GSA Public Building Service

FINDINGS, SEPTEMBER 2012

PLUG LOAD CONTROL

Advanced Power Strips Decrease Energy Consumption

Desk-based technologies and other electronics that plug into office building receptacles draw a considerable amount of power, some of it 24/7. In fact, “plug loads” account for roughly 25% of total electricity consumed within office buildings. GSA currently owns and leases more than 370 million square feet of building space in some 9,600 buildings nationwide. The size of this real estate portfolio alone suggests the possibility of enormous energy savings, if plug loads can be reduced. With this in mind, GSA’s Green Proving Ground (GPG) program recently assessed the effectiveness of advanced power strips (APS) in managing plug-load energy consumption in eight of its buildings. Three types of plug-load reduction strategies were evaluated: schedule timer control, which allows the user to set the day and time when a circuit will be energized and de-energized; load-sensing control, which monitors a specific device’s (master) power state and de-energizes auxiliary devices (slaves) if the master’s power consumption dips below a predetermined threshold; and a combination of the two. Results underscored the effectiveness of schedule-based functionality, which reduced plug loads at workstations by 26%, even though advanced computer power management was already in place, and nearly 50% in printer rooms and kitchens.

GPG Green Proving Ground Program

The Green Proving Ground program leverages GSA’s real estate portfolio to evaluate innovative sustainable building technologies. The program aims to drive innovation in environmental performance in federal buildings and help lead market transformation through deployment of new technologies.

INTRODUCTION

"Plug loads are an increasingly large portion of building energy profiles. Managing those loads is key to making federal buildings energy efficient."

John Remis
Facility Services Manager
Richmond Federal Building
GSA

What We Did

RESEARCHERS ASSESSED APS PERFORMANCE IN TYPICAL GSA OFFICES

The Green Proving Ground (GPG) program worked with a team from the National Renewable Energy Laboratory (NREL) to identify buildings with office setups and equipment distributions typical of the wider GSA building stock. Eight buildings from GSA's Mid-Atlantic Region, where plug loads average 21%, were selected. In each building, approximately 12 standard power strips with no control capability (the incumbent technology) were replaced with APSs, which monitored and provided power to an array of devices. More than 295 devices were monitored during the study, which consisted of three separate test periods, each four weeks in length. All buildings selected had workstation power management in place.

What We Measured

EVALUATION UNDERSCORED BEST OF THREE CONTROL SCENARIOS

The APS selected for this evaluation provides web-based control, monitoring, and data collection. Using this technology, NREL gathered three months worth of energy-usage data for each control strategy. Based on this information, researchers were able to determine overall performance at the end of each test period, compare that performance to baseline energy consumption, and adjust control strategy parameters in an effort to achieve maximum energy savings. Results were annualized and extrapolated for whole buildings. Researchers also surveyed occupant reception of the new technology.

FINDINGS

SCHEDULE TIMER MOST EFFECTIVE Use of the schedule timer control, which was the most successful of the three control strategies, resulted in an average energy savings of 48 percent. The largest savings were achieved when schedule timer controls were applied to devices that were powered 24/7. Printers and copiers were among these devices, as were kitchen appliances, such as coffee makers and water coolers.

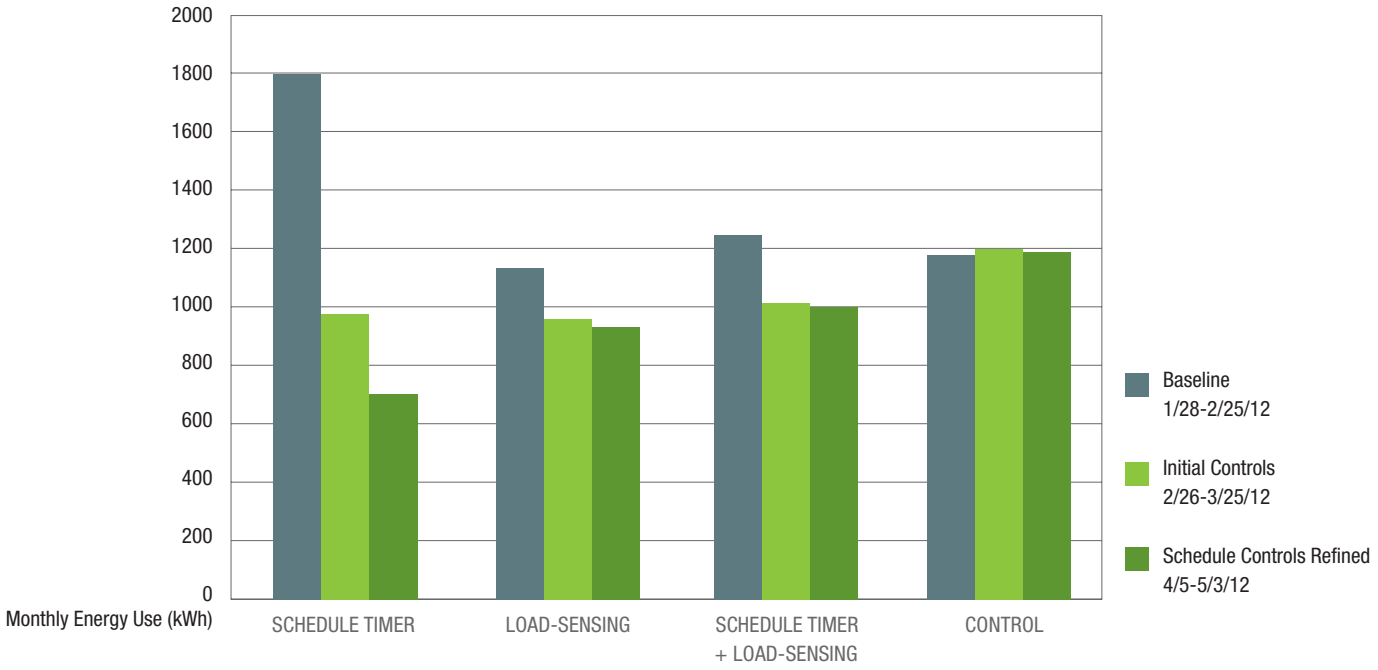
SHORT PAYBACK PERIOD For the APS installed as part of this study, simple payback for the schedule timer was less than 8 years in all applications: kitchens, 0.7 years; printer rooms, 1.1 years; and miscellaneous devices, 4.1 years. Even in workstations, where power management was in place, payback was 7.8 years.

SIMPLE CONTROL STRATEGIES ARE BEST Occupant surveys revealed that the majority of users did not wish to have more control over their individual APSs. However, they were willing to program power strips to reflect their personal work schedules. Users also wanted an easily accessible manual override.

JUSTIFICATION FOR WIDE DEPLOYMENT Energy savings and low simple payback argue in favor of deployment of APS with schedule time control throughout GSA's portfolio.

Energy Reduction For Tested Control Strategies

Schedule timer controls resulted in an average-energy reduction of 48%



CONCLUSIONS

These Findings are based on the report, "Plug-Load Control and Behavioral Change Research in GSA Office Buildings," which is available from the GPG program website, www.gsa.gov/gpg

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What We Concluded

BEST STRATEGIES MATCH ENERGY USE TO WORK SCHEDULES

Research shows that desk-based technologies and other electronics in office settings consume significant amounts of energy that are often neither metered nor managed in energy monitoring and reduction strategies. This is as true in buildings under GSA's management as it is in the private sector. Recently, however, several technologies that meter and control office equipment have become available. Those that employ control strategies that match office equipment energy use to user work schedules are particularly effective. The APS that was evaluated in this GPG demonstration project successfully reduced plug loads for equipment that (1) is used on a predictable schedule, and (2) is left powered on during non-business hours, weekends, and holidays. Findings from this study can be extrapolated for potential energy savings from plug-load control technologies in other GSA facilities and government offices.

Lessons Learned

LOAD-SENSING STRATEGY OF LIMITED UTILITY

Load-sensing and combination controls provided limited energy savings and relatively high simple payback. One reason for this is that when applied to kitchens or printer rooms, load-sensing control aggregates power-state data from APSs in surrounding workstations. Because all workstation APSs are monitored in search of a "master" device whose threshold would de-energize auxiliary devices, "slaves" are de-energized only when all workstations are de-energized, which seldom occurs if occupants are present. Because the cost of all monitored APSs must be included in the load-sensing simple payback calculation, payback is also high. That said, load-sensing might be worth pursuing for individual workstations when occupants have a variety of desk-top appliances and unpredictable schedules.

SIMPLER AND LOWER-COST SCHEDULE TIMER MOST EFFECTIVE

Given the success of schedule timer controls in this study, there is significant opportunity to deploy some of the simpler and lower-cost schedule timer power strips to address the majority of office plug loads. This would both optimize energy savings and require a lower initial investment.