Best Practices and the Benefits of Delivering Plug-Load Energy Efficiency in Businesses!

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ABSTRACT

The energy efficiency program industry recognizes the need to address the exploding plug-load electric consumption but there seems to be no consensus on the best strategy to target those end-uses. There are many programs, technologies, and measures emerging and under discussion to target these plug-loads. It is not clear which, if any, of the existing or planned programs are "best practice" that could serve as a model program for the rest of the industry. In addressing those needs, National Grid, Unitil, Western Massachusetts Electric, NSTAR, and the Cape Light Compact jointly sponsored a study of plug load efficiency opportunities in their service areas. The objective was to characterize the market for plug-load efficiency including potential energy savings, and to identify best practices to deliver those savings. The target markets for these programs include key commercial buildings with an emphasis on small businesses. The study will be used to develop strategies to delivering energy efficient plug-load measures to business sector customers.

The paper and presentation will describe the objectives, methodology, and results of the market assessment. The results can be used to help define measures and methods to target a difficult end-use market—plug-load electric use in the small business and other key commercial sectors. In addition, the paper will describe a methodology that uses a wide-range of primary and secondary data on programs, technologies and measures, and customer end-uses to provide reasonable estimates for the impacts of plug-load measures and programs.

Introduction

Plug-loads including office equipment and other electronics are 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 (EIA 2006). Energy consumption for PCs is estimated to grow 3 percent annually, while 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 during the same period of time (EIA 2006).

Industry sources, including facility site equipment survey data provided by PA Consulting Group from the New York State Energy Research and Development Authority's (NYSERDA's) Energy $mart^{SM} Offices program, indicate that about half of the plug-load usage can be saved in most offices (NYSERDA 2007).

Although ENERGY STAR equipment will provide significant savings opportunities for a number of plug-load equipment categories, 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. With the current economic conditions, those replacements may be further delayed. Some campuses have 10-year

contracts for cold beverage vending machines that represent a significant savings opportunity. In addition, there is an educational process that needs to happen to ensure these savings opportunities are maximized..

Programs that target plug-loads are needed to comprehensively address business and non-business office equipment and other electronics including:

- Computers, monitors, and servers
- Copiers, printers, scanners, faxes, and multifunction devices
- Computer speakers and other peripheral work area equipment
- Work area and residential hall 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, video games, and set-top boxes
- Personal chargers

At a minimum, a comprehensive plug-load efficiency program would address energy-efficient product procurement, computers and other plug-load equipment power management, staff policies and directives for plug-load equipment operation, and appropriate control strategies to power off equipment

The objectives of the study were to characterize the market for plug-load efficiency in businesses including potential energy savings, and to identify best practices to deliver those savings. The paper first discusses the methodology used for the market assessment study including key data sources followed by study results and ending with specific recommendations based on the study.

Methodology

This section describes the analytical approaches and data sources to conduct the two major tasks for the study—a market scan of programs and technologies, and an assessment of the market potential for plug-load energy efficiency.

Market Scan

PA began the study with a complete scan of the U.S. energy efficiency industry. Extensive Internet research was used to identify and document programs that are currently being offered to promote energy efficiency in plug-load equipment for all customer sectors. The plug-load equipment would consist of business office equipment and other non-business appliances and electronics. Interviews were conducted with selected program managers to gather additional information on those energy-efficiency programs that seemed most relevant for the current plug-load end user market in the business sector.

In addition to reviewing the current program offerings, PA identified the possible tools—hardware and software—and new energy management technologies that exist to support new programs designed to reduce plug-load energy use. These tools and efficiency measures were cross-referenced with existing industry program offerings but new technologies were included that have recently emerged and are being considered for plug-load efficiency programs. The new technologies were documented with links to manufacturers/suppliers web-sites. PA contacted suppliers to obtain additional information for promising technologies.

Market Potential Analysis

A major component of the study was to conduct a market potential analysis to provide estimated savings for computers and other major categories of business and non-business plug-load equipment for non-residential sectors for each of the sponsors of the study. Lacking specific plug-load equipment inventories for the study sponsors' service areas, the savings were based on the mix of equipment and energy use for similar facilities from secondary sources. In reviewing industry data, the decision was made to focus on the following market segments as having the great potential for plug-load savings:

- Small Offices
- Medium/Large Commercial Offices
- Government Offices
- Municipal School Districts
- Colleges and Universities
- Health and Hospitality

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In addition, the plug-load groups that provided the best data and the most opportunity for energy savings were analyzed. These included computers, copiers, printers, task lighting, major appliances, televisions, and miscellaneous electronics.

The methodology primarily used a top-down approach. First, the commercial sector annual electricity sales were summarized by the target commercial market segments for each of the five service areas. For these different target commercial market segments, the total plug load use was calculated as a percentage of the total annual electricity use. Once the plug-load energy use for different target commercial market segments was estimated, the next step was to calculate the contribution of each category of plug load equipment to the total plug load energy use for that segment. The final step was to estimate the energy saving potential for each plug-load equipment category for each of the commercial market segments. This analysis was repeated for each of the five study sponsor service areas.

The outcome of the study was then documented in a report that also discusses the best practices for delivering plug-load energy efficiency.

Data Sources

The data used for the study included a combination of primary and secondary data sources. The key sources included:

- **Industry programs**—the Internet research primarily identified programs described on numerous utility web-sites. In addition, there were some key documents that summarized specify types of programs such as computer power management by Beacon Energy Consulting (Beacon 2009).
- **Technologies and measures**—in addition to the technologies and measures identified in the industry program research, the Internet search included manufacturers and suppliers web-sites for items such as smart strips, vending misers, and total work space control systems.
- **Commercial customer billing data**—each of the five project sponsors supplied their billing data for non-residential customers. In most cases, the research team had to manually code a number of the records to provide a business type to improve the accuracy of the breakdown of commercial customers and their energy use.
- **Plug-load share of electricity consumption**—industry data from NYSERDA Energy $mart Offices

(NYSERDA 2007) and ESource (Sator 2008) indicated total plug-load usage for offices based on metered data from several facilities conducted for the NYSERDA project . Plug-load usage for other business types came from the Energy Information Administration Commercial Building Energy Consumption survey (EIA 2003). There was little or no data on plug-load equipment currently installed in their services areas to estimate market potential of the small business sector. PA also used secondary data such as the U.S. Economic Census, the Department of Energy's Commercial Building Energy Consumption Survey (EIA 2003) and educational facility web-sites to determine proportion of total electric consumption for various plug-loads that could then be applied to the summarized billing data for each sponsor.

- **Savings potential**—the savings per unit were developed using on on-site equipment surveys, including after hour observations of equipment power off rates, from NYSERDA **Energy $mart**[SM] project (NYSERDA 2007). There are calculators on EPA ENERGY STAR's web site for various office equipment measures similar to those used to estimate savings for the NYSERDA project. For monitor, vending machines, CPU and electric power supply (EPS), the "Energy Star" energy saving calculator for plug-loads was used to estimate the energy saving potential. For copiers, printers, task lights available literature on their energy saving potential have been used.

The analysis was completed using these data sources and typically more than one source was used to confirm the savings estimates.

Results of the Market Scan

The results of the market scan indicated there are still very few energy-efficiency programs that take a comprehensive approach to reducing plug load electricity use in businesses. In general, the numbers of programs are still fairly limited and they typically focus on one or two measures such as smart strips, power management of computers, and cold beverage vending machines. The most common program approaches and technologies or measures that were identified in the market scan are described along with some examples of relevant energy-efficiency programs.

Power Management and Plug-Load Control

There are two major types of programs that provide rebates and incentives to target office equipment at work stations. The most prevalent programs that offer rebates and incentives include control devices, using smart strips and surge suppressors, and computer and monitor power management tools. There are over 30 utilities that either have separate programs for network computer power management or they cover the measure in a commercial customer program. The following table lists some of the equipment types and programs that have offered incentives or rebates for that equipment. This is not a complete list and may include residential home offices.

Table 1. Power Management and Plug-Load Control Examples

Technology	Description and Cost	Example Program Incentives
Smart Strip Power Strip	Power strip that can turn off selected equipment when a computer is turned off. Cost is about $30 and goes up but the	4 of New Hampshire's Power Utilities are working with local merchants to provide a $10 rebate per smart strip but focus is residential. Some others:

	incremental cost over a standard power strip is about $20.	Platte River Power Authority $7.rebate. BC Hydro $7 rebate. National Grid Catalog $16.95 price.
Plug Strip with Motion Sensor (Watt Stopper Isole, PlugMiser)	Plug Load eight-receptacle surge suppressor with an occupancy sensor that controls a portion of the receptacles to power off electricity using equipment in offices or cubicles or shared copiers and/or printers. Total cost is around $90.	Energy Efficiency Rebates for Your Business by the City of Palo Alto, 2009 Business Lighting Program by Roseville Electric $22, Plug Load Incentive by SMUD $16.50, and Non-Residential Retrofit-Demand Response Program by PG&E offer incentive amounts ranging from $10-$16.50 per installed plug load sensor. SDG&E $15. Local government program South Bay provides bulk purchasing prices.
Total Work Space Control System	Convia Enabled Wiremold System combines a modular electrical system with fully integrated controls. Convia-enabled workstations let individuals control their environments while they are at their desks. When an occupancy sensor determines the worker has left the room, the Convia system can shut off plug loads, power down light levels, and reset thermostat settings. Pre-programmed power sweeps can further reduce electrical drawdown.	No utility programs found but getting attention: Convia Programmable Infrastructure is one of four technologies that Southern California Edison has installed to test an "office of the future" concept at the California Lighting and Technology Center. U.S. Green Building Council installed system in their building. Convia selected for Empire State Building Retrofit
Computer Power Management Software, SURVEYOR by Verdiem®, NightWatchman® from 1E and others	Energy monitoring software for computers - Identify work and non-work schedules to optimize power schemes based on PC use or on standby mode, includes several options for power savings and settings, and information that shows how PC power settings correlate to cost, kWh and CO2 savings. Cost about $25 per computer for commercial software.	Energy Efficiency Rebates for Your Business by the City of Palo Alto $15, Non-Residential Retrofit-Demand Response Program by PG&E, Data Center Optimization Program by Silicon Valley, and other power software programs by SMUD ($5-10 up to $25,000) and Avista $10. PC Network Energy Management by Focus on Energy. Utilities offer incentive amounts ranging from $10-$16 per controlled PC. Some limit the number of PC's that can be incentivized, say a limit of 500, or it's limited to a predefined dollar amount.

There are a number of smart strip programs that were found and more being planned, although there seems to be more emphasis on residential home offices. Several of the California utilities have rebate programs. In addition, PA's experience in managing NYSERDA's Energy $mart Offices found that several universities installed smart strip technologies in residential halls and administrative offices on college campuses.

Equipment vendors such as Convia have expanded their products that provide occupancy sensors to control lighting levels to include plug-loads in private offices. The Office of the Future (OTF) Consortium, led by New Buildings Institute, is moving forward with the development of a utility sponsored model program designed to reduce energy use by 25 percent and is considering the Convia product. The project targets the Tenant Improvement (TI) process where new or existing office spaces are customized for use by a specific tenant, but the package is also viable for retrofit projects. The program, Advanced Energy Office, has the goal of reducing the energy used by lighting, plug loads, and HVAC systems using a comprehensive systems approach. These measures are being tested through a series of 20 to 30 technical pilot projects scheduled to begin construction by the end of 2009. PA helped develop the plug-load component of the technical manual for the Advanced Energy Office that takes a comprehensive approach to plug-load energy

efficiency including the use of smart strip technology, power management, and procurement of high efficiency office equipment and other plug-loads.

The research team also interviewed two program managers who had exceeded their goals for network computer power management projects—one was from Sacramento Municipal Power District (SMUD) and the other implemented the Wisconsin Focus on Energy (WI FOE) program. SMUD had recently discontinued their program because they had greatly exceeded their program goals. The interviews along with PA's experience in managing NYSERDA's Energy $mart Offices program led to the following key findings:

- Annual energy savings per computer are estimated at 200 kWh although the average will depend on the level of existing power management for computers on the network
- Program staff need to be personally involved in the process and dedicate staff resources early on to promote the program to key customer decision-makers and to software service providers
- To remain cost-effective, the program must be vendor driven but there is a level of rebate needed to get the attention of the software vendors, which is likely about 50% of the software cost or $12 per computer
- The program needs to target larger customers (1,000 computers or more) to be cost-effective but small business customers, as a group, provide a substantial savings opportunity that could be addressed by focusing on chain accounts
- The IT staff must be involved in the process along with other upper management key decision-makers
- There are opportunities to promote computer power management along with data center and server efficiency that is getting increased attention within the IT organization
- The program should allow for multiple vendors without promoting any particular product to ensure the greatest flexibility in addressing network management needs including working with IT staff that may already have power management capability within their own network system tools
- The program should require that the power management is centrally managed and that the software provides accurate pre-and post-installation reporting

ENERGY STAR Office Equipment

The majority of office equipment that is purchased qualifies for the ENERGY STAR label. At the same time, there are still existing equipment that will not be replaced for several years. The Internet research identified only one program, Shakopee Public Utilities, offering rebates for ENERGY STAR labeled office equipment. To the extent that the rebates are effective in getting businesses to replace equipment sooner, there could be cost-effective energy savings. Otherwise, the incremental cost of computers and other office equipment that meet the ENERGY STAR standard are minimal and likely the reason why there are not many programs offering these rebates. The key is to properly enable the power management settings for the ENERGY STAR equipment to maximize the energy savings..

Table 2. ENERGY STAR Office Equipment Rebate Example

Technology	Description and Cost	Example Program Offerings

ENERGY STAR Office Equipment	Shakopee Public Utilities, MN 2009 Office Equipment Rebates Program limit of 5 rebates per product purchased (not leased) for commercial industrial customers.	**Product Rebate for ENERGY STAR labeled:** Computer $35 LCD Monitor $35 Printer $25 Multifunction Device $20 Scanner $15 Fax Machine $15 Mailing Machine $15 Occupancy Sensor (ceiling mount) $36 Occupancy Sensor (wall mount) $12

Televisions

Televisions represent another major opportunity for plug-load savings. ENERGY STAR models require only three Watts or less of power, which can result in a 75 percent savings over conventional televisions. In particular, the hospitality sector is a prime candidate due to the large number of televisions and the opportunity to purchase in bulk. Although there have been energy efficiency programs targeted to hotels and motels, such as NV Energy, PA's research did not identify any existing programs for ENERGY STAR televisions. Panasonic was very effective in partnering with major hotel chains such as Choice Hotels and Hilton Hotels Corporation to provide ENERGY STAR qualifying televisions. At the same time, there are business reasons such as durability of the screen and picture quality that are considered in product selection and are barriers that must be overcome.

Vending Machines

If you include cold beverage vending machines in the mix of plug-loads typically found in office buildings, colleges and schools, the number of programs increase significantly. ACEEE reports that USA Technologies, manufacturer of VendingMiser, has secured rebate programs with 24 utilities. Our team's experience with VendingMisers or similar control devices is that they have been an interim solution and that many programs address them because of the significant savings opportunity of 1,300 or more for retrofitting conventional cold beverage machines. The most effective approach is to ensure that Energy Star vending machines are specified when requesting bids to replace existing vending machines.

Table 3. Vending Machine Efficiency Measures Examples

Technology	Description and Cost	Example Program Offerings
VendingMiser and CoolMiser	Plug-in devices installed into vending machines to save energy; powers down the machine when the surrounding area is vacant. The cost is around $100-$190.	Some examples of program operators that give rebates for Vending Misers are NYSERDA $80 rebate; Northeast Utilities $75 rebate; Puget Sound Energy -- $40 rebate; Efficiency Vermont -- $45 rebate; and California's Express Efficiency program (operated by the three large investor-owned utilities) -- $30 rebate normally, but $60 during special promotions. Sure Bet Program from NV Energy offers a $90 incentive. Seattle City Light $80. Avista $95. TXU Energy $50 Austin Energy provides a free VendingMiser and free installation which is a $200 value. Other utilities such as Gainesville Regional Utilities, Idaho Power, Lakeland Electricity, MidAmerican Energy of Iowa, and Puget Sound Energy also offer the free product and

		installation.
SnackMiser	Plug-in device installed for non-refrigerated vending machines; infrared sensor to determine if anyone is w/I 25 ft of the machine & powers off after 15 min of vacancy. Cost is around $70-$80.	Austin Energy's Power Saver Program offers to provide a free, SnackMiser device along with free installation to all business customers. A $200 value. Other utilities such as Gainesville Regional Utilities, Idaho Power, Lakeland Electricity, MidAmerican Energy of Iowa, and Puget Sound Energy also offer the free product and installation. TXU Energy offers $20. Other programs range from $15-$30.

Comprehensive Plug-Load Efficiency 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.

NYSERDA's Energy $mart Offices took a comprehensive approach to reducing plug-load usage on local government and commercial offices, college campuses, and municipal school districts. The program included on-site plug-load surveys and savings potential analysis for 20 offices including local governments, state government, large commercial buildings, and small organizations, and 5 municipal school districts in New York State. Data was also collected on-site for 21 universities (SUNY and private) and 7 community colleges for NYSERDA Energy $mart Offices projects. These sites represented 113,760 computer users on campus with identified estimated potential plug-load savings of $3.5 million annually. For all projects, the average savings per computer user was close to 300 kWh including computers and monitors, other office equipment, and miscellaneous plug-load efficiency opportunities.

Office of the Future is moving to a new platform to complete the development steps needed to support demand-side program offerings across North America. New Buildings Institute (NBI) has been chosen as the Fiscal and Program Management Agent for OTF and will be responsible for tracking and accounting, for sponsor funding, managing the work plan, arranging and supporting meetings and facilitating communications. The Advanced Energy Office is in progress in California with 4 pilot projects. The sponsors include Southern California Edison, Sacramento Municipal Utility District, Pacific Gas & Electric Company, Sempra Utilities, National Grid, B.C. Hydro, NSTAR, Consolidated Edison, and Seattle City Light. The consortium for the Office of the Future will eventually will have 20 projects across the country including Seattle, Vancouver, and Boston. Most projects are one office but they are also conducting projects for multiple tenant business offices in one large building. The projects range from 2,000 to 20,000 sq ft. New Building Institute indicated they have do not information on the plug-load component of the project since measures are just being installed for lighting and HVAC. The plug-load measures will be implemented last, focusing on equipment vendors (such as Convia) and targeting property managers of large offices. The savings will be metered and when ready, each utility will implement the model program.

Results of the Market Potential Analysis

PA's on-site data collection and analysis for NYSERDA (NYSERDA 2007) indicated that about 25 percent of the office use was for plug-loads. The analysis is based on a more conservative estimate of 20 percent of the total annual energy consumption for office buildings is used by plug loads (Sator 2008). For purposes of this analysis, the study includes government offices and others that may not be traditional "businesses" such as municipal school systems and higher education. Computer usage alone averaged 9 percent of electricity use for college campuses participating in on-site data collection for Energy $mart Offices. However, for retail stores and hospitality (hotels/motels) buildings, the plug load energy consumption is unlikely to be as high as that in office buildings. PA estimated the ratio of plug load use to total annual energy consumption of these buildings from the CBECS database. Based on the above assumptions, the plug load energy use in retail and hospitality (lodging) building are estimated to be 3.2 percent and 5.8 percent of the total annual energy consumption respectively (EIA 2003).

The energy use allocation by measure is shown in Table 4. For example, computer monitors and vending machines use about 26 percent and 4 percent of total plug load energy consumption respectively.

Table 4. Plug Load Measures and Energy Use and Saving Potential

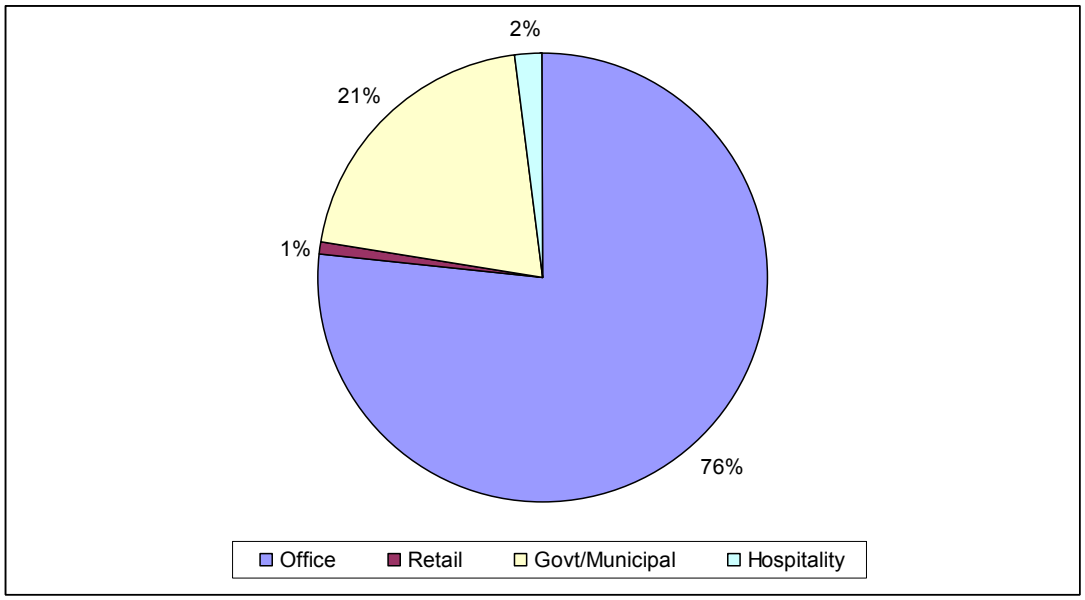
Plug Load Measures	Measure Contribution to Total Plug Load Energy Consumption*	Energy Saving Potential**
Monitor	26%	44%
CPU	18%	34%
Printer	13%	61%
Copier	10%	26%
EPS	5%	48%
Vending Machine	4%	23%
Kitchen and Task Lights	7%	73%
Additional Load at Panel	17%	20%

Sources: (Sabo & Korn 2004); See footnotes a through h

As shown for one of the utilities, the plug load energy use in office and government buildings contributes 97 percent of the total plug load energy consumption (Figure 1). Annual plug load consumption for office buildings was 46.7 million kWh and that for government/municipal buildings was 12.6 million kWh. Therefore, programs driving plug load energy efficiency improvement targeted for office and government/buildings would yield greatest value for this particular utility.

Figure 1. Plug Load Energy Use by Market Segment

a: Monitor: www.energystar.gov/ia/business/bulk_purchasing/bpsavings_calc/Calc_monitorsBulk.xls
b: CPU/Desktop Computer: www.energystar.gov/ia/business/bulk_purchasing/bpsavings_calc/Calc_Computer_bulk.xls
c: Printer: www1.eere.energy.gov/femp/pdfs/printer.pdf
d: Copier: www1.eere.energy.gov/femp/pdfs/copier.pdf
e: EPS: www.energystar.gov/ia/business/bulk_purchasing/bpsavings_calc/Calc_cordlessBulk.xls
f: Vending Machine: www.energystar.gov/ia/business/bulk_purchasing/bpsavings_calc/Calc_Vend_MachBulk.xls
g: Task Light: www.esource.com/esource/getpub/public/pdf/cec/CEC-TB-33_IntegOfficeLtgSys.pdf
h: Additional Load Panel: Assumed (a conservative assumption)



In addition, deploying energy efficient plug load measures can save about 40% of the total plug load energy use (Figure 2).

Figure 2. Plug Load Energy Use – With and Without Energy Efficiency Measures

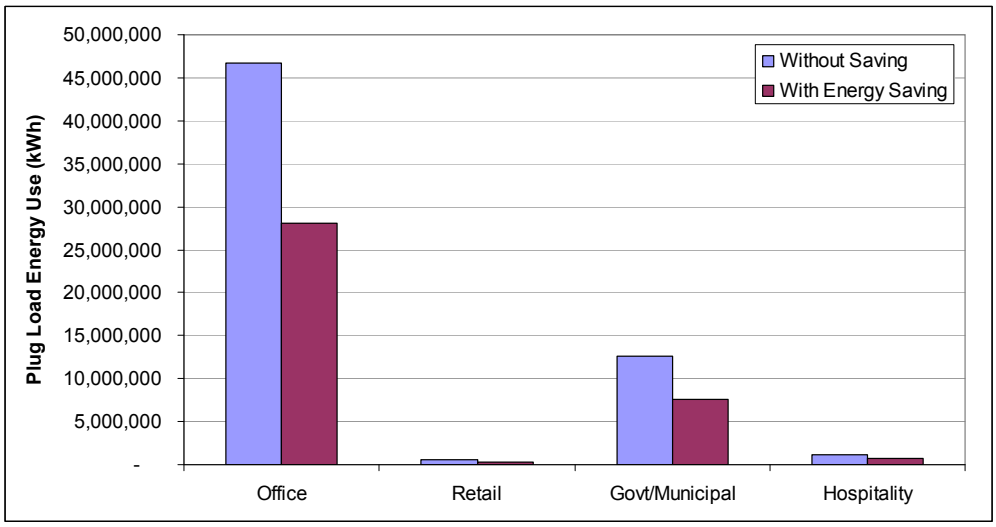
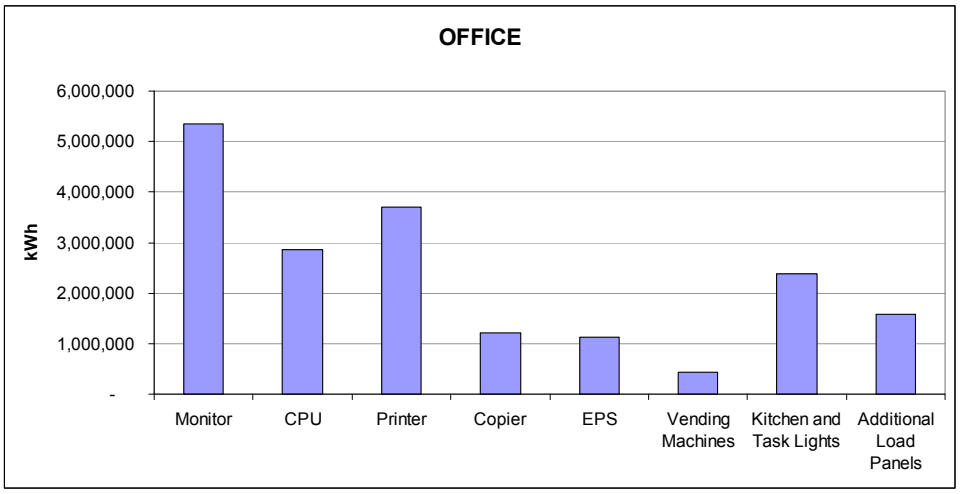


Figure 3 shows the distribution of plug load savings for commercial offices. Computers, including monitors and CPUs result in the greatest plug load saving potential and vending machines have least saving potential. Computers contribute about half of the total plug-load savings potential in commercial offices. Computers along with printers and copiers can yield about 75 percent of the total savings. Vending machines in offices have the least savings opportunity but offer a significant savings opportunity for major colleges and universities.

Figure 3. Office Energy Savings by Type of Plug-Load Equipment



These are just a portion of the market potential data that was developed by sponsor, target market segment, and end-use plug-load category.

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. The market potential analysis shows that at least 40 percent of the plug-load electric use could be saved in offices, which would result in a 10 percent electric savings overall for those buildings where 25 percent of the electric costs result from plug-loads. At the same time, there are few, if any, programs that could be considered "best practice" or serve as model programs to comprehensively address plug-loads in the business sector. At the same time, the market assessment findings point to some strategies that should be considered and perhaps tested with focus groups or as pilot programs. These lead to the following recommendations:

1. ***Integrate plug-load efficiency into existing programs***—there are a number of existing programs that target small businesses, local governments, school districts, and college campuses. These programs often involve some form of energy audit or technical assistance. The energy audit or on-site data collection should incorporate plug-load equipment. The format used by NYSERDA Energy $mart Offices could serve as a starting point for the audit template. In addition, other programs such as audit programs and installation of energy efficient technologies should be an opportunity to install smart strips and to enable appropriate power management settings on computers and office equipment for smaller offices and facilities. At a minimum, office staff and students on campuses should be encouraged to power off individual conventional power strips after powering off their computers to include all plug-loads at the work location.
2. ***Consider programs that target upstream market actors*—**there is a huge opportunity for individual unit savings for televisions in the hospitality sector and vending machines in schools and colleges. At the same time, it is critical to form partnerships with suppliers who are in the best position to influence the purchase of energy efficient units at the time of bulk replacement. In addition, those computer power management programs that were very successful were vendor-driven.
3. ***Explore the use of total work space control systems***—the Convia system has some track record with individual buildings, but more research is needed to confirm savings and performance. The system has been tested by Southern California Edison but primarily for lighting controls. The addition of

plug-load occupancy controls is fairly new and may be tested for the Advanced Energy Office. It would be worth interviewing facility managers who have implemented these systems to confirm costs and to identify strengths and weaknesses.

4. ***Provide plug-load efficiency training and education*—**training and educational workshops 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. The IT staff and key decision-makers should be involved in the group training and education. In many cases, plug-load energy savings can be achieved with low-cost/no-cost measures that can be easily implemented by informed IT and facilities staff. 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.
5. ***Don't ignore behavioral programs*—**although there is a concern that the savings will remain, end-users are often not aware of the savings opportunity and the level of commitment by upper management to save plug-load energy. Corporate and office policies should be established and enforced to ensure that plug-load equipment are appropriately enabled and powered off when not in use. In particular, corporations should understand the significance of plug-loads and which end-user groups contribute most to those costs.
6. ***Develop model programs through collaborative efforts***—there are many initiatives and working groups that are discussing programs to reduce plug-load usage including the Office of the Future Advanced Energy Office. Organizations such as CEE and NW RTF have given plug-load and consumer electronics efficiency a high priority but do not have a clearly defined program. 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.
7. ***Conduct appropriate research to inform the program designs***—given the difficulty in developing comprehensive programs, it would be particularly useful to get feedback from suppliers and end-users on what strategies would be most effective. The feedback could be through 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 business customers to implement plug-load efficiency measures and discuss what program features could be used to overcome those barriers.

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