What Lies Within: Improving the Efficiency of Internal Power Supplies

The Problem

Plug loads currently consume between 15 and 19 percent of the total electricity used in the California residential sector, with entertainment and information technology electronics products taking the largest share of plug loads—over 90 percent. The amount of energy consumed in these devices depends, in part, on the efficiency of the internal power supplies that convert high-voltage alternating current to low-voltage direct current (**Figure 1**). There are currently no standards to regulate the efficiency of internal power supplies, and there are no universally agreed-upon methods for determining their efficiency.

The Solution

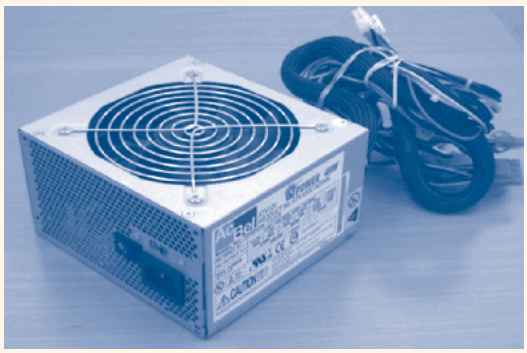
Researchers from Ecos Consulting and the Electric Power Research Institute (EPRI) worked with industry leaders and other stakeholders to develop test procedures and measure the efficiency of a sampling of internal power supplies used in today's electronic products. The researchers also presented their findings to outside parties to help spur the development of efficiency standards for these devices.

Features and Benefits

The procedures and test results from this project will help policy-makers set efficiency specifications for internal power supplies. Test results show a wide range of efficiencies among existing products, indicating that standards could cut energy use significantly.

Figure 1: An internal power supply

Internal power supplies like this one are found in electronic products such as desktop computers and TVs.



An Industrywide Testing Procedure for Measuring Efficiency. The difficulty in standardizing test procedures for measuring efficiency lies not in measuring input and output power, but in determining the appropriate loading conditions across a wide range of power supply types and sizes. With the help of industry leaders and other stakeholders, the researchers decided to proportionally load power supplies based on their rated output voltages and currents. For example, power supplies that have three separate output power rails—12 volts, 5 volts, and 3.3 volts—can handle different levels of maximum power. To account for these differences, the test procedure proportionally allocates the total power across those three rails while testing the power supply at various loads.

To simplify the testing process and to ensure consistent results, the researchers only tested power supplies that:

- Are separable from the main circuit board.
- Have nameplate output current and voltage ratings.
- Use standard output connectors.

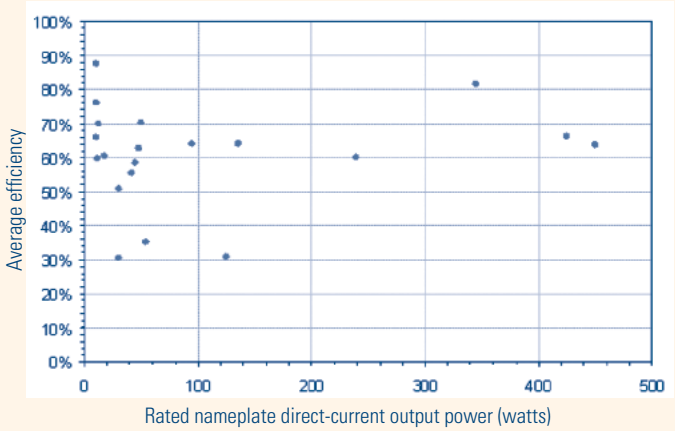
Internal power supplies that meet these criteria are generally found in desktop, workstation, and server computers. They are also used in computer monitors, automated teller machines, and home electronics.

Standardized Measurements of Power Supplies. The researchers applied the test procedures to 20 different power supplies found in home electronics—like TVs and audio equipment—to gauge the current state of the art. The test results show that internal power supply efficiency varies widely, ranging from 30 percent to almost 90 percent and averaging about 65 percent (**Figure 2**, next page). These measurements show there's plenty of room for improvement—and can provide insight to policy-makers about existing efficiencies and the potential for improvement through standards setting.

Spreading the Word. To get these results into the hands of interested parties, researchers held a workshop with stakeholders to get feedback on the test procedures, gave a presentation to power supply industry representatives, and updated www.efficientpowersupplies.org—where the researchers provide information on the test procedures, workshop materials, and related policy updates.

Figure 2: Internal power supply efficiencies

Test results reveal that internal power supplies range in efficiency from just above 30 percent to almost 90 percent. Most internal power supplies on the market have efficiencies of 60 to 70 percent—with 80 percent considered "high-efficiency."



Applications

The research results can be used to help set energy-efficiency specifications for internal power supplies found in electronic products like TVs, audio equipment, and microwave ovens.

California Codes and Standards

Currently there are no California standards for internal power supplies. However, this research may be used to guide future standard-setting efforts.

What's Next

Ecos Consulting will investigate the energy efficiency of high-end power supplies found in data center servers using a variant of the test procedure for assessing personal computer internal power supplies.

Power supplies for personal computers are being tested in a separate PIER project and continue to be tested in the 80 PLUS program (www.80plus.org) using the Ecos/EPRI test procedure developed for this project.

Power supplies used in imaging equipment and audio-video equipment generally did not meet the criteria established for this program and therefore were not tested; however, these may be the subject of future testing.

Collaborators

Ecos Consulting and EPRI Solutions collaborated on this project.

For More Information

For more information on this project, please contact the California Energy Commission researcher listed below.

More PIER Technical Briefs can be found at www.energy.ca.gov/research/techbriefs.html.

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About PIER

This project was conducted by the California Energy Commission's Public Interest Energy Research (PIER) Program. PIER supports public interest energy research and development that helps improve the quality of life in California by bringing environmentally safe, affordable, and reliable energy services and products to the marketplace.

Arnold Schwarzenegger, *Governor*

California Energy Commission

For more information see www.energy.ca.gov/research

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