LBNL-44654

Slowing Leaking Electricity to a Trickle

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What is leaking electricity?

Electronics play an increasingly pervasive role in home appliances and office equipment. This is generally a good thing because the electronics help provide new features and amenities. Electronic controls can also reduce energy use by providing the services only when consumers actually need them. On the other hand, these electronic features often continue to consume energy even while switched off or not performing their principal service. The technical term for this phenomenon is “standby power consumption” but it has acquired several common names, including “leaking electricity,” “waiting electricity,” “free-running power,” “off-mode power,” and “phantom loads.” The leaking electricity found in our televisions, VCRs, garage door openers, cordless phones and many other appliances has a surprisingly large impact on the global environment.

What appliances have leaking electricity?

Figure 1 shows appliances with standby power in American homes. The number of appliances with standby power consumption is rapidly growing both in number and diversity. An appliance probably has standby power use if it has any of the following features:

- It gets power from the mains through a stand-alone power supply
- It has a remote control
- It has a soft touch keypad
- It charges the battery of a portable device
- It is warm to touch near the switch when switched off
- It doesn't have an “off” switch

A brief inspection of any home or office will reveal many appliances having one or more of these criteria. We conducted an informal survey of homes and found that the average upper middle class house had eight appliances with stand-alone power supplies (those little black cubes). Many homes will have over fifteen appliances with standby power consumption.

We (and our colleagues around the world) have measured standby power use in hundreds of appliances. In Figure 1, we also show the minimum, median, and maximum values for each appliance.

It is surprising to see the range in standby for a single appliance. For example, compact audio systems have standby varying from 1.3 watts to 28.6 watts. Some of the range is caused by differences in features among the appliances; for example, certain audio devices have larger and brighter displays than others. But most of the variation arises from differences in design and choice of components, resulting in some units consuming four times as much power to provide the less services than another. A few appliances consume nearly as much power while switched off as switched on. Most television set-top boxes (also

called “cable boxes”) show nearly no change in power between the two modes. We also found several models of compact audio equipment and VCRs with similar “on” and “off” power.

Where does the standby power go? First, it is important to realize that the components providing the actual services, that is, the clocks, sensors, displays, etc., typically consume only a few milliwatts but the appliance’s total standby power consumption may be a thousand times larger! Most standby power is lost as heat by the transformer (or power supply) as the mains electricity is converted to a lower voltage. Some power is converted to heat even when there is no load, and further losses occur when supplying the small amount of power needed for standby operations. Many appliances keep circuits energized even when they are not needed, which further adds to the losses.

Global implications of standby

The standby power use by an individual appliance is typically very small – not more than a few watts – but standby is significant because it is a continuous consumption and because so many appliances exhibit this behavior. The average U.S. home has about 50 watts of standby, that is, like a 50 watt light bulb operating constantly (but which you think is switched off). This corresponds to five percent of the home's total electric bill.

There are over 100 million homes in the United States, so standby consumes roughly 5GW. After accounting for transmission and distribution losses and generation reserves, standby is responsible for about 8 GW. This corresponds to the output of eight large power plants. The commercial and industrial sectors probably have equal amounts of equipment with standby.

Standby power is responsible for about one percent of the world’s CO₂ emissions. This may seem like a small amount, but most of it is caused by appliances that are switched off or not performing their principal functions.

Technologies to reduce standby

It is technically feasible to reduce standby in most cases to below 1 watt per appliance. This corresponds to roughly a two-thirds reduction in today's typical appliance. A 1-watt target may not yet be economic in all situations today, but the trend is in that direction. Some appliances, such as certain cell phone chargers, have already fallen below 0.5 watt. Manufacturers are using new technologies primarily to decrease size of the charging units rather than saving energy, so the extra cost may not justify the energy savings. The greatest improvements are likely to occur in the power supplies. Recent innovations in the design of power supplies, notably “switch-mode” technologies, have cut no-load losses to as little as 0.25 watts and maintained very high conversion efficiencies at low power.

The future of leaking electricity

An increasing number of new appliances have standby power use. If no special measures are undertaken, global standby power consumption will increase. This trend, along with the global nature of the problem, has spawned an international initiative to reduce standby. The need to reduce CO₂ emissions has provided another reason. By reducing leaking electricity to just one watt per appliance—a trickle—global CO₂ emissions could be reduced by nearly one percent.

Bibliography

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Websites:

Lawrence Berkeley National Laboratory <http://eetd.lbl.gov/leaking/>
Environmental Protection Agency <http://www.epa.gov/energystar/>
International Energy Agency <http://www.iea.org/standby/>

Acknowledgements

This work was supported by the Assistant Secretary for Energy Efficiency and Renewable Energy, Building Technologies, of the U.S. Department of Energy under Contract No. DE-AC03-76SF00098.

Figure 1

A partial list of appliances with standby power consumption and a summary of measurements. Each bar shows the maximum, median, and minimum measured for that appliance.