



Energy Efficiency: Plug Load Management

An Online Continuing Education Course for Engineers

Course Number: E-3037

Credit: 3 Hours / 3 PDH / 3 CPD

Energy Efficiency: Plug Load Management

Lee Layton, P.E.



Table of Contents

<u>Section</u>	<u>Page</u>
Introduction	3
Chapter 1 – What’s the Problem?	4
Chapter 2 – Managing Plug Loads.....	9
Chapter 3 – “Smart” Power Strips	22
Summary	33

Introduction

Consumer electronics, office equipment and other equipment that is plugged into electrical outlets are called “plug loads” and consume 15 to 20 percent of total residential and commercial electricity in the United States. Much of this energy is consumed when these devices operate in low-power modes but are not actually in use. Any device that plugs into wall outlets distributed throughout a building is a plug load. These loads do not relate to general lighting, heating, ventilation, cooling, or water heating, and typically do not provide comfort to the occupants. Plug loads account for an average of 9% and perhaps as much as 30% of the electricity consumption in office buildings depending upon the nature of the work.

One way to reduce this unnecessary electricity consumption is to use smart plug strips. *Smart plug strips* vary in design, but typically employ some combination of load sensors, remote controls, occupancy sensors, and timers to automatically power down plug loads when they are not in use.

By automatically turning off plug loads when not in use, smart plug strips can provide energy savings in residential and commercial sectors. Applications for smart plug strips include workstations, home offices, and home entertainment systems.

Standby power—electricity used by appliances and equipment while they are switched off or not performing their primary function—associated with plug loads presents a large opportunity for energy savings. This power is consumed by power supplies, the circuits and sensors needed to receive a remote signal, soft keypads and displays including miscellaneous light-emitting diode (LED) status lights. Standby power use is also caused by circuits that continue to be energized even when the device is off.

Plug loads can also increase cooling loads, and decrease heating needs, and affect the associated HVAC energy use. An entity that strives to reduce energy use and energy costs must have a strategy to reduce plug load electricity consumption.

This course looks at the size of the problem, strategies that can be used to mitigate the problem, and discusses devices that may help minimize plug load energy consumption.

Chapter 1

What's the Problem?

Plug load is the term for energy used by electric equipment while plugged into an electrical socket. In commercial buildings, this includes a variety of devices, such as personal computers, printers, coffee makers, and vending machines. While all electric devices are plugged in, plug loads are often difficult to manage because they are decentralized. Because of this, facility managers often focus energy-efficiency efforts on manageable areas such as lighting or space conditioning. Reducing plug load, however, can be a fast, cost-effective way to save on energy costs.



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. Recently, however, several technologies that meter and control office equipment has become available. Those that employ control strategies that match office equipment energy use to user work schedules are particularly effective. An APS successfully reduces 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.

Office equipment is the fastest-growing commercial end use energy consumer. A recent survey by the U.S. Energy Information Administration, reported that 19% of the total energy used in an office building is attributed to plug load energy use, which includes office equipment, computers, and other energy using equipment. This is higher than the traditionally assumed average of 9% and may indicate a growing trend in new plug loads. A 2008 California study found that plug loads comprise 30% of total office electricity consumption. Among office plug loads, computers and monitors account for the largest share of energy, while office electronics such as printers, faxes, multifunction devices, and computer speakers account for 17% of plug load energy use. Miscellaneous devices such as portable lighting, telephones, and coffee makers make up the remaining 17%.

Much of this is wasted energy, consumed on nights and weekends when buildings are unoccupied. According to a recent study, 60% of personal computers and 34% of printers remain on after hours, consuming energy when not in use. Energy-saving power management functions are not used effectively either. Only 6% of personal computers and 5% of fax machines are put in *low power mode* when the building was unoccupied.

Plug Load issues

- Plug load is the energy used by equipment that is plugged into a socket.
- Plug loads account for up to 30% of electricity used in offices and much of this energy is wasted.
- Data servers and vending machines are often overlooked plug loads that present energy-saving opportunities.

Plug load energy efficiency

Although total plug load has decreased over time, equipment stock is getting more efficient: technology has advanced, and more effective sleep modes have been implemented. Studies have produced low energy consumption for desktop computers, fax machines, scanners, and copiers.

Although the efficiency of equipment has improved, that user behavior matters. Studies have shown that building energy use is significantly higher when percent of printers with sleep mode is not used.

Additionally, equipment efficiency is not the only factor in estimating plug load energy use. While most equipment has a "sleep" or "low power" mode, these states can represent as much as 94% in computer monitors.

There have been many studies using sub-metering systems to quantify and understand how plug loads consume energy and the amount of time spent in active mode or sleep mode. There have also been many psychology studies about how to influence human behavior.

Previous research using sub-metering systems to monitor plug loads have quantified various metrics about plug load energy consumption. For example, the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) published a great deal of information about diversity factors and power consumption in active, standby, and off modes. Sub-metering systems have also been used to examine how specific pieces of equipment contribute to the bigger picture energy consumption of the building and metrics such as kilowatt-hours per square foot (kWh/ft^2) have been used to extrapolate annual energy consumption. Other studies have used sub-metering to establish baselines and have extrapolated market analysis for plug load-

To view the remainder of the course material and to take the quiz for PDH credit, you must purchase the course.

Close this window and click "Add to cart" on the product page.