Plug-Load Research

UNIVERSITY OF ARKANSAS
Office for Sustainability

Overview

Plug-Load is the energy used by products that are powered by means of an ordinary AC plug (e.g., 100, 115, or 230 V). It generally excludes building energy that is attributed to major end uses (HVAC, lighting, water heating, etc.). It has been reported that the percentage of energy use from plug-loads is increasing. Plug loads are one of the fastest growing sources of energy use in commercial buildings today. In offices, they account for 15-20% of office electricity use. In offices that have already improved the efficiency of their lighting and HVAC systems, that number can be as much as 50%.[1]

This report outlines sources of plug-load consumption, the estimated annual averages for plug-loads, best practices to managing plug-loads, and other resources for understanding plug-load consumption. The goal of this research is to stress the importance and encourage the implementation of measures in both existing and future campus buildings that reduce electrical consumption by reducing plug-load consumption, especially when devices are not in use (vampire loads).

Assumptions

National Averages for Annual Plug-Loads

Plug and process loads (PPLs) account for 33 percent of U.S. commercial building electricity consumption. The remaining 66 percent is used by overhead lighting and HVAC heating and cooling systems, etc.[2]

Estimated Campus Use

It is estimated that the plug and process loads in academic and administrative buildings on a university campus account for around the same percentage (33 percent) as buildings in the commercial sector.

Based on FY2013 data, looking just at Academic and Administration Buildings, annual plug-load consumption accounts for 16,117,131 kWh of electricity; this costs the university $1,112,082.04 a year.

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[1] "Managing Your Office Equipment Plug Load." New Buildings Institute, p 2. Web. <https://www.smud.org/en/business/save-energy/documents/plug-in-load.pdf>.

[2] Sheppy, Michael, Chad Lobato, Shanti Pless, Luigi Gentile Polese, and Paul Torcellini. "Assessing and Reducing Plug and Process Loads in Office Buildings." National Renewable Energy Laboratory: 1. Web. <http://www.nrel.gov/docs/fy13osti/54175.pdf>.

Plug-Load Sources for Campus (Offices and Classrooms)

- Computers
- Monitors
- Chargers
- Elevators
- Projectors
- Break Room Equipment
- TVs
- Audio Systems
- Desk Lamps
- Coffee Makers
- Fax Machines
- Printers
- Scanners
- Copiers

Vampire Energy

The main problem with plug-load sources is that most devices still use electricity when they are turned off. In fact, any electrical device that has an external power supply connected to it will still use electricity while powered off. In addition to using devices that have low energy demands, the solution is to eliminate the unnecessary power draws by unplugging appliances when they are not in use. According to the EPA, computers will draw up to 650 kilowatt hours per year when on they are in "stand by" mode or turned off.[3]

Nobody knows for sure how much of electricity use is attributed to vampire energy, but it's typically 5-10% of residential electricity use.[4] It can be assumed that the percentage is higher in university buildings since computers, printers, and wireless devices such as projectors, etc. draw the most electricity when in standby mode or turned off.

Keys to Reducing Plug-Load Electrical Consumption

Simple, Costless Measures

When it comes to energy reduction, the best rule of thumb is simply to turn off or unplug equipment when it's not in use. Signage can help in instructing people to turn off and unplug devices that aren't in use, encouraging people to use the stairs, and to decrease brightness on their screens. Quick 'power down' email reminders toward the end of each workday are helpful, too.

Kill/Vampire Switch

A Vampire Switch is a single, manual, easy-to-operate switch. Located near the exit of a workplace and wired to all the electrical outlets, this allows the last person leaving the office to shut off power to all outlets so equipment like computer monitors do not draw any power overnight (thus, so-called vampire loads are eliminated).

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[3] Brost, Roby, R. Emerson, M. Lutz, B. Fox, and B. Hampson. "Alliance Center Retrofit for Living Building Challenge Compliance Final Design Report." Alliance for Sustainable Colorado Living Building Challenge Assessment Comments. Bigfoot Engineering Consultants, 2 May 2011. p. 6. Web. <http://www.sustainablecolorado.org/alliance-center/high-performance-building-renovation/what-is-a-high-performance-building/high-performance-building-rating-systems/living-building-challenge>.

[4] Meier, Alan. "Standby Power." Lawrence Berkeley National Labratory, n.d. Web. <http://standby.lbl.gov/faq.html>.

In the case of a net-zero energy office retrofit done by DPR Construction in Phoenix, Arizona, which was a successful Living Building Challenge Project, the vampire switch was utilized. They implemented lessons learned in the course of another net-zero office project in San Diego. After seeing how much energy the San Diego office consumed at night, the Phoenix team opted to install vampire switches to manage night-time energy consumption. In this building, this feature reduced night-time plug load consumption by 90%.[5]

Advanced Plug Strips

One way to make it easier to power down is to use an advanced plug strip. Two types of strips are particularly helpful:

- Load-sensing plug strips use a master/slave approach. They can be set so that when you turn off your computer, everything else in the plug strip also turns off.
    - In a study done at the University of Idaho[6], load-sensing plug strips saved an average of 20 percent on energy demand related to plug-loads.
    - This could lead to savings on the University of Arkansas Campus of 3,223,426.2 kWh per year, which amounts to $22,416.41 per year.
- Occupancy-sensing plug strips detect the presence or absence of a user and automatically turn equipment on and off in response.
    - In the same study mentioned above, occupancy-sensing plug strips saved an average of 17 percent on energy demand related to plug-loads.
    - This could lead to savings on the University of Arkansas Campus of 2,739,912.27 kWh per year, which amounts to $19,053.95 per year.

Summary

Plug-loads make up a significant portion of a building's total energy use. As an institution that is concerned with its environmental impact, plug-load consumption of new and existing buildings must be considered, especially when it comes to vampire energy. As mentioned above, there are solutions to these problems that can make a big impact environmentally and financially. Savings could amount to over $20,000 per year in wasted energy if retrofits were made to existing Academic and Administration buildings.

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[5] Lahad, Akash and Kristen Parrish. "Phoenix's First Net-Zero Energy Office Retrofit: A Green and Lean Case Study." *Journal of Green Building.* Vol. 8 No. 4. (2013). p. 10.

[6] B. Acker, C. Duarte, K. Van Den Wymelenberg, "Office Space Plug Load Profiles and Energy Saving Interventions," Proc. of the 2012 ACEEE Summer Study on Energy Efficiency in Buildings, Pacific Grove, CA, 2012.