Achieving Real Energy Savings through Consumer Electronics Programs

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ABSTRACT

Consumer electronics products represent an increasingly large amount of household electricity use, some 11 percent according to the Consumer Electronics Association. New electronics products are proliferating at a high rate and many existing products are getting bigger and/or performing more complex functions. Forecasts call for a continuing upward trend in energy consumption.

The efficiency community has historically devoted few resources to supporting energyefficient consumer electronics products. One reason is that per-unit energy savings numbers for electronics products have been relatively small. This is changing, with new or updated ENERGY STAR specifications completed or under development for televisions, set-top boxes, computers and monitors and several other products. The demand for increasing energy savings is also prompting efficiency programs to look for savings in new product areas, and electronics offer great potential. These two circumstances, combined with the availability of new data detailing residential electronics use patterns and energy use and the completion of test procedures, are prompting substantial interest in electronics programs.

This paper reviews progress to date in developing program approaches for consumer electronics. The authors provide an overview of the data they have collected, what their outstanding data needs are, and where they believe the most promise is for capturing energy savings from consumer electronics products. Achieving those energy savings will require a blend of old and new approaches deployed both at purchase and to address ongoing use of the product.

Introduction

Consumer electronics products now collectively represent a major electricity end-use in residences in the United States, Canada and abroad.¹ A 2007 study commissioned by the Consumer Electronics Association estimates that consumer electronics products represent 11 percent of U.S. residential electricity consumption (Roth and McKenney 2007, 14). Other studies show this amount as being even higher, such as in California where the number is in the range of 15-18 percent (Chase, Ramos & Pope 2006, 2; KEMA-XENERGY, Itron & RoperASW 2004, 3). And the forecasts call for continued growth. In the United Kingdom, consumer electronics are forecasted to be the biggest single user of domestic electricity by 2010 (Energy Saving Trust 2007).²

These percentages rival other end uses, such as lighting, refrigeration and space cooling and heating (Figure 1). Yet while products like appliances and space cooling have long track

¹ Consumer electronics products include a wide variety of equipment. The two primary types addressed in this paper are home entertainment equipment (e.g., televisions, set-top boxes) and home office equipment (e.g., computers and monitors).

² This may be exclusive of electric space heating. The EST report is unclear on this point.

records of promotion through efficiency programs, there has been little-to-no program activity for electronics products. There are several reasons for this lack of activity, and they are all changing.



Figure 1. U.S. Residential Electricity Consumption by End-Use

One reason for hesitance in pursuing electronics programs has been that electronics products individually did not as a rule consume a large amount of energy. This is no longer the case. Electronics products are increasing in size and are performing more functions of increasing complexity that demand extra electricity. Today's high definition, 50-inch television can use as much electricity as many refrigerators.

A second reason for a paucity of electronics programs has been that ENERGY STAR specifications for these products have generally not offered sufficiently substantial energy savings to trigger efficiency program interest. The currently effective ENERGY STAR television specification, for example, only applies to standby power. The new Version 3.0 specification—effective in November 2008—will for the first time extend qualification to On Mode power consumption. ENERGY STAR has also recently completed or will complete specifications for digital-to-analog converter boxes (DTAs), set-top boxes (STBs), computers, computer monitors, and external power supplies. All boost savings opportunities substantially and present strong prospects both individually and collectively.

In recent years, it has been fairly easy for program managers to push aside electronics programs with the excuse that it is simply too difficult to stay abreast of a category with such rapid technological innovation and product proliferation. Regulatory demands are simply too strong for this to continue to be the case. In British Columbia, for example, BC Hydro has been mandated to meet 50 percent of the incremental demand for electricity over the next 20 years through demand-side management programs. New sources of savings need to be identified to meet this mandate and electronics offer strong potential.

The information presented in this paper reflects discussions conducted over the course of the past year by the Consortium for Energy Efficiency's (CEE) Consumer Electronics Committee, of which all authors are members. The potential program approaches were initially developed in a brainstorming session at CEE's January Program Meeting in Long Beach, California. They have been further developed by several working groups meeting regularly since then.

Something Old, Something New, Something Borrowed, Something Blue

There is certainly nothing new about the basic outline for a program to promote energyefficient products. The "old" lessons learned and the relationships developed through promoting efficient appliances and lighting will be particularly important for electronics programs and can be borrowed and leveraged with relative ease. But in other regards, there is new ground to be covered. Energy efficiency programs are a relatively new concept for many electronics manufacturers. Accessing necessary data specific to electronics products and their use is also a new area. Capitalizing on the success of "Blue" (i.e., ENERGY STAR) will be essential to making strong inroads with manufacturers, retailers and consumers. This section will highlight what CEE member efficiency programs know, what they do not yet know, and what approaches preliminarily appear to be most promising.

What Is Known

Thanks to the Consumer Electronics Association, the ENERGY STAR specification development processes for electronics products, and work CEE member programs have conducted, there is a good general picture of the absolute and relative electricity consumption of many electronics products. Analog televisions³ (222 kWh/year), STBs (133 kWh/year), and desktop computers (237 kWh/year) are the most consumptive electronics products in the home (Roth and McKenney 2007, 15, 26).⁴ And while the bulk of their electricity use (68 percent) is from active or On Mode use, they still use a large amount of electricity in the aggregate when they are not in active use, but rather in a Sleep, Idle/Standby or "Off" Mode (32 percent).⁵ ENERGY STAR has also provided estimated per unit electricity savings numbers for ENERGY STAR-qualified electronics products under their new specifications and the assumptions on which these savings numbers were developed, which is crucial to program planning activities. Some programs (e.g., BC Hydro, Pacific Gas & Electric) have also collected information on the installed base for electronics products.

Research and anecdotal information also show that the electricity use for electronics products is trending upwards. Televisions are getting bigger, computers and STBs are performing more functions, market penetration continues to increase, and new products are rapidly appearing in the marketplace, which in many instances renders their predecessors obsolete (MTP 2007; Rainer et al. 2004).

³ At the time CEA's study was prepared, data was not available for digital televisions.

⁴ Data provided in association with the ENERGY STAR specification development processes indicates that these per unit numbers may be even higher for televisions and set-top boxes. (http://www.energystar.gov/index.cfm?c=prod_development.prod_development_index).

⁵ Monitors, computers and analog televisions consume the most power in On Mode. The Off Mode energy use is greater than On Mode use for compact audio, DVD players, VCRs and set-top boxes (Roth and McKenney 2007, 16).

What Is Not Known

There are additional data needs that must be met if program managers are to develop and successfully implement electronics programs. Product shipment and sales data are essential to determine the progress made over time in shifting the market towards more efficient equipment. These data would ideally include total shipments, number of ENERGY-STAR qualified units, and data regarding product characteristics that meaningfully affect energy consumption (e.g., STBs with digital video recorders versus boxes with only basic functions, televisions sizes and types). Location-specific data are also crucial.

More data on consumer behavior is also needed. What are the key factors influencing consumer purchasing decisions? How does the consumer use the product and does this vary by demographics? If consumers are buying a newer version of a product they already have, what are they planning to do with the old one?

Since programs managers do not have a real track record with electronics programs, it is important to increase understanding of the industry. CEE has made some promising inroads with the Consumer Electronics Association, and it is time to strengthen relationships with individual manufacturers to learn more about their product design considerations, manufacturing and sales timelines, and marketing strategies. There is also a lack of understanding as to which of the tools of efficiency programs' trade will be of greatest interest to them once it is demonstrated how they can benefit from them: upstream incentives such as buy downs and cooperative marketing are just two with which efficiency programs have had success with other products.

Retailers will be essential players in this effort. Fortunately, efficiency programs already work with many retailers who sell electronics products (e.g., Wal-Mart, Best Buy). There is more to learn about electronics-specific retailers and their interest in promoting ENERGY STAR products. For all retailers, there is a need to better understand the scope of their interest. Are those that are interested in selling energy-efficient products also willing to work with efficiency programs on consumer education that extends to use of the product as well? What tools (SPIFFS, stocking incentives) are of greatest interest to them? Are they willing to share sales data?

Program Approaches of Greatest Interest

There appears to be only a handful of energy efficiency programs targeting consumer electronics.⁶ This leaves few best practices from which to draw that are specific to electronics programs. Many other efficiency organizations are examining possible program approaches for deployment in the near future. This section provides an overview of some of the concepts CEE members have preliminarily expressed the most interest in exploring. They fall into three main groups: program design, consumer education, and evaluating advanced specifications. Given the substantial power use of electronics products in both On and Standby Modes, it is essential that electronics programs encompass both consumer purchasing decisions and consumers' daily operation of those products.⁷

⁶ Pacific Gas & Electric and Southern California Edison are promoting energy-efficient LCD monitors. NYSERDA is working with manufacturers and retailers to bring "smart" power strips to market that will enable consumers to more effectively manage the energy use of their electronics products.

⁷ The disposal of electronics products is obviously a vital topic as well (EPA 2001). This topic is briefly touched on in this paper and merits more careful examination by efficiency programs at a future point in time.

Program design. As mentioned earlier, efficiency programs have a long track record of successful techniques for promoting energy-efficient products. Those techniques with the best apparent transferability to electronics products will be the first resort for consideration.

Starting at the top of the supply chain, efficiency programs will be looking at working with manufacturers to buy down potential higher first costs for products. To date, there is no strong information regarding incremental costs, but it appears that ENERGY STAR-qualified STBs will likely have a higher incremental cost, in part due to the substantial network 'head-end' upgrades that will be needed. The goal in buying down this cost would be to encourage service providers to purchase them. Some of the developing technologies for televisions, such as Organic Light Emitting Diodes (OLED), may also have a higher incremental cost and be candidates for buy downs. The 80 PLUS®⁸ campaign for computer power supplies may be a good model for other electronics products. A "golden carrot" reward for efficient product design is always a possible approach at the manufacturer level. Efficiency program managers also have an interest in working with manufacturers on product design issues. For example, can manufacturers confirm that products will not be harmed if they are unplugged or turned off using a power strip each night? Can cable and satellite service providers more efficiently manage the frequent download of information and programs, many of which a large number of consumers rarely use? Finally, there appear to be some good opportunities for working with manufacturers to capture energy savings outside of existing ENERGY STAR programs. The energy-saving potential of whole house automation systems and "smart" power strips-for which ENERGY STAR specifications do not presently exist-merit careful examination.

There is great efficiency program interest in deploying strong tools at the retail level. The starting point for this is to leverage existing relationships with retailers and work closely with ENERGY STAR and its retail partners. This year, ENERGY STAR will be adding electronics products into the campaign framework that it has established for the "Change a Light, Change the World" campaign. They have expressed strong interest in partnering with efficiency programs on this promotional campaign. Some of the tools that are of interest at the retail level including marketing partnerships, stocking/market share incentives, buy downs, developing instore displays such as end caps (end of aisle), providing incentives to sales associates (SPIFFs), and instant customer rebates issued at point of sale. Several utilities capture these concepts and more by issuing requests for proposals to retailers, who get money for meeting predefined goals using whatever means they prefer. It may be necessary to bundle electronics products to reach the energy savings goals many programs will establish. A logical grouping would be to offer incentives for a home entertainment system (television & DVD player) and/or a home office bundle (computer, monitor & printer/scanner/copier). At the same time, programs managers must be careful about adding additional load.

Many program managers are losing enthusiasm for downstream rebates to consumers, in large part due to the costly administrative burden of processing a large number of rebate requests and "breakage," a term used to describe the situation where consumers are eligible to receive a rebate but don't claim it, meaning an energy efficiency program cannot get credit for the savings. Nevertheless, they are a tool that programs will continue to use and merit careful consideration, particularly if they can be issued at the point of sale. Bulk purchasers like hotels may also be fruitful targets for capturing large energy savings at the downstream level.

The measurement and verification challenges that efficiency programs face for all program areas could be particularly acute for electronics. For televisions and computers, there

⁸ More information about the 80 PLUS® campaign may be found at <u>http://www.80plus.org</u>.

are real concerns about free ridership and actually realizing savings. Often, when a new television or computer is purchased, the older one goes into a bedroom or basement or to a friend or relative. Buyback programs need to be considered as a tool to ensure rebates used for televisions and computers are not actually facilitating increased energy use. Similar programs currently being conducted for refrigerators will be particularly instructive here, and there is a great opportunity for partnerships with retailers and local organizations conducting electronics recycling events. There is also a concern that consumers will just apply savings from television rebate dollars to buying a larger television, effectively negating potential energy savings. It will be essential to gather additional information to understand the implications of deploying consumer rebates. There is a great opportunity for programs to collaborate on regional research in this area.

Consumer education. Efficiency program managers think there is great potential for achieving energy savings in consumer electronics through educating consumers. The first major educational opportunity is the one-time shot posed by the transition from analog to digital television signals, scheduled for February 17, 2009 in the United States and for September 1, 2011 in Canada. Unfortunately, the timing is not optimal for capturing maximum energy savings in the United States, since the new ENERGY STAR television specification is not effective until November 1, 2008 and the ENERGY STAR set-top box specification will be effective on January 1, 2009. By then many consumers will have made their choices, likely assisted by a tax rebate from the U.S. Government in May 2008. Nevertheless, efficiency programs should be able to capture some savings by preparing a coordinated educational message in partnership with ENERGY STAR and the Consumer Electronics Association about making energy-efficient choices during the transition. These could include purchasing ENERGY STAR-qualified DTAs, encouraging cable and satellite providers to become ENERGY STAR partners, and managing the energy use of electronics devices through power strips. In addition, the California investorowned utilities plan to deploy a television program on November 1, 2008. Canadian efficiency programs should be in a stronger position to capture energy savings from their transition.

Many educational approaches can be deployed through partnerships with retailers. These might include training for sales staff, point-of-display information about ENERGY STAR, a second price tag label showing annual and lifetime operating costs, and messages of positive reinforcement on sales receipts (e.g., "thank you for your energy-saving purchase"). This could be successfully and efficiently accomplished by developing a coordinated message and approach with ENERGY STAR.

Given a growing body of research on the substantial standby power consumption of electronics products (Bertoldi et al. 2002; NRCan 2007), there is strong interest in supplementing messaging about purchases with persuasive information regarding reducing the energy use of electronics devices through power management. This term is most frequently used for computers, which allow a user to configure settings so as to use less energy. It is time to extend this concept to all electronics products. For televisions, it might mean educating consumers about the implications of increasing the brightness of their televisions. Game console users may also be a promising target (Horowitz 2008). Terms like "phantom" and "vampire" loads may be catchy enough to entice consumers to use low-tech solutions like unplugging devices such as cell phone and notebook computer chargers from the wall when not in use or plugging products into a power strip that can turn off all the equipment in one fell swoop when not in use. More and more programs are investigating the savings opportunities offered by a new generation of power strips

with advanced capabilities like timers and automatic shutdowns. The New York State Energy Research and Development Authority (NYSERDA) and Ontario Power Authority are already promoting these products. Other themes that might capture consumers' attention are reducing greenhouse gas emissions and messages that are appealing to children. Beyond the traditional tools that programs use (general information on websites and in bill stuffers), these messages are well suited to a public service announcement and interactive website tools like NYSERDA's Energy Pirates game⁹ and fun and informative displays at events like state fairs. Once again, ENERGY STAR will be a major partner in this effort, and we need to further examine how the electronics industry can be incorporated.

Advanced product specifications. The inclusion of On Mode or active power consumption for the new ENERGY STAR specifications for televisions, STBs and computers is a big step forward. For many programs, however, it might not be enough to meet their savings targets. High levels of On Mode power consumption are also of concern to utilities with increasing interest in peak load reduction. Rapid innovation in the electronics category makes it challenging for ENERGY STAR to keep up, although its approach of identifying future tiers has some promise for capturing future innovations in television and STB technologies. Additionally, the energy savings numbers for individual products are often small.

The new ENERGY STAR television specification is a case in point. There is significant variation in the energy use of different television technologies and by features such as high definition, and manufacturers aggressively sought a specification level that would ensure their products would qualify. The result is a specification in which there is a qualification rate of 27.4 percent of the models that were included in the data set for the specification. There is great potential that the qualification rate will even be higher in November 2008 when the specification goes into effect. As for per-unit savings, ENERGY STAR preliminarily estimates an ENERGY STAR-qualified television will save 360 kWh over its lifetime when compared to a non-qualified unit. There is much more potential to be captured. Figure 2 shows the new ENERGY STAR television specification line for average On Mode power consumption for products having 768 and 1080 lines of native vertical resolution. At the 60-inch screen size, the least consumptive model consumes roughly 230 watts less power—or 400 fewer kWh per year—than another model that just meets the specification.

⁹ <u>http://www.getenergysmart.org/energypirates/</u>.



Figure 2. Final Version 3.0 ENERGY STAR TV Products Specification

Over the course of 2008, CEE will be exploring whether to pursue an advanced specification for televisions. STBs and computer monitors may merit examination as well.¹¹ An advanced specification for STBs is of particular interest in Canada as they prepare for the digital transition. There may also be other products for which new specifications may be warranted (e.g., power strips), and efficiency programs may be able to make recommendations to ENERGY STAR based on our investigations. The process of developing advanced specifications will require careful study, including assessment of program energy savings goals, product availability and future technological developments, and close consultation with manufacturers and ENERGY STAR.

Partnerships

Throughout this paper, there has been mention of the partnerships needed to achieve energy savings with consumer electronics programs. This section elaborates on the partnership opportunities already identified and highlights other collaborations that offer strong potential.

Electronics industry. Earlier in this paper, key opportunities for partnerships with manufacturers in pricing, designing, and marketing electronics products to increase their efficiency and market adoption were highlighted. An outstanding outcome would be a partnership that increased efficiency programs' access to key data necessary to support program design and evaluation. These data include incremental cost and shipment data as well as information on trends in consumer purchasing decisions and use of electronics products. It would also be extremely beneficial to develop the type of relationship with manufacturers that would

¹⁰ LCD is Liquid Crystal Display, DLP® is a trademarked technology of Texas Instruments used in rear projection televisions, LCD-RP is Liquid Crystal Display-Rear Projection.

¹¹ For computer monitors, PG&E and Southern California Edison are rebating LCD monitors that are 25 percent more efficient than ENERGY STAR.

allow efficiency program managers and manufacturers to work side by side in identifying and evaluating promising emerging technologies, such as for whole house automation systems. It will be necessary to work both with the industry's trade association—the Consumer Electronics Association—and individual manufacturers and retailers to be successful.

The unique situation of set-top boxes provides an excellent opportunity to partner with cable and satellite providers. Consumers generally do not purchase set-top boxes, but rather lease them from the provider of the cable or satellite television service. Most providers allow their customers to choose from just a few boxes that offer a variety of different functions. The boxes are purchased in large numbers¹² and service providers' demands are very influential with manufacturers. In addition, the new ENERGY STAR STB specification allows cable and satellite providers to qualify as ENERGY STAR partners either through purchasing new STBs that meet the performance specification or through meeting a fleet requirement for new, refurbished and/or boxes upgraded in the field that meet the required performance level.¹³ An energy efficiency program that develops a successful partnership with a service provider has a tremendous opportunity to generate large energy savings numbers in the aggregate. This is a high priority opportunity in both the United States and Canada.

ENERGY STAR. Energy efficiency practitioners have a tremendous investment in the ENERGY STAR brand with its strong consumer name recognition. Leveraging the Energy Star brand for new opportunities is essential. Although energy efficiency is often not an important criterion in consumer purchasing decisions, the brand's bundle of meanings—quality, value, environmental protection—can help efficiency programs achieve their goals. ENERGY STAR staff is committed to capitalizing on and promoting their new specifications. Its relationships with manufacturing and retail partners are strong and will be quite valuable to programs.

Other efficiency programs. Efficiency programs have started their partnership work in electronics through their collaboration on ENERGY STAR specifications and possible program approaches at CEE. There are many more opportunities to work together. Regional approaches seem particularly appropriate in working with retailers and cable and satellite providers or conducting studies on consumer behavior in the purchase and use of electronics products. To make national progress on specific fronts, it will be important to share lessons learned.

Customers. It is probably not often that utility customers and ratepayers served by non-utility efficiency programs are identified as partners, but success in achieving energy savings goals depends on customers' respect for efficiency organizations and on their commitment to working with efficiency programs to achieve energy savings. It is important to leverage the respect earned from operating other programs into the consumer electronics realm. Providing customers with high quality, consistent information that they can count on in making product purchase, operation, and disposal decisions is very important.

¹² For example, Comcast Cable Communications has some 24 million subscribers in the United States and Time Warner Cable more than 13 million (NCTA 2007). Many of those customers own multiple televisions.

¹³ <u>http://www.energystar.gov/index.cfm?c=revisions.settop_box_spec</u>.

Crafting Dynamic Approaches for a Dynamic Industry

It is easy to resort to the tried and true approaches that have proven successful for us in the past. This rapidly evolving, dynamic product category and industry are going to demand energy efficiency programs deliver these approaches and more. To be successful, it will be important to employ knowledgeable people, namely technical and marketing experts.

As program managers grasp for necessary data and work to stay abreast of new technologies and products, there is nonetheless confidence that there will be a number of electronics programs and successes to showcase at the 2010 Summer Study. The issues outlined and the approaches set forth above are a strong start for realizing that outcome.

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