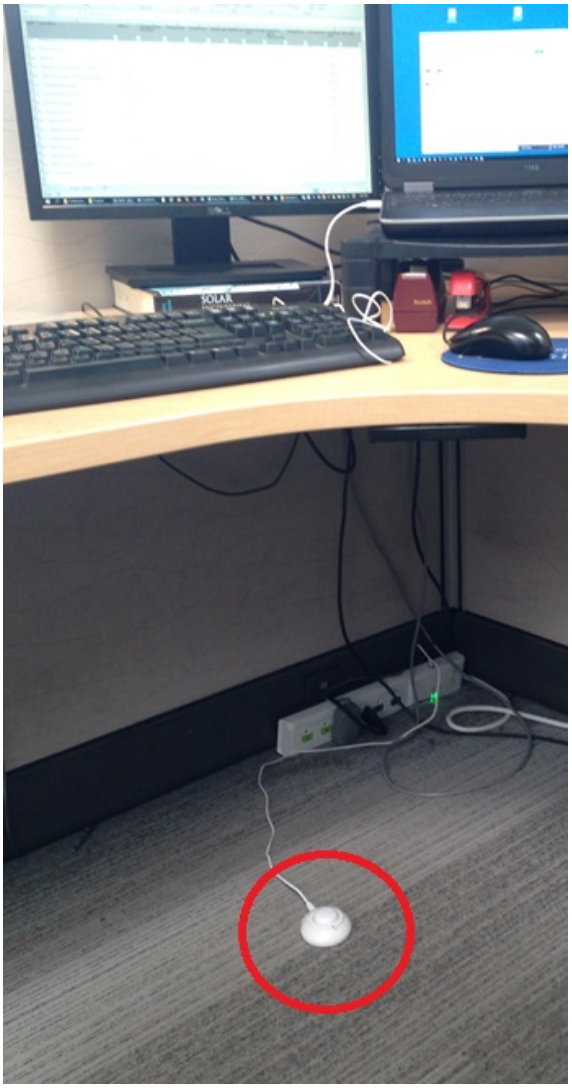
Powering Down, Powering Off: Office Plug Load Strategies

Figure 1. An advanced power strip controlled by the occupant (foot pedal).



In the quest to reduce energy usage in offices, plug loads are becoming difficult to ignore. In Midwest office spaces they generally consume 28% of the energy in office spaces (according to the U.S. Energy Information Administration 2012 Commercial Buildings Energy Consumption Survey). However, as we install ever-more efficient lighting in these spaces, replace HVAC equipment, and

commission and tune lighting controls, the fraction of plug load use increases—the CARD study that is the subject of this article found that in many high performance buildings it is closer to 40-50%.

There are a number of basic solutions that can be employed to reduce energy use from plug loads, and Seventhwave, along with the Center for Energy and Environment and LHB Corp, have completed a CARD-funded field study to demonstrate and measure the savings from some of these. The research team also characterized the types of devices and baseline usage in those offices and documented occupant acceptance, operational issues, and cost-effectiveness of reduction strategies. The team related these impacts to potential improvements in Conservation Improvement Programs (CIPs) in Minnesota, where these solutions have the potential to save over 100 million kWh annually in the state.

Effective strategies

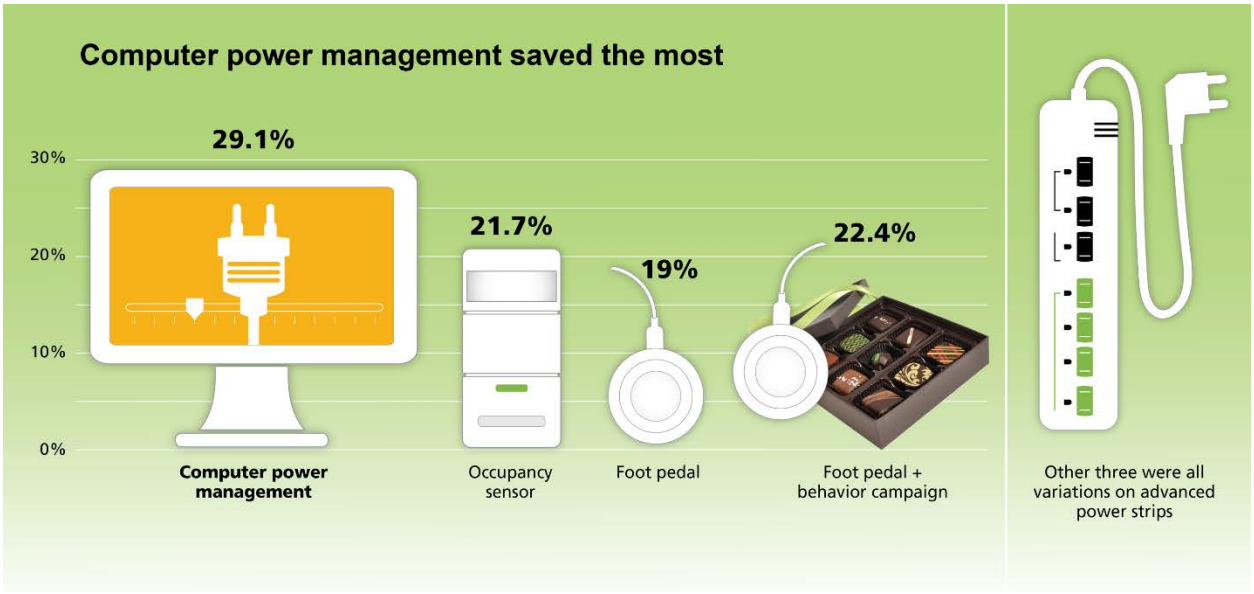
This research project demonstrated four energy reduction strategies in office workstations (see Figure 2):

- computer power management,
- advanced power strip controlled by an occupancy sensor,
- advanced power strip controlled by the occupant (foot pedal), and
- a behavior-change campaign paired with the advanced power strip.

The project also tested timers on common area equipment such as coffee makers, water coolers and printers.

Measures tested in the study are described below and compared in Figure 2.

Figure 2. Percentage of energy savings per office station workstation.



Computer power management (CPM)

Energy use at workstations is driven primarily by the computer which can account for as much as 66% of workstation usage for desktop computers and 30% for laptops. Implementing power management controls that automatically put computers and monitors in low power mode after a period of inactivity can achieve significant savings. But this strategy is more complicated to implement because it must be integrated with IT department protocols and interact with other software, including remote desktop access. The research team was able to address IT staff concerns, even in offices with intense demands on computer use. In the end, implementing ENERGY STAR® recommended settings yielded a 29% savings in workstation energy.

Advanced power strips (APS)

Advanced power strips save energy from peripheral loads such as task lights and monitors that are left on when not in use. The study found that a lot of people leave equipment on: night and weekend workstation power at most of the sites monitored was at least 25% of the daytime use (and up to 45% in one site). Two control strategies using APS were tested: occupancy sensors and a foot pedal switch. The foot pedal switch could be used to manually turn off the controlled outlets, but was also equipped with a timer to turn everything off at the end of a work day (for those less engaged with the manual control). These APS devices saved between 5% and 28% of the workstation energy use in these tests. Participants expressed a slight preference for the foot pedal switch over the occupancy sensor because it gave them more control over their equipment.

Behavior campaign

Technology solutions for reducing plug load energy use are only one possible component of a holistic plug load strategy—educating people and modifying their behavior can unlock additional energy savings. The study included a behavior campaign built around the APS with foot pedal control technology. The campaign had three components: education, feedback, and rewards. Posters and emails were used to give office occupants information on how to reduce their plug load energy use. An LED light placed on the desktop let people know if their power strip was on, providing a reminder to turn off the strip as they left their workstation. Finally, small rewards such as chocolates and coffee gift cards were given to people who demonstrated energy saving behavior. The campaign was tested in two offices; it increased savings (beyond the power strip alone) by just 16% in one, but showed tremendous potential in the other, increasing savings by 147%.

Common area strategies

There is also significant energy to be saved implementing strategies on common area equipment, outside of workstations. Two effective approaches are time-based control and equipment removal. Removing extra equipment will of course prevent it from using energy—annually from 550 kWh for coffeemakers to 170 kWh for printers based on the research results. For common area equipment that is installed, energy intensive equipment like coffeemakers, water coolers, and printers can be put on a simple timer or have the circuit scheduled to cut all power on nights and weekends. Savings from timers in the study sample ranged from 45 kWh annually for each television to 110 kWh annually for each coffeemaker.

Other research results

Our tests also yielded a few other interesting results:

- Typical workstations had five devices plugged in and annually used an average of 330 kWh each.
- The energy savings of many firms switching from desktops to laptops is being partially offset by firms adding more and bigger monitors.
- Both the IT department and sustainability champion in a firm are instrumental in successful plug load control.

Recommendations for CIP

Results from the study suggest the following recommendations for Minnesota CIP:

- Provide incentives and assistance to increase adoption of CPM, and provide technical support for those implementing it.
- Provide incentives and assistance to increase adoption of simple controls, especially APSs with appropriate user interaction, and simple device timers.
- Develop a strong relationship with IT departments to facilitate these offerings.
- Consider more innovative program approaches (beyond a basic incentive), such as direct install, behavioral, targeted outreach, and upstream offerings.
- Integrate simple plug load reduction strategies into more holistic programs like retrocommissioning, turnkey small business, and new construction programs.
- Include messaging for the user in all program offerings.

For more information, sign up for the webinar on Nov. 22 at 1:00 pm (see separate announcement in this newsletter). In addition, a copy of the final report "Impacts of Office Plug Load Reduction Strategies" (pdf) is available on the Commerce website. You can also contact project manager Mark Garofano or CARD program administrator Mary Sue Lobenstein.