Berkeley Lab Projects Could Save California More Than $2 Billion Annually in Energy Costs

New technologies could significantly improve energy efficiency of televisions, gaming computers, pool pumps, and a variety of other plug loads.

By Julie Chao • **APRIL 13, 2016**

Plug loads, or devices that plug into the wall, are responsible for at least 25 percent of electricity use in California buildings. And not only is that percentage growing, it's a hard number to manage since "plug loads" include hundreds of device types—from small appliances to electronics to lighting—making device-specific solutions ineffective in most cases.

Now the Department of Energy's Lawrence Berkeley National Laboratory (Berkeley Lab) has launched three projects to address this challenge and potentially save California as much as 13 terawatt-hours (TWh), or about $2 billion in energy costs, per year. The projects will be funded by the California Energy Commission as part of its Electric Program Investment Charge (EPIC) Program, which was created to support development of clean energy technologies.

"Consumers are purchasing more items for their homes that plug in, and the electrical grid has to support the energy they use," said California Energy Commission Chairman Robert B. Weisenmiller. "The Energy Commission is interested in studying the amount of energy used by digital devices and identifying promising avenues for policy to lower energy costs. The goal is to reduce power consumption but still have all the features consumers love and rely on. These studies will examine power saving capabilities in several fastest-growing end uses of energy."

Your home's new energy hog: computer gaming

The first project aims to bring down the energy consumed by playing computer games. Berkeley Lab researcher Evan Mills broke new ground last year when he released a first-of-its-kind study on the huge energy savings potential of gaming computers. He found that they are energy hogs, representing only 2.5

percent of the global installed personal computer (PC) base but accounting for 20 percent of the energy use.

What's more, the number of such gaming PCs is growing fast, at 5 percent per year. Together with consoles they account for 5 percent of total residential electricity use and 18 percent of residential miscellaneous plug loads in California. Mills and fellow Berkeley Lab researcher Norm Bourassa propose a series of steps to build, measure, and report the energy usage of a number of gaming platforms. "We intend to lower energy use in gaming PCs through a combination of improved hardware, firmware, software, and behavioral adaptations," Mills said.

The Berkeley Lab researchers will develop a standard benchmarking protocol since none exists at present, and benchmark top-selling gaming platforms. They will work with software and hardware makers to demonstrate specific energy-saving measures and energy reporting approaches. Emerging technologies such as 4k displays and virtual reality goggles will also be evaluated.

Mills estimates that the project can achieve energy savings of $500 million annually, or 3 TWh, and the equivalent of 1 million tons of CO_2 emissions each year.

Getting to zero standby power

The second project will research and develop energy efficient plug load devices, such as zero standby-power plug loads, direct DC-powered devices, and strategies for specialty security and medical equipment. Plug loads are inefficient partly due to how they are powered, as they usually require conversion of grid power from alternating current (AC) to direct current (DC). What's more, they tend to spend long periods of time in standby mode.

Led by Alan Meier and Rich Brown, this project will develop a zero-standby power supply, employing energy harvesting and storage to eliminate most no-load losses and supply some power to operation of the device. For some devices that can be easily powered by batteries or solar energy, such as routers, network extenders, and sensors, which are proliferating rapidly in number, they will develop low-energy DC versions, reducing costs and plug loads while improving system reliability.

"A newly constructed house in California has at least 20 devices constantly drawing power before anybody even moves in," Meier said.

A major participant and subcontractor will be Belkin International, a leading manufacturer of consumer electronics based in Playa Vista, CA. Meier estimates the technologies will save California 5.1 TWh per year. "These innovations will also enable more California buildings to achieve zero net energy or near-zero-net energy use, resulting in lower carbon emissions," he said.

The language of plug loads

The third project aims to develop technology to allow various devices to monitor and communicate their own energy use to a local network. “More and more devices, not just electronics, can communicate. In the not-too-distant future, most new appliances will have network connectivity. For example, networked lighting is becoming more available and less expensive, and most electronic devices are already networked,” said Berkeley Lab researcher Bruce Nordman, who leads the project. “As long as they can communicate, they might as well keep track of how much energy they’re using over time, and whenever they’re asked, report that information.”

One of his main tasks will be to develop a common language and set of open standards for this communication. Next his team will build some sample devices that speak this language and develop open-source software to receive and process the data from all devices in a building. The project will also investigate how such technology could be incorporated into California’s codes and standards.

“Whether and when California should make this feature mandatory—people can debate that, but it should be an informed discussion,” he said.

The energy savings in California are estimated to exceed 5 TWh per years in residential and commercial buildings. Project partners include Belkin and the Natural Resources Defense Council, with support from Southern California Edison and the Collaborative Labeling and Appliance Standards Program (CLASP).

The data would be reported locally, such as to the home or building owner. A large part of the energy savings would come just from knowing with more detail what devices are consuming the most energy. “The idea is it can really help people understand what’s going on in their buildings and know where energy is going and use that information to replace or fix devices, or change how they are used,” Nordman said. “It’s sort of like getting an itemized grocery receipt instead of just a total.”

If successful, the impact of these technologies could extend well beyond California. “Everybody agrees that plug loads—these miscellaneous uses of energy—are the fastest growing fraction of energy consumption in most developed and many developing countries,” Meier said. “Any progress in reducing their energy use will have an impact on energy consumption and carbon emissions throughout the world.”