opposed to the other product categories. The majority of opportunities applied to new products versus existing products, or those already in people's homes (79% or 27 of 34). More than twice as many opportunities saved energy by reducing active mode power draw as by reducing the product's duty cycle (16 versus 7), with a large number (11) reducing energy use in some other way.

Four of the identified opportunities were projected to have savings in NEEA territory of over 20 gigawatt hours (GWh) from 2012 to 2014. They included three TV opportunities and one desktop PC opportunity. Two of the opportunities applied to new products, both for TVs. These opportunities were to alter TV design to include new functionality: occupancy sensing technology and efficiency tips in the TV's menu. Two opportunities applied to existing products. One, for TVs, involved optimizing TV brightness to reduce brightness where possible. The other, for desktop PCs, involved increasing the use of PC power management.

## Making the Energy-Savings Calculations Transparent: Harder than it Looks!

One of the key project tasks involved calculating the savings potential of each opportunity. The project team decided that because of the large number of assumptions required

to make these estimates, NEEA would be best served by having access not only to the team's calculation approach, but to editable workbooks documenting each and every calculation. In addition, NEEA was willing to make the workbooks publicly available, for other efficiency program managers and researchers to use.

The team developed workbooks for each product category, four in total, each of which is downloadable from NEEA's website (http://neea.org/research/reportdetail.aspx?ID=1474). Each workbook includes three tabs: an overview tab that summarizes the findings for each opportunity; a calculations tab that provides the full calculation used to determine technical and achievable potential savings for each opportunity; and a constants tab that lists all the inputs to the calculations used in more than one opportunity calculation. Figures 2 and 3 show screen shots of a portion of the overview and calculations tabs of the TV workbook.

**Figure 2. Overview Table Tab Screen Shot, TV Workbook**

| | A | B | C | D | E | F | G | H | I | J | K | L |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | Confidence H = high L = low | Opportunity | Achievable potential 2012-2014 (Total GWh) | Achievable potential 2012-2014 (Total aMW) | Technical savings potential 2012-2014 (Total GWh) | Savings timeframe | Description | Ecos/RI/Interview | | Secondary Source | Applies to: N= new E = existing | NEEA "play" |
| 3 | H | **Occupancy Sensing Technology:** Increase penetration of occupancy sensing technology | 48 | 5.4 | 60 | 2014 | A motion sensor detects a viewer's presence in front of the TV and alters the device's mode if no viewers are present. Differs from auto-power-down in that it can turn off the display while leaving the audio on. Sony was the first TV brand to debut a model with this feature at CES 2009, in screen sizes > 40 inches. | x | x | | N | Introduction |
| 4 | H | **Optimize Brightness:** Optimize brightness settings on existing TVs using direct install approach | 42 | 4.8 | 755 | 2014 | A recent study estimates that all TVs were shipped in "bright" mode prior to November 2008 and 90% remain in this mode. | | | x | E | Saturation |
| 5 | H | **Efficiency Tips:** Add energy efficiency tips/options to menu | 28 | 3.2 | 69 | 2014 | Add functionality to the forced menu such that the user is instructed to set other efficiency options, like turning on an occupancy sensor or automatic brightness control; and/or provided energy saving tips, like creating optimal viewing conditions. | | | x | N | Saturation |
| 6 | H | **ES v6 Test Procedure:** Ensure final ENERGY STAR v6 test procedure incorporates improved ABC test procedure | 18 | 2.0 | 33 | 2014 | Currently, ENERGY STAR only tests devices with ABC at 0 and 300 lux, which does not reflect conditions in which the devices are actually used and leaves open the opportunity for manufacturers to "game the system." Instead, the room-to-screen brightness curve should be limited to a given range. This would close the gap between reported and actual energy consumption. | x | | | N | Adoption |

**Figure 3. Calculations Tab Screen Shot, TV Workbook**

| | A | B | C | D | E | F | G | H |
|---|---|---|---|---|---|---|---|---|
| 1 | | **Opportunity** | **Constant** | **2012** | **2013** | **2014** | **3-year Total** | **Notes/Sources** |
| 2 | | | | | | | | |
| 3 | | **Reduce active mode power draw** --> TV uses less power when on | | | | | | |
| 4 | | | | | | | | |
| 5 | | **Optimize Brightness:** Optimize brightness settings on existing TVs using direct install approach | | | | | | |
| 6 | | % TV installed base currently employing measure | | 38% | 50% | 60% | | Estimate, based on Roth and Urban 2009 estimate of 90% IB older than 2008 |
| 7 | | % TV installed base that cannot employ measure | | 0% | 0% | 0% | | Estimate |
| 8 | | **TOPP (%TVs)** | | **62%** | **50%** | **40%** | | Calculation |
| 9 | | **TOPP (#TVs)** | | **8,507,630** | **7,026,284** | **5,710,082** | | Calculation |
| 10 | | **TOPP: # TVs (older than 2009) per HH** | | **1.62** | **1.33** | **1.07** | | Calculation |
| 11 | | % US households (HH) w/ pay-TV | | 83% | 83% | 83% | | Roth and Urban 2009 |
| 12 | | % Pay-TV HH visited annually by service providers (SP) | | 15% | 15% | 15% | | Roth and Urban 2009 |
| 13 | | % households willing to change brightness | | 50% | 50% | 50% | | Roth and Urban 2009 |
| 14 | | Persistance of measure over 3 years | | 90% | 90% | 90% | | Estimate |
| 15 | | **AOPP (%HH)** | | **6%** | **6%** | **6%** | | Calculation, % HH w/ pay-TV assumed to be reachable |
| 16 | | **AOPP (#HH)** | | **293,676** | **296,613** | **299,579** | | Calculation |
| 17 | | % UEC savings for measure | | 13.5% | 13.5% | 13.5% | | Roth and Urban 2009 |
| 18 | | **AOPP (#TVs)** | | **476,640** | **393,648** | **319,907** | | Calculation |
| 19 | | Average installed base UEC | | 268 | 263 | 256 | | Constant |
| 20 | | Average annual UEC savings per TV (kWh/year) | | 36 | 36 | 35 | | Calculation |
| 21 | | **Technical Savings for Measure (GWh)** | | **308** | **250** | **198** | **755** | Calculation |
| 22 | | **Achievable Savings for Measure (GWh)** | | **17** | **14** | **11** | **42** | Calculation |
| 23 | | | | | | | | |

The challenges to systematically quantifying 27 energy savings opportunities at the program level were numerous. Perhaps the most significant required making the following estimates for each opportunity:

- **Installed base already employing the opportunity**. Because many of the opportunities were at the component level, saturation of the installed base was often unknown. The team made an estimate based on secondary and primary research.

- **Achievable penetration of the opportunity**: This estimate required a hypothesis about NEEA's future implementation method. The team aimed for consistency across all opportunities. For example, component-level TV opportunities applying to new products were estimated to reach all the products manufactured by the top seven TV brands, an estimate premised on an upstream implementation method.
- **Per-unit savings:** How much energy would the opportunity actually save? In many, if not most cases, this was an unknown as no lab research or citable studies existed. The team relied on comparable research findings and queried interview subjects to arrive at estimates. In many cases, the estimate also required the team to make assumptions about the product's duty cycle, a particular problem with game consoles, for which data are lacking.

In the end, the team was able to quantify savings for 70% of the list, or 19 of the original 27 opportunities. The team deemed an opportunity unquantifiable if they determined it to be a strategic opportunity or program implementation approach as opposed to a technical or behavior change; or if data on potential per-unit energy savings could not be estimated without further research, for example lab testing or *in situ* energy use and duty cycle studies.

## The Findings: 13 High-Confidence Opportunities for TVs, Desktop PCs, Game Consoles, and Streaming Media

The research team worked closely with NEEA program managers to prioritize the resulting list of 19 quantified energy-saving measures. NEEA ultimately selected 13 of those measures as having a "high confidence" for success, given NEEA's knowledge of its implementation capabilities and the priorities of its current portfolio. Table 1 summarizes the 13 high-confidence opportunities. Seven opportunities apply to TVs, four apply to desktop PCs, and one opportunity applies to game consoles and streaming media devices, respectively.

Following the table, each opportunity is described in detail, with caveats to the calculation noted and a brief discussion of potential implementation approaches. The calculation methodology, input values and sources, and a more thorough discussion of the caveats and uncertainties of each calculation can be found in the study, available at NEEA's website: http://neea.org/research/reportdetail.aspx?ID=1474

**Table 1. Summary of High-Confidence Opportunities**

| Opportunity | Total Achievable Potential Savings 2012-2014 | | Applies To Products That Are… | Savings Approach | NEEA-Defined Opportunity Type* |
|---|---|---|---|---|---|
| | GWh | Average MW | | | |
| **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 |

| Opportunity | Total Achievable Potential Savings 2012-2014 | | Applies To Products That Are… | Savings Approach | NEEA-Defined Opportunity Type* |
|---|---|---|---|---|---|
| | GWh | Average MW | | | |
| **TVs** | | | | | |
| **Efficiency Tips**: Add energy efficiency tips/options to menu | 28 | 3.2 | New | Other | Saturation |
| **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 |
| **ENERGY STAR 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 |
| **Automatic Brightness Control (ABC):** Increase penetration of automatic brightness control | 5 | 0.6 | New | Power draw | Saturation |
| **TV Auto-Power-Down (APD):** Increase penetration of auto-power-down 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 APD enabled by default (set to 1 hour) | 17 | 2.0 | New | Duty cycle | Saturation |
| **Streaming Media** | | | | | |

| Opportunity | Total Achievable Potential Savings 2012-2014 | | Applies To Products That Are… | Savings Approach | NEEA-Defined Opportunity Type* |
|---|---|---|---|---|---|
| | GWh | Average MW | | | |
| **TVs** | | | | | |
| **Eliminate Multi-DVR Homes:** Increase the replacement of multi-room DVR set-top boxes with a thin client set-top box | 7 | 0.8 | New | Power draw | Adoption |

* 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.

** Since this report was published, the ENERGY STAR test procedure for TVs was revised to reflect the change recommended here.

## 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, was estimated to result in savings of up to 48 GWh (5.4 average megawatts (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 (Tarr 2011). 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.

**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 (Roth et al. 2009). This level of brightness is suboptimal for most home viewing conditions (it is 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, was estimated to save up to 42 GWh (4.8 aMW) in NEEA territory in 2012-2014.

**Efficiency tips: add energy efficiency tips/options to menu.** User behavior affects TV energy consumption. For example, user behavior will increase consumption when users disable efficiency settings or leave the unit on when not in use. Even today's best-in-class TVs will not

meet expectations if users do not utilize efficiency features like motion sensors and automatic brightness control (ABC), 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 was estimated to save up to 28 GWh (3.2 aMW) in NEEA territory in 2012-2014.

**ENERGY STAR v6 test procedure.** 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." (Ecos Consulting 2010). 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 was estimated to save at least 18 GWh (2.0 aMW) in NEEA territory in 2012-2014.

**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 kilowatt hours (kWh) more per year than today's best-in-class models. The average unit energy consumption of a pre-2006 TV with a screen size greater than 32 inches was estimated at 188 kWh per year (Rosen et al. 1999), compared to a best-in-class TV with an average unit energy consumption of 81 kWh in 2012, declining to 70 kWh in 2014 (estimates were based on energy data for TVs listed on the website www.topten.org). The early retirement of these TVs, when replaced by a best-in-class model, was estimated to save at least 12 GWh (1.4 aMW) in NEEA territory in 2012-2014.

**Automatic brightness control (ABC): increase penetration of ABC.** Properly functioning ABC, combined with dim-room viewing conditions, has the potential to reduce TV energy consumption by up to 20%, based on calculations using energy data for a sample of TVs listed on the website www.efficientproducts.org. 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 is 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 was estimated to save at least 5 GWh (0.6 aMW) in NEEA territory in 2012-2014.

**TV auto-power-down (APD): increase the penetration of APD capability enabled by default.** 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." (EES 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. Despite these uncertainties in market knowledge, NEEA thought greater adoption of APD deserved a "high confidence" designation because of the potential for a TV program to work with manufacturers to increase the penetration of efficiency features, like APD, in new TVs. APD was estimated to save up to 5 GWh (0.6 aMW) in NEEA territory in 2012-2014.

**Desktop PC Opportunities**

**Installed base power management: increase the use 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 (ECW 2010). 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. For most desktop PCs, enabling power management takes only a few clicks and does not lead to a noticeable change in the amount of time required for the computer to go into and come out of sleep mode. This measure could be implemented in several ways and was estimated to save up to 21 GWh (2.4 aMW) in NEEA territory in 2012-2014.

**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. Unlike commercial desktop computers, many of which incorporate high-efficiency power supplies, 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 was estimated to save up to 7 GWh (0.8 aMW) in NEEA territory in 2012-2014.

**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 was estimated to save up to 6 GWh (0.6 aMW) in NEEA territory in 2012-2014.

**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 was estimated to save up to 3.4 GWh (0.4 aMW) in NEEA territory in 2012-2014.

**Game Console Opportunity**

**Auto-power-down (APD): increase the penetration of consoles shipped with APD enabled by default (set to 1 hour).** 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). Despite these uncertainties, NEEA thought APD merited inclusion as a "high confidence" opportunity because it is one of the only opportunities identified for game consoles that is implementable within a programmatic context and which applies to the current generation of consoles. Increased adoption of a 1-hour default APD was estimated to save up to 17 GWh (2.0 aMW) in NEEA territory in 2012-2014.

**Streaming Media Opportunity**

Streaming media players use considerably less electricity than set-top boxes. Annual unit energy consumption for a streaming media device like the Apple TV was estimated at 10 kWh/year, compared to 200 kWh/year for a typical household with two high-definition set-top boxes. Although the study identified an opportunity to reduce consumption by increasing the number of pay-TV subscribers who "cut the cord" or unsubscribe from pay-TV service, NEEA did not consider this a high confidence opportunity and it is not included here.

**Eliminate multi-dvr homes: 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 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 multiple DVRs per home with thin client set-top boxes was estimated to save up to 6.7 GWh (0.8 aMW) in NEEA territory in 2012-2014.

## In the Field: How Did NEEA Use the Study?

NEEA program managers have been working to evaluate the opportunities identified in the study and incorporate them into the next iteration of their consumer electronics program. Their current work includes the following activities and opportunities:

- NEEA has been active in the ENERGY STAR TV specification revision process. NEEA has been advocating changes to the draft specification that would eliminate a TV manufacturer's ability to "game" the test procedure and allow a TV to qualify for ENERGY STAR with improperly functioning ABC.
- NEEA is in the early stages of developing a pilot program with a Northwest utility to target early retirement of large, inefficient TVs and is working to identify the best way to evaluate and quantify potential program impacts.
- NEEA's Emerging Technology team is evaluating opportunities identified for desktop PCs, game consoles, and streaming media for 2013 programs.

## References


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

[ECW] 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.

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

Rosen, Karen B. & Alan K. Meier. 1999. *Energy Use of Televisions and Videocassette Recorders in the U.S.* Lawrence Berkeley National Laboratory.

Roth, Kurt W. & Bryan Urban. 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.

Tarr, Gregg. April 18, 2011. "Sony ships 2011 Bravia LCD line." *TWICE*. Retrieved from shttp://www.twice.com/article/466945-Sony_Ships_2011_Bravia_LCD_Line.php.