Standby Power Use: How Big is the Problem? What Policies and Technical Solutions Can Address It?

Paolo Bertoldi, European Commission
Bernard Aebischer, CEPE Swiss Federal Institute of Technology
Charles Edlington, Australian Greenhouse Office
Craig Hershberg, U.S. Environmental Protection Agency
Benoit Lebot, International Energy Agency
Jiang Lin, Lawrence Berkeley National Laboratory
Tony Marker, Australian Greenhouse Office
Alan Meier, Lawrence Berkeley National Laboratory
Hidetoshi Nakagami, Jyukankyo Research Institute
Yoshiaki Shibata, Jyukankyo Research Institute
Hans Paul Siderius, Novem
Carrie Webber, Lawrence Berkeley National Laboratory

ABSTRACT

Standby power, as defined in this paper, is the electricity consumed by end-use electrical equipment when it is switched off or not performing its main function. Standby power consumption represents an increasing fraction of energy use in Organization for Economic Cooperation and Development (OECD) countries; the rapid penetration of new and digital technology is likely to accelerate the growth of standby power use. Standby power is currently estimated to account for about 3 to 10 percent of home and office electricity use. Recently, the International Energy Agency (IEA) launched a worldwide initiative to reduce standby power consumption, and there is general agreement that action is urgently needed to avoid large increases in standby power use. Reduction of standby power consumption worldwide could reduce CO_2 emissions by one percent.

A number of OECD countries and regions already have policies to address standby power use; other regions have launched policy initiatives in response to IEA's recent international workshops on standby power. Global policy efforts are needed to influence manufacturers, who generally produce and market products worldwide, to reduce the standby power consumption of their products. Some leading manufacturers are already responding to global calls to reduce standby power consumption by developing new technologies and products.

The paper presents the most recent figures on standby consumption in OECD countries and China; discusses trends, details of national strategies, policies to reduce standby consumption, and technical solutions; and concludes with a renewed call for international efforts to reduce standby power consumption.

Introduction

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Standby power, as defined in this paper, is the electricity consumed by end-use electrical equipment when it is switched off or not performing its main function. The most common users of standby power are televisions (TVs) and video equipment with remote controls, electrical equipment with external low-voltage power supplies (e.g., cordless telephones), office equipment, and devices with continuous digital displays (e.g., microwave ovens). The actual power draw in standby mode is small, typically 0.5–30 watts. However, standby power is consumed 24 hours per day, and more and more new appliances have features that consume standby power. Although consumption by individual appliances is small, the cumulative total is significant. Recent estimates (see the references in Table 1) of standby use range from 3 to 10 percent of residential electricity use, depending on the country and the specific measurement procedures used in the surveys. However, when all electronic appliances in homes and offices in a single country are aggregated, the standby power they consume represents a significant fraction of total electricity use. In a typical Japanese or Danish home, standby power use corresponds to 10 percent of total electricity consumption; in the U.S., standby power use accounts for about 5 percent (or about 50 watts) per home. Estimates of standby power consumption in the European Union (EU) range between 5 and 10 percent of total residential electricity consumption.

Standby power is also consumed in commercial buildings (by office and building equipment and appliances, e.g., personal computers, copiers, phone systems, hot-water pumps, central computing devices) but is not yet well documented. A theoretical investigation (Menti 1999) suggested that standby consumption should account for less than 10 percent of total consumption in commercial buildings. However, actual measurements of 32 building appliances in Switzerland (Menti 1999) show that an average of 36 percent of total consumption is due to standby consumption at night (between 20:00 and 6:00) and during weekends. The study did not investigate what fraction of this consumption is due to end-use electrical equipment switched off or not performing its main function (i.e., standby power) and what fraction is due to building equipment and lighting performing a required function, e.g., night cooling, security, etc.

Several features of standby power and the manufacture and marketing of the equipment that consumes it argue for an international effort to reduce the losses attributable to it:

- Standby power consumption by electrical equipment is a uniquely international issue because the manufacture of many of the appliances that use standby power [TVs, video cassette recorders (VCRs), mobile phones, computers, etc.] typically involves many countries. A computer, for example, may be designed in the U.S., assembled in China using parts from Japan and Korea, and sold in Europe.
- Electronic devices are marketed internationally, so setting standby power use limits country by country would be unnecessarily difficult and costly.
- New electronic equipment will continue to proliferate at an increasing rate, so the share of energy use attributable to standby power consumption will rapidly increase.
- Governments worldwide are trying to find ways to cost effectively reduce CO_2 emissions; eliminating unnecessary electricity losses from standby consumption is an attractive strategy. Reducing standby power use may be one of the first

opportunities for coordinated international action under the rubric of global climate protection.

Several policy instruments can be used to tackle the international problem of standby power consumption, ranging from labeling to imposing minimum performance standards, and from voluntary schemes to regulation; individual countries can select the approaches that best fit their circumstances. However, an open, coordinated international initiative will help transform the entire electronics market by stimulating manufacturers of products and components to use low-loss components and designs.

International collaboration improves the cost-effectiveness of policy efforts by:

- reducing the number of disparate regulations and commitments according to which manufacturers must design and test their products,
- increasing the economies of scale for manufacturing advanced standby technologies,
- minimizing interference with industrial competitiveness and trade, and
- reducing the costs of developing, operating, and evaluating government programs to address standby power consumption.

Estimates of standby power use and savings opportunities are based on a limited number of measurement studies of homes (and essentially only one study of commercial buildings). These measurements are sufficient to roughly quantify the size of standby power use in particular regions but are inadequate for policy and other purposes. More complete information is needed to answer these questions:

- What is the overall size of standby power consumption (nationally and globally)?
- What are the key contributors to standby power use?
- Is standby power use growing or declining?
- What are the potential savings from reducing standby power consumption?
- Are current policies to reduce standby power use succeeding?

Answers to these questions are important, particularly because many governments have already begun substantial programs to reduce standby power use. For example, the EU introduced, in 1996, a voluntary agreement to significantly reduce standby consumption by TVs and VCRs; the U.S., along with many partner countries, has invested heavily in the ENERGY STAR® program to reduce standby power consumption in consumer electronics (and to encourage use of low-power, sleep modes in office equipment). Australia has formally adopted a "one-watt plan" to reduce standby power use. Other countries, such as China, are now seriously considering programs to address standby power consumption. For these reasons, it is important to have an accurate description of standby power use. Because a coordinated international estimate effort is unlikely, it will be necessary to rely on careful compilations of local investigations. [One such compilation was undertaken by Lebot et al. (2000)]. This paper relies on both older and recent measured data, including, for the first time, measurements in less developed countries.

What is the Overall Magnitude of Standby Consumption?

Measurement methods

Standby power use is quantified in three ways:

- Whole-house/building measurements
- Bottom-up estimates
- New-product measurements

These three methods are described below.

Whole-house measurements involve measuring the standby power consumption of every piece of electrical equipment that consumes standby power in a household. Consumption data are tabulated and reported for each home. Measurement teams sometimes compare the sum of their measurements to the consumption shown on the utility meter when all appliances that do not consume power in standby mode (e.g., appliances with hard switches and no remote control) have been switched "off." This comparison confirms that no appliances with standby consumption are overlooked. Monitoring of a representative group of homes can establish a reasonably accurate and highly credible estimate of standby power use in a region. One problem, however, is to ensure that the homes surveyed are a representative group; this is especially difficult because most studies rely on volunteer homes.

All available key findings from whole-house measurement studies are shown in Table 1.

Table 1. Whole-House Measurements of Standby Power Use

Country/Region	Number of Homes Surveyed	Year Of Survey	Standby Power Use (W)	Standby Energy Consumption (kWh/year)
Australia (Harrington & Kleverlaan 2001)	64	2000	87	760
Australia (Harrington 2002)	1	2001	112	980
Canada/Nova Scotia (Aulenback et al. 2001)	79	2001	38	329
China/Beijing (Warner et al. 2002)	42	2001	33	n.a.
China/Guangzhou (Warner et al. 2002)	115	2001	35	n.a.
Denmark (Sidler 2001)	100	2001	60	530
France (Sidler 2000)	178	1999	38	235
France/Paris (Lebot 1999)	1	1999	70	600
Greece (Sidler 2001)	100	2001	50	440
Italy (Sidler 2001)	100	2001	57	500
Japan (Nakagami et al. 1997)	36	1997	60	530
Japan (Nakagami 2001)	42	2000	45	398
Japan/Tokyo (Murakoshi 2000)	1	1999	80	700
New Zealand (EECA 1999)	29	1999	100	880
New Zealand/North Island (Isaacs 2001)	1	2001	125	1,100
Portugal (Sidler 2001)	100	2001	46	400
Sweden (Molinder 1997)	1	1997	80	475
United Kingdom (Vowles et al. 2001)	32	2000	32	277
USA/California (Ross & Meier 2000)	10	2000	67	590
USA/California (Meier & Lebot 2002)	4	2001	115	1,010
USA/Colorado (Geller 2002)	5	2001	46	405

Source: Meier & Lebot 2002.

Bottom-up estimates of standby power use (shown in Table 2) estimate either average standby power consumption per home or national standby power consumption. These estimates are based on measurements of standby power use in specific appliances, multiplied by the average saturations of the appliances measured. For example, 50 measurements of

TVs may show an average standby power use of four watts. If the average home has 2.3 TVs, TV standby power consumption per home would be 9.2 watts. The average home's standby power use would be calculated from a combination of field measurements and known appliance saturations. Bottom-up estimates are usually accurate for larger, common appliances (because large numbers of measurements have been made and saturations are well known) but are not necessarily accurate for "minor" appliances (e.g., cordless phones, garage door openers, coffee makers, etc., which are responsible for much of standby power use) because little information is available about their saturations. As a result, bottom-up estimates probably underestimate actual standby power use.

Table 2. Bottom-Up Estimates of Standby Power Use

Country (Reference)	Year of Survey	Average Standby Use per Home (W)	Fraction of Total Residential Electricity Use	Other Items Included in addition to TVs, VCRs, Set-top boxes
Argentina (Tanides et al. 2000)	2000	7	3%	
Australia (Harrington & Kleverlaan 2001)	2000	86	12%	All; included a few heating devices and defective units
Canada (Aulenback et al. 2001)	2001	41		All
France (Sidler 2000)	2000	38	7%	All
Germany (Rath et al. 1997, Cremer & Boede 2001)	2001	52	n.a.	All; may include some heat standby
Netherlands (Siderius 1995)	1995	37	10%	None
Switzerland (Meyer & Schaltegger AG 1999)	1999	19	3%	Stereos, some rechargeable appliances, PCs
USA (Rainer et al. 1996)	1996	50	5%	All

Source: Meier & Lebot 2002.

New product measurements are made in stores or factories where standby power use of many new products can be measured at one time. This is an excellent technique to quickly assess levels of standby power consumption; however, the results may not match in-home measurements of older models. New TVs in Europe (Group for Energy Efficient Appliances 2002) and Japan (Energy Conservation Center of Japan 2002**)** consume far less standby power than older models typically found in homes. It will take many years for the performance of the entire stock to catch up with the performance of new products. Some organizations, such as the Energy Conservation Center of Japan, the Group for Energy Efficient Appliances, the U.S. Department of Energy, and the ENERGY STAR Program, collect standby power measurements submitted by manufacturers for new products and post them on the worldwide web.

Data

Twenty-one surveys of whole-house standby power consumption were compiled. These surveys combined represent measurements of more than 1,000 homes around the world. Results are shown in Table 1. About half of the studies listed have not yet been reported in the literature. The largest survey involved 178 homes in France (Sidler 2001);

studies in China (Warner 2002) and several European countries are nearly as large. Six studies involved more than 100 homes.

The results are not fully comparable because of significant differences in measurement procedures. Most studies defined standby power as the minimum power of a device while still plugged into the electrical main. According to this definition, if a device has a hard-off switch, standby power use is zero; however some surveys included other standby modes for some appliances (e.g. TVs). Other reasons for differences among the surveys were related to differences in the characteristics of the sample group of households studied. The variations in results caused by these differences in survey methods are generally small and do not affect the comparability of the results. Average standby power use measured in these studies ranges from more than 100 watts per home in New Zealand to about 30 watts in China. The weighted average of the measurements is about 50 watts. (Future studies will also include a population weighting.) The high values are somewhat misleading because these studies examined relatively few homes. In addition, the New Zealand measurements captured several heaters and defective appliances. Inspection of the detailed data from each country suggests that standby power use of common appliances (TVs, VCRs, etc.) is higher in less-developed countries (China and Argentina) than in developed countries. The reason appears to be a prevalence of less-efficient and older appliances in less-developed countries. An amount equivalent to the energy produced by several large power plants could be eliminated simply by reducing standby power use of Chinese TVs (for example) to levels found in Japan.

Standby power consumption in Europe has been well documented in several large surveys. Standby power use in European countries is about 30 to 60 watts per household. There is essentially no information about standby power in three large regions of the world: South Asia (India, Pakistan, etc.), South America, and Africa. Comprehensive data are not necessary, but important variations among countries may influence what policies will be most effective to reduce standby power use in a specific country. China's standby power consumption, for example, has two unique characteristics: high saturation of video compact disk players (VCDs) and an unusually high fraction of time when consumer electronic equipment is unplugged.

Standby power consumption in the residential sector in OECD countries represents about 1.5 percent of total electricity consumption (124 TWh) and contributes 0.6 percent (68 million metric tons) of CO_2 emissions. In the commercial sector, data are still lacking on the magnitude of standby power consumption. A German study (Rath et al. 1997) suggests a ratio of two watts of standby power use in the German residential sector for each one watt of standby consumption in the commercial sector. If this ratio is used with estimated residential consumption figures, the results suggest that combined residential and commercial standby power consumption may account for 2.2 percent of OECD electricity use. Standby power use appears to be responsible for as much as one percent of global CO_2 emissions, and recent measurements in China suggest this estimate may be low.

Is Standby Power Consumption Growing or Declining?

The information available is insufficient to determine trends, but all evidence points to a global increase in standby power consumption because efficiency improvements in some

equipment (e.g., TVs) are outweighed by the increase in the numbers of appliances that consume power in standby mode. The European Commission estimated in 1999 that residential standby power consumption would increase from 36 TWh in 1995 to 62 TWh in 2010 without significant intervention. Although new TVs, VCRs, and a few other appliances use significantly less standby power than older models, and these new models are beginning to lower in-home standby power use [e.g., it appears that standby power use in Japanese homes is declining (Nakagami 2001], the simple number of appliances with standby power mode continues to increase worldwide. New appliances that consume standby power, such as DVD players, are appearing, and updated models of older, traditional appliances, such as rice cookers, washing machines, etc., now have standby power modes. The net effect of these trends is likely a continuing increase in global standby power use. In particular, TVs are rapidly moving toward digital broadcasting technology. As a result, set-top boxes (STBs) will likely be the source of significant new standby power demand in most economies in the near future. STBs may remain in active standby mode continuously, consuming up to 25 watts of power. In the UK, STBs (digital-to-analog converters) are predicted to add 8 TWh per year of standby consumption by 2010 if no policy action is taken (Harrison 2002).

The growth in standby power use reflects a trend in residential energy use from a situation where appliances are either "on" or "off" to one in which appliances are always "on" but in different modes. This trend greatly complicates the practical task of monitoring a building's energy use. Operating hours and cycles are less reliable indicators of energy use than has been true in the past, and electricity consumption is distributed among many more appliances.

Standby power consumption may increase as households become "totally automated." A Swiss study (Aebischer & Huser 2000) indicates that standby power use in the Swiss residential sector may be as high as 400 kWh per household per year in 2020. The main contributor will be electronic components in white goods. Estimates of standby power usage by interconnected white goods (including networking and controllers) in the year 2000 are already as high as 350 kWh per totally automated household per year.

Current National/Regional Policies: Are They Enough?

Recent U.S. Developments in Standby Power Policies

Standby power consumption is a key issue addressed in President George W. Bush's energy-efficiency policy. On July 31, 2001, he issued Executive Order 13221, which requires that "Each agency, when it purchases commercially available, off-the-shelf products that use external standby power devices, or that contain an internal standby power function, shall purchase products that use no more than one watt in their standby power consuming mode. If such products are not available, agencies shall purchase products with the lowest standby power wattage while in their standby power consuming mode. Agencies shall adhere to these requirements, when life-cycle cost-effective and practicable and where the relevant product's utility and performance are not compromised as a result" (Bush 2001).

For several reasons, this order is a milestone in addressing standby power consumption. Prior to this order, the only federal policy addressing standby power was the ENERGY STAR Program, operated jointly by the U.S. Environmental Protection Agency

(EPA) and the U.S. Department of Energy (DOE). At the time of President Bush's order, standby power specifications were still being set on a product-by-product basis, taking into consideration current efficiency levels and the costs of design changes, and none of ENERGY STAR's standby specifications was as low as one watt (although a one-watt specification for audio equipment was scheduled to take effect in 2003).

In addition, the executive order leveraged the buying power of the federal government to transform the market for electronics devices. The federal government accounts for one to two percent of U.S. purchases of commercial-sector products. Its share of residential products is smaller although the Department of Defense is a large consumer of products for use in military housing. Although one to two percent may not seem like enough to influence the market, the federal government is the largest single buyer for many products.

However, the order falls short in its attempts to reduce standby power consumption for a number of reasons.

First, for the executive order to be effective, federal purchasers must be able to identify compliant products; at the time of the order, this was virtually impossible without a power meter. Even if purchasers had power meters, the order does not specify measurement guidelines and does not define standby power.

Moreover, the only office equipment products with an ENERGY STAR standby power specification at the time were copiers. Personal computers, monitors, fax machines, scanners, printers, and multi-function devices were covered by the program, but the specifications required only that devices drop into a low-power state when idle and did not restrict standby power use as the term is intended in the executive order.[1]

Another difficulty is that the scope of the executive order is quite broad. It covers any product type that might use power in standby mode, including not only office equipment and consumer electronics (the product groups targeted by ENERGY STAR) but also white goods, remote-controlled devices, rechargeable tools and appliances, and some lighting fixtures. For most of these products, there is no formal test procedure, and test procedures that are currently used may not include standby power. For example, the DOE test procedure for clothes washers (as of May 2002) measures only the energy used per load and does not account for energy consumed between loads.

How to overcome these obstacles?

The problem of identifying compliant products will in part be addressed by the executive order's directive to compile a list of products that would be subject to standby power requirements. For the order to be effective, a list of qualifying models must also be compiled. These tasks fell to DOE's Federal Energy Management Program (FEMP), which, among other activities, provides guidelines for federal procurement of energy-efficient equipment.

One way to facilitate the procurement process would be to make ENERGY STAR and FEMP specifications consistent. Manufacturers will be more likely to support a one-watt ENERGY STAR specification if they already face a one-watt requirement in the federal sector. Combining ENERGY STAR and FEMP requirements could also simplify testing and reporting

[1] In the past, some ENERGY STAR specifications used the term "standby" to refer to a low-power mode (for personal computers and monitors, for example). More recent specifications use the term "sleep" to refer to low-power mode.

of product information. It would benefit FEMP, which would be able to simply advise federal purchasers to buy ENERGY STAR-certified equipment rather than maintaining its own list of qualifying products. Data collection and information dissemination could be consolidated between the two agencies.

Existing test procedures could be modified to include standby power consumption, which might affect federal efficiency standards for products such as clothes washers, dishwashers, and room air conditioners. The subsections below highlight recent U.S. actions in the wake of the executive order in the areas of procurement, labeling, and standards.

Procurement. To begin the monumental task of making the executive order work, FEMP first had to define standby power. The definition chosen was simple: the lowest power-consumption condition when a device is connected to the main electricity supply and used in accordance with manufacturer instructions (FEMP 2002b).

FEMP's next step was to develop a list of product types that would be covered by the executive order. Given the range of products purchased by the federal government (from pencil sharpeners to weapons), this was a difficult task. For simplicity, FEMP focused only on products that plug into an outlet with a power cord (FEMP 2002b). This excludes the many hardwired sources of standby power use, such as doorbells and smoke detectors. The current list of covered products includes office equipment, telephones and related equipment, TVs and VCRs, audio equipment, room air conditioners, clothes washers, dishwashers, microwaves, ceiling fans with remote controls, portable power tools, desktop halogen lamps, and exercise equipment (FEMP 2002a).

FEMP developed measurement guidelines for standby power only (which effectively constitute a test procedure) and posted them on its website (FEMP 2002b). To enable identification of qualifying products, manufacturers will test their own products; the data will be listed on the FEMP website. As of January, 2002, a list of one-watt and low-watt standby products was available on the worldwide web at: http://oahu.lbl.gov/cgi-bin/search_data.pl.

Labeling. Since President Bush issued the executive order, a new ENERGY STAR manufacturer agreement for telephone products has been finalized. An immediate one-watt specification was viewed as too aggressive because few, if any, products currently on the market would satisfy the requirement. However, the power requirement will drop to one watt in 2004 for answering machines and cordless phones that do not have spread spectrum technology. (EPA believes that with sufficient lead time, manufacturers will be able to develop cost-effective one-watt products.) EPA is currently negotiating a one-watt ENERGY STAR specification for TVs, VCRs, and TV/VCR and TV/DVD combination units; the dates on which those specifications will take effect have not been finalized. A revised computer monitor specification is in the earliest stages of negotiation; the draft specification presented to the monitor industry in April 2002 included a proposed two-watt standby (or "off") requirement (EPA 2002).

Standards. Many of the products covered by DOE's efficiency standards use power in standby mode. In the past, this power was not included in the test procedures for most products. Now, however, DOE is taking steps to incorporate standby power in all of its test

procedures by the end of 2003. The dishwasher test procedure has already been modified. These changes ensure that standby power will not be ignored in future policy work.

European Strategy for Reducing Standby Power Use in Consumer Electronics

The EU strategy for reducing standby power use was presented in 1999 in the European Commission Policy Paper on Standby losses (European Commission 2001). An agreement setting targets of less than six watts for standby consumption of TVs and VCRs was negotiated in 1997 with the European Association of Consumer Electronics Manufacturers (EACEM) (Bertoldi et al. 2000) and has been successful in keeping industry on track toward the targets, demonstrating the effectiveness of negotiated agreements as alternatives to mandatory efficiency requirements. The agreement terms were worked out based on 1995 average standby consumption of 7.5 watts for new TVs and VCRs. The year-2000 average sales-weighted standby consumption for new products was 3.7 watts for TVs and 3.8 watts for VCRs.

The European Commission negotiated an agreement with EACEM for audio equipment in 1999 (Bertoldi, Berrutto, and Conti 2000), establishing the following targets, which take effect sequentially: 1) maximum allowable standby consumption of five watts for all equipment marketed after 1/1/2001, 2) maximum allowable standby consumption of three watts for all equipment marketed after 1/1/2004, and 3) maximum allowable standby consumption of one watt for all equipment marketed after 1/1/2007.

Digital TV equipment is predicted to rapidly penetrate the EU market, following the example set by the UK. STBs, which have relatively high standby consumption, will likely increase rapidly in number with digital TVs and increases in services such as tele-shopping and internet access. STBs are produced to service providers' specifications, so STB manufacturers have no incentive to require low standby consumption limits, particularly given that some service providers require the devices to remain permanently on to permit remote access for downloading new software and other tasks. Moreover, STBs change rather quickly, and new generations with additional features are introduced every year. The predicted rapid increase in STB penetration makes it very important to take action regarding the standby power consumption of these devices in order to avoid the roughly one-year period (the time needed to replace the installed stock) that has been required for other appliances before the full effect of policy action has been felt. To this end, the European Commission has issued the *EU Code of Conduct for Digital TV Services (STB CoC)* (European Commission 2001), which sets maximum standby power consumption levels. All major EU STB manufacturers and one major service provider have agreed to the code and committed themselves to achieving the efficiency improvements.

The code sets maximum consumption in active standby mode for the period 1/2003 through 12/2004 as follows:

- Set-top boxes [integrated receiver-decoders (IRDs)] 9 watts
- Digital TVs with built-in IRD 10 watts

These levels represent a substantial improvement over the standby consumption and on-modes of current models (on average, about 16 watts for standby and 25 watts respectively for on-mode). What is most important is that all the parties concerned (silicon chip and STB

manufacturers, service providers, etc.) are now aware that energy consumption of STBs is an important issue, and all are committed to introduce power management and minimize standby consumption.

Power supplies are widely used in all consumer electronic equipment and as stand-alone equipment to charge batteries or provide DC voltage. Several power supplies are typically found in households. Because of poor design, they consume one to two watts of power in off-mode. Technical solutions are available that can limit off-mode consumption to less than one watt, but policy implementation for these devices is complex because they are produced in large quantities and supplied to original equipment manufacturers, for example mobile telephone suppliers, who have no incentive to reduce standby consumption. In July 2000, the European Commission issued the *Code of Conduct on Efficiency of External Power Supplies* (European Commission 2001) to reduce standby consumption. A large number of manufacturers has already agreed to the code. During the recent IEA standby initiative, the European Commission proposed the code's requirements (shown in Table 3) for adoption worldwide because external power supplies are traded globally and many manufacturers are not based in the EU.

Table 3. EU Standby Requirements for External Power Supplies

	Maximum No-load Power Consumption		
Rated Input Power	**Phase 1 1/1/2001**	**Phase 2 1/1/2003**	**Phase 3 1/1/2005**
≥ 0.3 W and < 15 W	1.0 W	0.75 W	0.30 W
≥ 15 W and < 50 W	1.0 W	0.75 W	0.50 W
≥ 50 W and < 75 W	1.0 W	0.75 W	0.75 W

Australia's Standby Policy

A joint initiative of Commonwealth, State, and Territory Governments in Australia has adopted a one-watt target for standby energy consumption of all manufactured or imported products. This target is intended to send a clear message to industry and provide a uniform basis for programs reduce standby power consumption. A national strategy is being developed to reduce standby power consumption by individual products to one watt by 2012. The strategy will maintain existing standby power reduction measures and add a range of new measures. A product-specific plan will initially propose voluntary measures and subsequently consider mandatory options if necessary. Table 4 shows existing and proposed measures.

Defining a national strategy fulfills three objectives:

1. Ensuring that Australia significantly reduces standby energy consumption, and thus greenhouse gas emissions, within a set time frame;
2. Giving certainty and advance notice to industry; and
3. Ensuring that consumers do not bear unnecessary costs of excessive standby energy use.

Australia's governments are committed to reducing standby power consumption in a coordinated manner so that all jurisdictions face a consistent standard and are in step with measures undertaken by other governments throughout the world.

Table 4. Existing and Proposed Policy Measures in Australia

Existing measures
ENERGY STAR Australia's governments have supported the ENERGY STAR Office Equipment Program since 1999 and the Home Electronics Program since 2001. Substantial resources are being allocated to promoting and developing the ENERGY STAR program, resulting in a large number of manufacturers and retailers signing up as partners. In addition, a significant marketing effort promotes the benefits of purchasing energy-efficient ENERGY STAR appliances. More information can be found at www.energystar.gov.au.
Energy Rating Label Display of Energy Rating labels is mandatory on refrigerators, freezers, clothes washers, clothes dryers, dishwashers, and room air conditioners. These appliances are rated between one and six stars. The methodologies currently used to determine the star rating measure *in-use* energy consumption. Standby energy consumption is not adequately accounted for in the current estimation of annual energy use.Australia's governments have committed in principle to support revision of testing methodologies to ensure that standby power consumption is incorporated into annual energy usage figures and star ratings. More information can be found at www.energyrating.gov.au. *Annual in-store measurement surveys of individual products* Standby consumption of individual products is measured annually in stores to determine the trend line of available stock. These surveys are useful to identify within a large range of products the areas needing particular government attention. These surveys cover as many as 1,000 products and are made public.
Proposed measures
Industry Code of Conduct An industry code of conduct would enable industry-wide agreement, through industry associations, on the intent to reduce standby power consumption to one watt by 2012 for identified product types or ranges.
Australian Standard Standards will be used to communicate the governments' one-watt target.
Publication of Standby Statistics Industry will be asked to submit standby power data for all products, to be published on a government website.
Penalty Labeling A mandatory label could be employed to identify products with continued poor standby power profiles once the majority of competitive products meet the target. This measure would only be taken after a product had been given reasonable lead time to comply, and voluntary measures had proved ineffective.
Mandatory Energy Performance Standards (MEPS) MEPS is a regulatory tool to remove the least energy-efficient models on the market. This measure is a last resort and would only be adopted when cost effective for consumers. More information can be found at www.greenhouse.gov.au/energyefficiency/appliances/meps/index.html.

Japan's Standby Policies

Current National Strategies. The Japanese measurement campaign (Ohashi et al. 2001) shows that standby energy consumption was 400 kWh/household or 9.4 percent of household electricity use per year in 1999. If existing appliances were replaced with the most up-to-date efficient models, standby electricity consumption would be reduced by 43 percent, to 228 kWh/household per year.

Two policies address standby power in Japan. One is the ENERGY STAR Program, in effect since October 1995 under an agreement with the U.S. government. Computers, monitors, printers, fax machines, copiers, and scanners are included in this program. The other national policy is the Law Concerning Rational Use of Energy (known as the Energy Conservation Law), which was revised in 1998. This law requires manufacturers and importers of designated appliances to make efforts to improve the energy efficiency of their products. The "Top-Runner" approach was introduced into the law to set targets for the weighted-average energy efficiency of each manufacturer's and importer's shipments by

product category; targets are set to the level of the most energy-efficient model in each category on the current market. Nine types of machines or appliances are identified in the law; standby power is addressed only for TVs and VCRs. The method for calculating annual electricity consumption of TVs takes into account standby power use. For VCRs, only standby power use is evaluated. The target energy-efficiency levels for TVs and VCRs in Japan are shown in Table 5.

Table 5. Target Energy-efficiency levels for TVs and VCRs in Japan

Product	Standards Levels	Unit	Target deadline (fiscal year)
Televisions	varies by function and screen size	kWh/year	2003
VCRs	1.7~2.5	W	2003

In January 2001, at the Subcommittee for Energy Conservation of the Advisory Committee for Energy and Resources of the Japanese Ministry of Economy, Trade, and Industry, several household appliance associations announced their intention to:

1. Reduce standby power consumption to less than one watt by the end of fiscal year 2003 for products whose standby power cannot be eliminated entirely (e.g., products with remote control, clocks, and timers).
2. Reduce standby power consumption to as close to zero as possible by the end of fiscal year 2003 for all other products.

These efforts are significant given that appliance manufacturers have already significantly reduced standby power consumption.

In addition to these efforts, a mechanism must be established that will allow consumers to easily recognize products with low standby power use. Support is also needed to increase consumer awareness of energy conservation and appropriate use of appliances.

Commercial Sector. Although standby power consumption in households has been the subject of much discussion in Japan and efforts under way are expected to reduce it, standby power consumption in the commercial sector has not yet been addressed. A study to measure the energy consumption in an approximately 9,400m^2 office building in Tokyo (Nakagomi 2001) reveals 20 kW (equivalent to about 2 W/m^2) of standby power consumption. This figure suggests that a much broader measurement effort is needed, covering a variety of commercial buildings, to estimate energy conservation potential in the commercial sector and form the basis for policy.

China's Standby Policies

Standby power use in China is increasing steadily as consumer electronic products penetrate Chinese households. In urban China, color TV ownership has reached more than 100 percent (i.e., more than one TV per household) in 1999; ownership of video disc players (VCDs and DVDs) is approximately 25 percent. Other types of equipment that consume standby power, such as rice cookers, microwave ovens, cellular phones, and audio systems, have proliferated in China as well.

A recent survey of Beijing and Guangzhou homes found on average 12 products consuming 30 to 35 watts of standby power household (Lin et al. 2002). These numbers are

modest in comparison to those observed in more developed countries. However, given the enormous size of the Chinese market for consumer electronics, several large power plants are already needed to power the current number of devices in urban China alone. As ownership of consumer electronics grows in rural China and average Chinese consumers purchase more electronic products that draw standby power, standby power use is certain to increase significantly unless policy interventions are undertaken.

Estimating standby power consumption in China is complicated by the fact that a large portion of Chinese consumers disconnect their electronic devices when not in use. However, anecdotal evidence suggests that this habit is changing, particularly among younger consumers. Initial results indicate that standby power consumption is responsible for roughly 10 percent of monthly electricity consumption in Guangzhou homes.

China has recognized the growing importance of standby power consumption and sent a delegation for the first time to participate in the 3rd IEA Workshop on Standby Power Use in Tokyo in February 2001. At the China-IEA Workshop on Appliance Standards, Labeling, and Standby Power Use in Beijing in November 2001, China announced its plan to regulate standby power consumption. The China Certification Center for Energy Conservation Products (CECP) has taken the lead in developing China's standby power policy and has articulated its intention to harmonize efforts with international programs, such as the U.S. ENERGY STAR Program and the global effort to reduce standby consumption to one watt, initiated by the IEA.

After months of research and dialogue with Chinese industry, CECP announced its first standard, for color TVs, at a meeting with nine major television producers in January 2002. This standard adopts the test procedure used by the ENERGY STAR Program and limits standby power consumption to three watts. This standard is consistent with the current ENERGY STAR specification for televisions.

CECP is currently working closely with several Chinese manufacturers on qualifying their products, and the first CECP-labeled television set is expected to be on the market in spring 2002. In its communication with Chinese manufacturers, CECP indicated its intention of revisiting the TV standby energy consumption standard following the expected revision of ENERGY STAR specifications and other international developments.

CECP is also evaluating the feasibility of launching similar programs for video disc players and printers in the near future. A survey of office equipment usage is planned for the second half of 2002 to support expansion of CECP's labeling program to office equipment.

Toward a Harmonized Solution?

Given the worldwide proliferation of national and regional initiatives on regulating standby power use, it is imperative to coordinate efforts internationally to facilitate participation by industry. To facilitate international discussion and cooperation on standby power issues, the IEA (IEA 2001) organized three workshops:

1. Paris, January 18-19, 1999: First International Workshop on Standby Power '*Standby Power : a Global Issue*" http://www.iea.org/standby/workshop.htm

2. Brussels, January 17-18, 2000: Second International Workshop on Standby Power "*Reducing Standby Power: Opportunities & Challenges*" http://www.iea.org/standby/brussels.htm
3. Tokyo, February 7-8, 2001: Third International Workshop on Standby Power *"Towards a Harmonised Solution"* http://www.eccj.or.jp/iea/01/text/index.html

The workshops successfully brought together standby power stakeholders and generated dialog among government, industry, academic, and non-governmental organization representatives. The workshops explored the benefits of international collaboration to encourage national efforts. However, the IEA initiative did not generate a joint solution for the most common standby-power-consuming devices (battery chargers) or worldwide discussion of and agreement on requirements for digital TV equipment.

Nonetheless, one very important result of the IEA workshops is that standby power may soon be included in energy test protocols and energy-efficiency policies for all products that consume significant standby power. One step toward this end was taken by the International Electrotechnical Commission (IEC) Technical Committee TC59, which is responsible for household appliances and created, in October 1999, an *ad hoc* working group to examine test procedures for standby power on appliances and electrical equipment.

The global and dynamic nature of the market for appliances that consume standby power will be best served by coordinated efforts among industry and government. Internationally coordinated efforts would reduce the burden on manufacturers of globally marketed products, encouraging cooperation with and support for greater reductions in standby power consumption. Perhaps more importantly, an international approach would eliminate the confusion created by redundant energy-efficiency labels and labeling schemes in different countries. A uniform international policy could simplify the process of educating and informing consumers about the issue and stimulate greater demand for energy-efficient products and appliances.

Recommendations

The following recommendations would help facilitate reductions in standby power consumption worldwide:

Develop guidelines for lowering standby power use in appliances not currently covered by any program. Many of the newest technologies will use some standby power. To avoid having "networked homes" that are also "high-standby-consumption homes," it is important to identify new appliances that will consume standby power and develop guidelines for lowering standby power use in these appliances as well as those that are not currently covered by any program.

Avoid the proliferation of different labels to reduce standby power. Some regions or countries have introduced their own labels or schemes to encourage the purchase of equipment with low standby power consumption. If these labels are maintained after the adoption of an international scheme, it would be appropriate to, at a minimum, ensure that the criteria among them are consistent. To this end, it is recommended that the consumption

levels specified in the EU Code of Conduct for External Power Supplies be used by all labeling schemes and public procurement and efficiency standards programs.

Address the specific case of STBs for tomorrow's digital TVs. Television broadcasting is rapidly moving toward digital technology; as a result, STBs will likely soon be responsible for significant new standby power demand in most economies. Countries should rapidly coordinate efforts, especially communication and power management protocols, to ensure that the standby power mode of the new generation of STBs is as energy efficient as possible. Service providers must be closely involved in this effort.

Include standby power information on existing appliance energy labels. Appliance energy labels are used in most IEA member countries. Most of these labels do not indicate how much energy is consumed while the appliance is on standby. For some appliances, such as electric ovens in some countries, the annual standby consumption is as high as the on-mode consumption. Forthcoming updates of appliance energy labels should include an indication of standby power consumption; a first step toward this goal has been achieved with the new EU label for electric ovens.

Stimulate research on new low-standby technologies. New solutions to reduce standby power should be encouraged. Research and development activities should be stimulated at all levels, especially to help manufacturers encountering technical obstacles to reducing standby power.

Establish an international network of accreditation organisations. An international network of accreditation organisations should be set up to reduce the costs to manufacturers of qualifying products with low standby consumption under multiple different regional programs.

Conclusions

An international approach to reducing standby power makes consumption sense. The problem of standby power consumption is significant and also strikingly uniform in developed and developing countries, in part because trade and manufacture are becoming increasingly global, especially for end-use technologies such as electric and electronic equipment that consume power in standby mode.

Energy-efficient solutions are already available to substantially reduce standby power use. In a business-as-usual scenario, some low-standby solutions would no doubt be brought to market but perhaps not rapidly enough to compensate for the overwhelming growth of standby power consumption that will likely accompany the next generation of electronic equipment. Tackling the problem from an international platform is the most effective way to increase global penetration of these technologies.

Standby power consumption is already being reduced internationally as multinational companies understand the need to improve the energy efficiency of the standby modes of their products. This is encouraging, but government intervention must stimulate and reinforce these achievements.

The IEA's standby power initiative has demonstrated to policy makers worldwide that energy efficiency can significantly reduce energy waste. This initiative is a model for future international collaborations to reduce energy use and improve the environment. An effort to transform the global market for distribution transformers, lighting, and electric motors is already being considered.

Prompt implementation in both developed and developing countries of the recommendations of this paper will significantly advance efforts to reduce standby power consumption.

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