Serious Programs for Plug-Load Hogs and Phantoms!

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ABSTRACT

Electronics in households now account for at least 11 percent of electric use and is growing rapidly. A significant portion of that load comes from "phantom loads" that continue to draw power even when they are turned off. Plug-loads also consume over 20 percent of the electricity in offices and often more. A number of states and regions that lead the industry in energy-efficiency programs, including New England, the Northwest, and California, are discussing how to best approach plug-load energy efficiency. At the same time, there have not been many creative programs for end-users to effectively and comprehensively address the huge potential savings from plug loads and related phantom loads. Information and education alone is not sufficient to motivate customers to take actions to reduce their plug-load energy use from computers, printers, and other business equipment and electronics. Most energy services companies do not have the technical background to recommend approaches and measures to reduce those loads. Smart strips are becoming more prevalent but it is time to starting thinking about more innovative approaches to reduce plug loads.

The intent of the paper is to confirm the significant opportunity to reduce plug-load electric usage and discuss the barriers to adoption of plug-load efficiency measures and practices. In the context of those barriers, the paper will describe program approaches that have been used to target those loads. The paper will also discuss ideas that can lead to better program design and what may constitute best practices for plug-load efficiency programs for the residential and business mass markets in the future.

Introduction

There are significant opportunities in both the residential and non-residential sectors. EPA ENERGY STAR estimates that plug loads now account for more than 11 percent of household use. They project that electronics will account for 19 percent of electricity use in homes by 2020. In addition, "phantom" loads occur in most electronics, such as VCRs, televisions, stereos, computers, and kitchen appliances. According to the U.S. Department of Energy, 75% of the total electricity used for home electronics in the average home occurs while the products are turned off. The growth in the number of units has also contributed to the significant increase in electricity consumption for consumer electronics. For example, Nielson Media Research reported that in 1981, there was an average of 1.39 televisions per home. By 2008, households on average had 2.79 units per household. During that same period of time, the percentage of households with television sets did not change much going from 98.1 percent to 98.2 percent. It would probably be a difficult "sell" to get consumers to remove extra televisions. At the same time, an educational program on the "phantom" energy use could be used to encourage them to unplug those units that are not used frequently.

The energy industry recognizes the importance of household electronics on the growth of electric consumption in the U.S. and is taking actions to adopt efficiency standards. In a recent AESP Brown Bag (February 14, 2008) that the author conducted with EPA ENERGY STAR, Katharine Kaplan presented the following, Table 1, showing the progress at that time in establishing ENERGY STAR specifications for consumer electronics. These standards will help ensure that new

equipment is more energy efficient but there are opportunities that are being missed until that new equipment is installed.

Table 1. Status of ENERGY STAR Standards for Consumer Electronics as of February 2008

Product Category	Status	ENERGY STAR Modes
Computers & Notebooks	Tier 2 under development; anticipated effective date July 1, 2009. Tier 1, Version 4.0 effective July 20, 2007	Idle; Sleep; Standby (Off) External and internal power supply requirements
DTAs **Set-top Boxes**	Version 1.0 effective January 31, 2007 Version 1.0 for Service Providers, 2.0 Boxes; under development ; anticipated effective date Dec 15, 2008	On; Sleep Typical Electricity Consumption (TEC)
External Power Supplies (EPS)	Version 2.0 under development; anticipated effective date second half of 2008. Tier 1, Version 1.1 effective January 1, 2005	Active; No-Load
Monitors	Specification revision initiated in October 2007 Tier 2, Version 4.1 effective January 1, 2006	On; Sleep; Off
TVs	Version 3.0 final, effective date November 2008.	On Standby
Imaging Equipment	Tier 2 under development; anticipated effective date April 1, 2009. Tier 1, Version 1.0 effective April 1, 2007	Typical Electricity Consumption (TEC) for high-use Sleep and Standby for other products EPS requirements
Audio/DVD	Tier 2, Version 1.0 effective January 1, 2003	Standby
Telephony	Version 2.0 effective November 1, 2006	Standby; Also includes EPS requirements
Battery Charging Systems	Version 1.0 effective January 1, 2006	Nonactive Energy Ratio covers Battery Maintenance and Standby

Plug-loads in the non-residential sector including office equipment and other electronics are also growing at an alarming rate. PCs and non-PC office equipment are estimated to be the fastest growing energy uses for the commercial sector through 2030 according to the Energy Information Administration—Annual Energy Outlook 2006 Report:

- Energy consumption for PCs is estimated to grow 3 percent annually
- Energy consumption for other office equipment is estimated to grow 4.1 percent annually
- In comparison, energy consumption for other end-uses such as space heating is estimated to grow about 1 percent

Data collected on-site for NYSERDA's **Energy $mart**[SM] Offices project, indicate that plug-loads account for at least 25 percent of the electric use in commercial offices. Prior to 2007, computers met ENERGY STAR specifications if they included the capability to enable low-power or "sleep mode." The Tier 1 specification for ENERGY STAR computers that went into effect in July 2007 is much more stringent. Even with the new ENERGY STAR compliant equipment, the overall growth in electronics may offset those savings without additional measures to ensure electronics are powered off or set appropriately for power management. There are few, if any, programs that have

taken a comprehensive approach to plug-load efficiency including offering incentives to customers to ensure recommended measures are implemented.

Although ENERGY STAR equipment will provide significant savings opportunities, there is a need to address existing equipment that will not be replaced for several years. Computers, for example, are typically replaced no more often than every 3 years. Businesses may have servers on site that can be more efficient. At the same time, there are considerable opportunities to replace inefficient units of non-business equipment with ENERGY STAR vending machines, task lights, large coffee makers, and individual compact refrigerators in offices. In addition, other electronics are found in significant quantities including set-top boxes (cable modems), televisions, and external power supplies that are likely not ENERGY STAR.

This paper begins with a discussion of plug-load equipment and opportunities for plug-load savings. Next, the barriers to adopting efficient plug-load equipment and taking measures to reduce plug-load equipment usage are described. Finally, the paper discusses some of the approaches and specific plug-load efficiency programs that have been offered to target the residential and business sectors.

Plug-Load Equipment

Plug-load equipment would typically consist of business and non-business office equipment and other electronics. A comprehensive program would address, but are not limited to, the following equipment:

- Computers, monitors, and servers
- Copiers, printers, scanners, faxes, and multifunction devices
- Computer speakers and other peripheral work area equipment
- Work area and home office task lighting
- Power strips and surge suppressors
- Cold beverage vending machines
- Break room refrigerators, water coolers, and large coffee machines
- Clothes washers in laundry facilities (residence halls)
- Personal mini-refrigerators, space heaters, and fans
- Entertainment: televisions, DVR players, and set-top boxes
- Personal chargers

At a minimum, a comprehensive plug-load efficiency program would include the following types of measures:

- **Purchase "best" ENERGY STAR equipment:** Encourage businesses to develop and enforce purchasing/leasing standards that specify the most efficient ENERGY STAR office equipment as a minimum. These include computers, copiers, printers, task lighting, vending machines, water coolers, clothes washers, mini-refrigerators, consumer electronics, and other plug-load equipment. Provide education to consumers on the availability and benefits of ENERGY STAR equipment.
- **Power management:** Work with businesses to ensure that all applicable ENERGY STAR® office equipment such as PC monitors (and computers where applicable), printers, and copiers are enabled to go into "low power" or "sleep mode" when idle for a specified time.

ENERGY STAR equipment is typically shipped with appropriate power management settings but IT and end-users often disable those settings. Recommend optimal settings based on end-user group—residential customers, office staff, faculty, students, and lab computer users.

- **Power off:** Educate all users to turn off plug-load business equipment (PCs, monitors, printers, copiers, speakers, task lights) after hours and when not being used for several hours. In businesses, recommend timers to control the operating hours of other inefficient equipment such as large coffee makers that heat water 24 hours a day. Turn off water heating in coolers that have both hot and cold water taps. Promote the effective use of power strips to reduce electric use from phantom loads.
- **Recycling:** Residential and business computers and monitors, televisions, and other electronics should be recycled to reuse precious metals, copper, and engineered plastics and to minimize environmental impacts. A comprehensive program should provide information on resources available in the region to recycle electronics equipment.

Barriers for to Implementing Plug-Load Efficiency Measures

Despite the opportunity to save close to half of plug-load electric use with little or no capital investment, there are still very limited adoption of plug-load efficiency measures. Making ENERGY STAR equipment available alone is only a starting point to achieve significant energy savings. There are many barriers that need to be addressed by innovative programs to maximize energy savings for consumers and businesses. Those barriers are discussed in more detail in this section.

Lack of Awareness of the Savings Benefits for Consumers and Businesses

The number one barrier to achieving plug-load energy savings is that consumers and business decision-makers are still unaware of the major impact of plug-load equipment on their electric bills, coupled with a lack of understanding of the significant savings opportunities. Although the ENERGY STAR program, for example, provides a wealth of information on their web-site concerning consumer electronics and business office equipment, there are still many individuals who are not familiar with those resources. Education should provide plug-load energy use information specific to the home or business. At the same time, education alone may not be effective without offering some incentives, financial or otherwise, to take action. There is considerable knowledge and adoption of compact fluorescent lamps today but few recognize that plug-load efficiency may provide greater savings opportunities in today's mass markets of residential homes and offices. Replacing a plasma television with an ENERGY STAR version can yield similar savings to replacing 10 or more incandescent lights in the home with compact fluorescent lights.

Myths and Technical Realities for Consumers and Businesses

Once the information barrier is resolved, the next major barrier to major plug-load opportunities such as computer power management is due to misperceptions or bad experiences with older equipment. For businesses, the IT staff can represent the biggest obstacle or the most effective ally. A certain level of technical expertise is also needed for consumers who are concerned about the impact of powering off their electronics. For that reason, an effective program must provide appropriate technical support.

Lack of Staff Resources to Implement Measures in Businesses

For businesses, facilities managers and property managers often wear many hats including that of physical plant administrator, energy manager, safety inspector, and maintenance person. In that context, they have little time or motivation to implement new projects to reduce plug-load electric use. IT staff are also time-constrained in responding to client problems and maintaining high levels of reliability and security for the information system network—computer power management becomes a lower priority for them. Larger, more comprehensive plug-load efficiency projects may justify the significant hand-holding and follow-up that is often needed. Other approaches are needed for mass market smaller businesses that do not yield the same level of savings to justify the investment of "face time."

Organizational Hurdles in Businesses

Unlike other energy-efficiency programs that target the business sector, facilities managers or property managers may need to work closely with multiple groups to facilitate comprehensive plug-load efficiency. Those groups may include key decision-makers from information technology (IT), procurement, and administrative management staff that may or may not be located at the site. In some small offices that are part of national businesses, the information system is maintained at a central location in another city.

Misplaced Incentives in Businesses

The end-user, group, or business may not directly benefit from the cost savings from implementing plug-load efficiency projects. Many small businesses are tenants where the lease arrangement does not allow the tenant to share the benefits of reducing their electric use. In addition, there is no direct incentive to key stakeholders such as information technology (IT) staff to implement policies and procedures to save energy costs. If the IT staff saves significant energy costs by fully enabling the power management settings on computers, they do not typically get credit for those savings in their IT budget. A significant portion of the identified plug-load savings (typically at least two-thirds) will not happen unless the IT director signs off and approves IT staff time to implement power management strategies on the network computers. A recent article on the BusinessGreen website[1] suggests that IT should be made responsible for the energy bill associated with the IT system). IT would then reallocate those costs to the appropriate end-user departments. Although the approach described in the BusinessGreen article may not be workable, the concept of making end-user groups responsible for their energy costs would make it much easier to get plug-load efficiency measures implemented.

Plug-Load Efficiency Programs

There are programs such as NYSERDA's Energy $mart Offices that took a comprehensive approach to reducing plug-load usage for larger offices, college campuses, and municipal school districts. There are few, if any, similar programs for the mass market of residential and smaller businesses although the overall savings potential is significant due to the large numbers of customers.

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[1] See http://www.businessgreen.com/articles/print/2203621

The previous discussion focused strictly on the barriers for the targeted end-users. There are also a number of concerns or limitations for energy-efficiency program managers that affect the availability and comprehensiveness of these programs for both residential and business sectors:

- ***Lack of technical expertise***, particularly in information technology—most energy service providers do not have staff with the background to be conversant with the IT director. They are not able to address the concerns and barriers that can usually be overcome by a technical expert.
- ***Ensured sustainability of savings***—a comprehensive program would include behavioral changes, such as powering down office equipment and home electronics when not in use. Although these changes can lead to major savings, there is no guarantee or easy way to ensure that these savings are occurring.
- ***Difficulty in estimating savings***—there are a number of calculators provided by EPA ENERGY STAR on their web-site to estimate savings that include default values. The equipment specifications and the operation can vary substantially, and so can the savings. For larger facilities, equipment surveys can be conducted and plug-loads may be metered at the electric panel before and after comprehensive measures are implemented. For the mass market, these methods of estimating savings for each project are not realistic or cost-effective.
- ***Designing cost-effective programs***—it is very difficult to design a cost-effective comprehensive plug-load efficiency project for individual mass market customers that goes beyond education or limited technologies such as smart power strips.

Despite the barriers to developing effective comprehensive plug-load efficiency programs for the mass markets, there are some programs that target these customer groups. The most common approaches are described along with specific examples.

Upstream Market Actors Programs

The most prevalent approach has been to work with the electronics industry to promote more efficient design of electronics. Ecos **80 PLUS®** is one example of a major program that targeted computers using a push-pull market strategy. According to the web-site, 80 PLUS is "an innovative, electric utility-funded incentive program to integrate more energy-efficient power supplies into desktop computers and servers." The program targets the computer industry, end-users, and utility program managers. Large commercial and institutional consumers are encouraged to specify 80 PLUS in their procurement policies. A number of utilities and energy efficiency programs are providing incentives for **80 PLUS®** primarily in the commercial sector. The current sponsors include Northwest Energy Efficiency Alliance, Efficiency Vermont, NV Energy, Pacific Gas and Electric, and Xcel Energy. In addition to offering incentives for 80 PLUS qualified PCs and servers, NV Energy offers incentives for ENERGY STAR qualified PCs.

In July 2008, PG&E proposed California's Statewide Electronics Program to the California Energy Commission that would include retailer incentives for the most efficient televisions on the market. These would include those that surpass the ENERGY STAR level, scheduled to become effective in November 2008, by at least 15%. More recent presentations indicate that the focus for the utility program will be on the upstream and midstream market actors including incentives to retailers and manufacturers. PG&E and Ecos are working with the other CA utilities on a program that pays incentives to big box retailers for high efficiency consumer appliances. The incentives are

fairly small (~$10)—not enough to influence a purchase decision—the objective is to move Best Buy, Wal-Mart, and other major consumer electronics retailers to either carry only approved appliances, or to promote them more aggressively to purchasers.

Codes and Standards

The **80 PLUS®** program played a major role in ENERGY STAR establishing more rigorous standards for qualifying computers and servers. ENERGY STAR is expected to continue working to establish standards for other plug-load equipment including televisions, set-top boxes, and external power suppliers. At the same time, there is a need to ensure the consumer and mass market businesses are aware of the benefits of ENERGY STAR equipment and take action to always purchase the most efficient qualifying equipment. Effective January 1, 2007, California established its own state standards for external power supplies used with laptop computers, mobile phones, printers, print servers, scanners, personal digital assistants (PDAs), and digital cameras. These types of programs are important to the industry but there is still a need for interim programs to replace equipment more quickly and to provide additional savings from power management and appropriate powering off policies.

Software Solutions for Monitor and Computer Power Management

EPA ENERGY STAR provided software solutions that could be downloaded from their web-site to poll and/or set power management on single computers or groups of computers on a network.. These tools included EZ Save and EZ Wizard programs. The computer monitor power management campaign, Sleep is Good, is a national effort by EPA/DOE to promote energy savings in computer monitors. Other commercially available software solutions were offered in the industry. The Northwest Energy Efficiency Alliance provided matching funds to Verdiem to launch its Surveyor Network Energy Manager software, which allows companies to automate energy management on their PC networks. In general, the software solutions have become less important since the network management software that is typically used today for larger organizations already includes the capability of reimaging computers to establish power option settings. Further, there is less need for power management software tools for homes or smaller businesses where the settings can be done manually for the small number of computers.

Educational Programs

There are numerous states and utility program administrators that provide education on computers and consumer electronics on their web-site and in other consumer materials. They typically provide tips for saving energy with consumer electronics by encouraging customers to purchase ENERGY STAR-qualified electronics or to turn off and unplug consumer electronics that are not in use. There are few, if any, that provide a specific audit or component of an audit that focuses on plug-loads and consumer electronics.

Rebates and Incentives for Office Equipment

There are a number of low-cost devices available to reduce plug-load usage including the Watt Stopper and Smart Strip. Both power off equipment that is plugged in particular outlets on the power strip. One uses an occupancy sensor while the other turns off selected equipment when the

computer is powered off or goes into sleep mode. Sacramento Municipal Utility District is one program that offers incentives for plug load efficiency in offices that include power management of computers and plug load occupancy sensors. The incentives include $10 per PC for using installed software to control the power settings of networked personal computers (PC) at the server level. When requested, customers must allow SMUD access to customer property site to verify the software license installation and the number of PCs being controlled. SMUD also provides a $16.50 per plug-load occupancy sensor. Only passive infrared and/or ultrasonic detectors are eligible and they must control a minimum of 50 watts of electric equipment in offices or cubicles, or control shared copy machines and/or printers.

Summary and Recommendations

There is general agreement that more emphasis is needed to reduce plug-load equipment energy uses that include office equipment and other electronics. At the same time, there is a lack of programs that comprehensively address efficiency in plug-load equipment. The limited numbers of programs, particularly new initiatives, focus primarily on upstream market actors. The emphasis is on establishing codes and standards and offering incentives to ensure the design and manufacture of more efficient equipment. Although important, it is not clear that this is enough given the rapid growth of plug-load energy use in the residential and business sectors. While a more efficient power supply in computers can save an estimated 85 kWh per computer user, the NYSERDA Energy $mart Offices program estimated that an average of 300 kWh could be saved per computer user with a more comprehensive plug-load efficiency program for offices and educational facilities. The mass market would also benefit from more comprehensive plug-load efficiency programs. In addition, current programs for upstream market actors do not address existing plug-loads and consumer electronics that may not be replaced for several years. Further, these programs do not offer an opportunity to gather data about the purchaser and their plug-load equipment.

There are many market barriers for end-users and program concerns that must be considered in designing an effective program to address plug-loads in the mass market. With that in mind, the following recommendations are proposed.

1. ***Integrate plug-load efficiency into existing programs***—there are a number of existing national residential programs including ENERGY STAR New Homes and Home Performance with ENERGY STAR that take a holistic approach to energy efficiency. At the same time, these programs do little to address plug-loads, particularly consumer electronics and related phantom loads. Home and business energy audits should collect and analyze data on plug-loads and make specific recommendations to reduce those energy uses. In addition, programs that include installation of low-cost measures should also consider installing control devices including smart strips for appropriate applications. Home automation systems and EMS can also help provide consumption information.
2. ***Develop model programs through collaborative efforts***—there are many initiatives and working groups that are discussing programs to reduce plug-load usage including those in California, the Northwest, and Northeast. Organizations such as CEE have given plug-load and consumer electronics efficiency a high priority. A series of workshops could be held to develop effective approaches that would include industry experts, policymakers, equipment suppliers, technology specialists, program managers, researchers, and consumer marketers.

3. ***Conduct appropriate research to inform the program designs***—for the mass market, it would be particularly useful to conduct surveys, focus groups, and product design research to create effective plug-load efficiency programs. The focus groups would be used to identify specific barriers for residential and business customers to implementing plug-load efficiency measures and discuss what program features could be used to overcome those barriers. Programs that target larger customers, such as NYSERDA's Energy $mart Offices, include site data collection and analysis with appropriate follow-up and are still cost-effective. The mass market has fewer savings per customer and requires more creative and effective program design to ensure high participation with limited personal contact.
4. ***Provide plug-load efficiency training—***training should be available for the end-users and for the energy services providers. The end-users, particularly for businesses, should understand the energy costs of plug-load equipment in their facility and how to manage those costs. Energy services providers need to know about plug-load equipment energy use and savings opportunities. They also need to know how to conduct a plug-load equipment survey and analysis, and have at least a limited understanding of information technology issues. Residential consumers need to get better information on the energy costs of different types of equipment and tips on how to operate equipment more efficiently to reduce those costs.
5. ***Consider programs that target other key market actor groups—***the emphasis is on equipment manufacturers but there are other types of equipment vendors that have a major influence on consumer purchases and equipment setup. For example, those vendors who sell and lease computers, copiers, and printers could be encouraged to work more closely with their customers to ensure appropriate power management settings are enabled. These vendors also represent an opportunity to explain and perhaps sell devices such as smart strips to help reduce energy usage of their equipment. Even sales staff in consumer electronics stores could be trained to provide useful education on how to minimize the electric use of their products. Energy efficiency could become an effective sales tool.