Using Government Purchasing Power to Reduce Equipment Standby Power

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Abstract

Although the government sector represents only 10 to 15 percent of the economy in most countries, carefully targeted public procurement can play a significant role in market transformation through its influence on both buyers and suppliers. Government leadership in energy-efficient purchasing can set an example for other buyers, while creating opportunities for leading manufacturers and distributors to increase their sales and market share by offering energy-efficient products at competitive prices. Under proper circumstances, a highly visible government purchasing policy can have a disproportionately large influence on the market for efficient products.

In the United States, President Bush signed an Executive Order in 2001 directing all federal agencies to buy products with low standby power (1 watt or less where possible). This represents a deliberate choice to use government purchasing – rather than regulations or incentives – as a market-based strategy to encourage energy savings. It also builds upon existing efforts to encourage Federal purchase of energy-efficient products (Energy Star products and others in the top 25th percentile of efficiency).

This paper summarizes the Federal Energy Management Program's first 18 months of experience in implementing this Executive Order, including analysis of data on standby power, interactions with manufacturers and industry groups, and the relationship between these efforts and other federal programs concerning product labelling, testing, rating, and efficiency standards. After five years of implementing low-standby power purchasing, we estimate energy savings for federal agencies alone at about 230 GWh/year (worth US$14 million), with spillover effects on the broader market that will save all US consumers nearly 4000 GWh/year (US$300 million).

Introduction – What is Standby Power; Why Does It Matter?

A rapidly growing number of small and not-so-small devices with electronic circuits, sensors, or displays are currently designed so that they continue to use a small amount of electricity even when they are not performing a primary function, like processing data, receiving and displaying a video signal, charging a battery, or printing a page.[1] Many of these products do not even have an off-switch, or where there is a switch, it may shut off only secondary circuits, leaving the primary circuit connected to the mains and the power supply still drawing power.

[1] For general background on standby, see http://www.standby.lbl.gov/.

For a single device, this represents a small amount of power (typically 3-5 watts but sometimes 20+ W). Due to the large (and rapidly growing) number of small devices, however, and to the fact that standby power loads continue for many (or all) hours of the year, electricity waste due to standby already represents up to 10% of residential electricity in developed and developing countries, accounting for about 68 million metric tons of CO_2 for the OECD countries alone (Lebot et al. 2000, IEA 2001, Meier 2002). Within the US, a recent study for the Department of Energy (DOE) estimated today's standby electricity use in residential and commercial buildings at about 75,000 GWh, with a potential to grow to 130,000 GWh in 15 years under a business-as-usual case (EES 2002).

As we continue to make progress in reducing the operating-mode energy for many appliances and other equipment through improved technology, labels and other voluntary programs, and mandatory energy efficiency standards, energy use in standby mode is becoming one of the most attractive remaining opportunities to save energy at a very low cost per kilowatt-hour saved.

In this paper we briefly describe the problem, summarize some technical solutions, and review studies and policy initiatives in a number of countries. Until recently, there has been no large-scale attempt to transform the market by *focusing the government's own buying-power* on requirements for low-standby power products, in order to encourage a voluntary, market-based response from industry. We examine in detail one such case, the program implemented by the DOE Federal Energy Management Program (FEMP) in response to an Executive Order by President Bush.

Defining Standby Power

While there is no single definition of "standby" shared by all the countries, organizations, and individuals involved, there are some important common threads (IEA 2001). A very basic definition, initially offered by Alan Meier (see the "brief history," below) is that standby refers to a status when the device is "switched off or not performing its primary function." However, for some products it may be difficult to specify just one "primary" function. And "switched off" may have one common-sense meaning to the consumer but a very different one to a design engineer, especially for a complex device with multiple functions or a requirement to be available on-demand (for example, a consumer device that the user turns "on" with a remote control).

Recognizing this complexity, some participants at the annual workshops organized by the International Energy Agency (IEA – see http://www.iea.org/standby/) have offered an incremental approach to defining standby. This definition begins with power use when there is zero load from the device served by a power supply, then proceeds in steps as the level of functionality increases. This more complex approach would require a product-specific test method and constant updating to keep pace with product innovation.

A third criterion for standby is based on "lowest power use while connected to the mains." This definition has been accepted by the FEMP program (see below) and incorporated in a draft test method for standby now being considered by a committee of the International Electrotechnical Commission (IEC 2002). This approach has the advantages of simplicity, an easy test procedure, and fairly broad applicability. One limitation is that it deals only with the minimum power mode and fails to address other low-power modes. Also, it credits those appliances with a "hard-off" switch as having zero standby power – even if consumers might never use the hard-off switch. (Familiar examples include a fax machine or other networked device with constant availability but extended periods of time with no primary activity other than waiting for a signal).

Regardless of the definition used, there are practical reasons for distinguishing between standby mode and the "sleep" mode as defined by the Energy Star label, for office equipment.[2] Under the Energy Star definition, a personal computer (PC), monitor, or printer must be capable of automatically entering a low-power sleep mode after a specified period of idle time and then automatically waking up to perform its main function(s). To simplify, standby generally involves a *user-initiated* change of status (i.e., to "off") rather than the *automated* power management required of Energy Star office equipment. But there are some product-specific exceptions, and the likelihood of more to come.[3]

Technical Measures to Reduce Standby Power: Costs and Benefits

There are several technical approaches to reducing standby power at very low cost (also see IEA 2001). These are not mutually exclusive; the best approach may depend on product design, consumer usage patterns, and other

[2] Energy Star labels for consumer electronics, by contrast, are based on low standby power as defined by FEMP, i.e. when the device is, from the user's perspective, ostensibly "shut off."

[3] In other contexts, the term "standby" is also used to refer to pilot lights in combustion appliances, the energy needed to maintain hot water temperature in a boiler or water heater, and even to the ready-to-copy mode of an office copier – characterized by virtually no reduction in power use.

factors. The costs of implementing a given solution can vary with production scale and the timing of improvements with respect to product design and manufacturer retooling cycles. The most important approaches are:

- **Select a high-efficiency power supply** (typically a "switch mode" power supply)**.** An easy option for many products is to replace the present linear power supply – often procured from a separate supplier – with a low-standby, switch mode power supply, which has the added benefit of being more efficient in full-power mode. Incremental manufacturing cost may range from US$0-$1, depending on whether it is an internal or external power supply, other specifications, and purchase volume. Manufacturers may make this change for other reasons (such as reduced inventory or shipping costs), so the increased cost may not be passed to the buyer.
- **Re-design circuitry, displays, and other components to reduce power draw.** Circuitry costs vary enormously. In some cases, the circuits already have power management capabilities that have not been implemented, so the main cost is for re-programming. In other cases, new processors will be needed, but if low-power standby is included with other redesign specifications the incremental cost may be minimal, or zero.
- **Install hard-off switches, or move switches to the high-voltage side of the power supply**. Hard-off switches are a known technology and cost less than US$1 in bulk plus installation costs (these are product-specific).
- **Install auxiliary or standby circuits.** If the manufacturer installs a separate power supply and circuit for standby functions, the cost could rise by a few dollars. However, many office equipment and consumer electronics products already include auxiliary power supplies and circuits to meet the Energy Star sleep specifications. In these cases, incremental cost to achieve low standby (off) mode power would be much less.

In general, implementing low-standby strategies would typically cost about US$0-1 per device. We have not been able to find a systematic difference in the retail price paid by consumers for products with very low standby power levels and those with higher standby. For example:

- **Consumer Electronics** - with few exceptions, there is little or no additional cost for low-standby products. For example *Consumer Reports* identified a component stereo that drew over 20 watts in standby, while another model, requiring only 2 watts, offered equal performance and cost less.
- **Office Equipment -** Some low-standby office equipment may have a small incremental cost when first introduced, depending on product design and the path chosen to reduce standby (see above). Manufacturers such as Dell Computers are rapidly redesigning their equipment to achieve the FEMP standby levels within this highly competitive market.
- **Other products -** Comparing two recently introduced high-efficiency, front-loading clothes washers: one model (Maytag Neptune) requires 5 watts in standby while a competing machine (Whirlpool), at about the same retail price and wash-cycle efficiency, draws about 0.5 watts.

Many low-standby designs offer multiple advantages in addition to energy costs savings:

- **Energy cost savings from reduced standby power consumption**. Standby power savings per device range from 1-10 watts; we estimate average savings at about 3 W per device. Over a year, saving 3 W in standby mode corresponds to about 30 kWh/year (or $1.80/year at government electricity prices). Lifetime energy savings (assuming a six-year life) would be about $10 – an order of magnitude more than the cost of achieving the standby reduction.
- **Lower operating costs while the device is "on."** More efficient power supplies that reduce standby power use will also reduce energy use while the device is on. Depending on the device, these on-mode savings can be either negligible or even greater than savings from reduced standby.
- **Reduced costs and greater convenience of outlets and power strips.** Standby devices with external power supplies are often so large that they cover more than one outlet, forcing the consumer to purchase extra power strips and extension cords. Many low-standby devices use switching power supplies that are smaller and cover only one outlet. They are also lighter and thus less likely to fall out of wall outlets.
- **International portability of low-standby power supplies.** Low-standby products with switch-mode power supplies can be used in countries with different voltages or frequencies. Carrying only a single power supply is far more convenient for travellers. A multiple-voltage power supply also lowers inventory requirements for manufacturers and purchase costs for the buyer, especially large buyers, such as military units or other agencies with overseas bases, embassies, and the like.
- **Heating and cooling impacts.** Low-standby devices generate less waste heat. This heat is a benefit in the winter but a burden during the cooling season – especially in office settings where electronic equipment is often concentrated in interior spaces with excess heat during most of the year.

Brief History of Standby Power: Analyses and Policy Response

There are many twists and turns in the story of how standby power evolved from a topic of casual interest to a handful of analysts, to a focal point for several international meetings, and then an important target of opportunity for energy saving policies and programs in a growing list of countries on at least four continents (see timeline, **Figure 1**).

1986	First LBNL report on standby energy for office equipment
1987	LBNL report on home "misc." energy use (including standby)
1992	Swiss study of standby power for consumer and office electronics
1992	US Energy Star labels for low "sleep" power office equipment.
1993	US Executive Order: federal agencies to buy Energy Star office equip. First articles on "Leaking Electricity" - *Home Energy* magazine
1995-97	EU-SAVE studies + workshop on low-standby power.
1996	ACEEE conf. paper estimates standby ≅ 5% of home electricity. Swedish proposal for monitors with 1-W "deep sleep." EU voluntary agreement on low standby TVs/VCRs.
1997	Design for switching power supply with very low standby power. US Energy Star labels expand to consumer electronics (TVs, VCRs)
1999	First IEA international workshop on low standby power (Paris).
2001	US Executive Order: federal agencies to buy low-standby products. EU "Code of Conduct" for low standby external power supplies. GEEA label criteria for 22 low-standby products.
2002	US DOE and California CEC studies. Proposed US legislation on mandatory standards for low-standby equipment. Australia 10-year strategy for low standby.

Figure 1 - Low-Standby Timeline

One of the earliest investigations of standby power was undertaken in 1986 at Lawrence Berkeley National Lab (LBNL) led by Jacques Roturier, a French physics professor visiting on sabbatical. This study began with the question: "Why do computers use so much energy when they are not actually in use?" The answer was that no one had bothered much with this seemingly small amount of electricity – except in the case of laptops, with their built-in "sleep" circuits designed to help stretch battery life. This began to change in 1992, when the US Environmental Protection Agency (EPA) created the first Energy Star™ voluntary labelling program for office equipment with power management features that could automatically enter and recover from a low-power sleep mode.

At first, manufacturers paid little attention to this new voluntary program, until April 1993, when President Clinton issued an Executive Order directing all federal government agencies to buy only Energy-Star qualified PCs, monitors, and printers. Almost overnight, Energy Star participation skyrocketed, as manufacturers scrambled to modify their products and test them for Energy Star compliance in order to avoid losing their share of the lucrative and growing federal market – or fall behind in the broader market of public and private buyers expected to follow the federal lead.

At about the same time, there was growing interest and activity in Europe on ways to reduce wasted energy in both sleep and standby modes. In the early 1990s, the Swedish energy and technology agency (NUTEK) commissioned a study of off-mode power use by TVs and audio equipment. The results were published in the 1993 ECEEE *Proceedings*, along with the first reference in English to the term "leaking electricity"[4]

Researchers at LBNL published additional articles on standby power, characterizing standby as a major component of the poorly documented "other" uses of electricity in homes. Several of these articles appeared in *Home Energy* magazine starting in 1993, followed by a paper at the 1996 ACEEE Summer Study which estimated standby power at about 5% of electricity use in US homes (Meier, et al. 1996). In parallel, the EU-SAVE programme in Europe continued to sponsor studies (Wajer 1995, Molinder 1997). A May 1995 workshop in Copenhagen on "Energy Savings in Home Entertainment Electronics" addressed both standby and active power.

Under EPA's leadership, the US Energy Star labelling program expanded beyond office equipment into TVs, VCRs, and other consumer electronics (see http://www.energystar.gov/products/). For consumer electronics, however, Energy Star focused on reducing off-mode (standby) electricity use rather than the low-power sleep mode targeted

[4] However, decades earlier, the American humorist James Thurber had described his mother's fear of electricity "... dripping invisibly all over the house." The term "leaking electricity," while evocative to many consumers, seemed both inaccurate and unfair to many of today's safety-conscious manufacturers, who objected to its use.

for office equipment. Energy Star's aim was to set specifications strict enough to lead to real energy savings but also relatively simple to understand and implement, and at the same time able to attract support and voluntary participation by manufacturers with widely varying technical constraints, product cycles, and market strategies. The result was an Energy Star specification for consumer electronics that was both simpler and more generalized across product categories than had been the case for most of the earlier generation of office electronics. These same principles were later followed by FEMP in setting low-standby criteria for federal purchasing; the prior involvement with Energy Star provided useful experience as FEMP began to interact with many of the same industry representatives.

In the late 1990's, Alan Meier at LBNL continued his investigation of standby power by examining the physical requirements for standby power and how it could be further reduced. After consulting with other LBNL staff, UC faculty, and design engineers from the electronics industry, Meier recognized that the relatively new type of electronically-switched power supplies offered not only higher efficiency under load, but also opportunities to greatly reduce no-load (off or standby) power. One firm (Power Integrations) patented an innovative new power supply designed to use less than 1 watt in standby; this was later recognized with an award by *Discover* magazine.

Evidence that many common power supplies used by a wide range of products could be redesigned – potentially at little or no cost – to use 1 W or less in standby mode led Meier to propose in 1997 an across-the-board standby target of 1 W for consideration by policy-makers, program managers, and analysts in several countries.[5] The concept called for implementation to be deferred for more than ten years (to 2010). This would allow manufacturers time to re-design their products, or to change their specifications for outsourcing power supplies, with minimum disruption to normal product cycles. Finally, there was a call for government and other concerned groups to help define a common definition and test procedure for standby power. At the time, there were a number of quite different definitions of "standby" in common use, ranging from "off" mode for consumer electronics, to battery-charge for portable devices, to a "ready-to-copy" mode for office copiers offering little or no reduction in power.

In November 1997, the first session devoted to standby power took place at an international conference on energy efficiency in appliances, organized by Paolo Bertoldi of the EU, in Florence Italy. Participants from Sweden, the UK, the Netherlands, Japan, the International Energy Agency (IEA), and the US all offered presentations on standby energy use, savings potential, and policy options. One outcome was a decision that the IEA would coordinate a multi-country initiative aimed at 1-watt standby (see http://www.iea.org/standby/links.htm). Further discussions and elaboration of this concept continued at the 1998 ACEEE Summer Study on Efficiency in Buildings, followed by three annual workshops specifically on standby, organized by the IEA in early 1999 (Paris), Brussels (2000), and Tokyo (2001), with a meeting on how to define standby held in Washington DC (late 2000).

This three-year period saw steadily increasing levels of attendance and a gradual but notable shift in the stance of industry participants, from initial suspicion or outright hostility, to increased engagement in understanding the problem and exploring technical solutions, and finally, active interest in ways to reduce standby power through voluntary initiatives rather than government regulation. Among the important developments in individual countries:

- In Japan, a large-scale field study by the Jyukankyo Research Institute found that standby power accounted for about 10% of residential electricity. This led to a public information campaign, significant government R&D funding for low-standby technologies, and a government-industry agreement on (informal but quasi-regulatory) "guidance" for reducing standby – down to 1 W for many products, by 2003.
- In Europe, support from Denmark, the Netherlands, and Germany led to a 1997 agreement between the European Commission and an industry group on a voluntary "code of conduct" for industry actions to reduce standby, initially for TVs and VCRs, including more specific measurement procedures than those required for the Energy Star label. The Code of Conduct was later extended to audio equipment and small power supplies (http://energyefficiency.jrc.cec.eu.int/html/standby_initiative.htm). Several European countries formed the non-governmental Group for Energy-Efficient Appliances (GEEA), which established criteria for recognizing low-standby products that are somewhat more stringent than Energy Star criteria, and cover additional products (see http://www.gealabel.org/).
- In Australia, a residential metering study pointed to significant electrical loads attributed to standby power. These results, along with growing public support for a national response to the Kyoto Climate Change agreement, led to the adoption of a national strategy to reduce standby power across a wide range of products (Australia Greenhouse Office, 2002).

[5] The previous year, Olof Molinder in Sweden had proposed a one-watt target for computer monitors in "deep sleep" mode, roughly the equivalent of off or standby mode. At the time, this power level was significantly below either the Energy Star criteria or the best-practice models available on the market.

- China, partly in response to findings from a survey of standby power in Chinese homes, began a dialogue with its own electronics manufacturers about reducing standby power. That survey, presented at the 2002 IEA workshop, estimated average standby at 30 W in urban Chinese homes and well on the way to the much higher levels observed in Europe and North America.
- In the US, the Energy Star program continued to extend its labelling program to new categories of low-standby products including telephone equipment, "set-top boxes" for decoding cable and satellite TV signals, and remote-controlled ceiling fans. At the state level, the California Energy Commission sponsored a scoping study and public workshop to identify R&D needs to advance low-standby technologies and accelerate their market entry (Meier 2002). Nationally, the Department of Energy also commissioned a study to estimate standby energy use based on a review of LBNL reports and other primary sources (EES 2002).
- Perhaps the most significant recent event in the US was a decision by President Bush to use federal government purchasing power as a way to encourage manufacturers to voluntarily[6] shift their product designs toward low standby power. After seeing a hands-on exhibit[7] showing how much standby electricity was used by familiar consumer products, the President directed his staff to develop a voluntary program to help raise awareness by both industry and consumers. The result was Executive Order 13221, issued in July 2001 (Bush 2001). Steps taken to implementation this Order are described in the next section.

US Case Study: Market Leadership through Government Purchasing

Significance of Government Purchasing

There is enormous potential, largely untapped, to harness the buying power of public agencies to help guide both buyer and supplier sides of the market toward more energy-efficient products and services. In the US, for example, the federal government is not only the largest single customer in the country for most products – but the largest customer in the world (Harris and Johnson 2000). Data from different countries on shares of GDP, employment, and building floorspace show that the public sector as a whole – including national, state/provincial, local governments, and public schools and hospitals – generally represents between 10% and 20% of the entire economy. This finding is quite consistent across industrial, developing, and transition economies with widely varying levels of per capita income (Van Wie et al. 2002). However, the public sector's economic influence is seldom used in a deliberate, targeted way to help stimulate a market response toward more energy-efficient products from manufacturers, distributors, and (by example) from other buyers.

One notable exception has been the US government policy, dating from the early 1990's, that federal agencies should buy energy-efficient products, i.e., Energy Star labelled products and others designated by DOE/FEMP as products within the top quartile (25th percentile) of energy efficiency (www.eren.doe.gov/femp/procurement).[8] As mentioned earlier, an earlier Presidential order directing federal agencies to buy only Energy Star labelled office equipment provided the first powerful stimulus for manufacturers to sign up as Energy Star partners. One study has estimated that the federal purchasing policy will save agencies over US$200 million/year in operating expenses after several years of normal product turnover (Harris and Johnson 2000). This could be increased to US$1 billion/year of savings, if agencies at all other levels of government were to follow the federal government's lead. The State of New York has enacted legislation and a Governor's Executive Order applying similar criteria to energy-efficient purchasing by state agencies, and a few other jurisdictions have adopted similar measures for a limited set of products (most commonly Energy Star office equipment).

Implementing the Federal Executive Order

The Executive Order signed by President Bush in July 2001 states, in part, 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

[6] Although both houses of Congress introduced legislation in 2001 to establish mandatory national energy efficiency standards for low standby power, these provisions have not yet been enacted into law.

[7] The exhibit, created by LBNL, was personally demonstrated to the President by a power supply manufacturer with close ties to the Administration.

[8] In the mid-1990's, a similar initiative on energy-efficient government purchasing (mainly for office equipment) was sponsored by the Swiss Federal Energy Office.

> 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)

The Order established a tight timetable for implementation; the FEMP program had lead responsibility, working closely with other agencies and especially with the EPA-DOE Energy Star program.

Program Design – with Input from Industry and Federal Agencies

Within the first few months after the President's Executive Order, DOE's Federal Energy Management Program (FEMP) held a public workshop and began a series of in-depth meetings with key manufacturers and federal agencies, to get their input in designing the program. It was quickly determined that there were inadequate data available on the range of current (or readily achievable) standby power to allow FEMP to set recommended levels for federal purchasing. Nor was it evident which products should be covered by the FEMP guidelines, or exactly how to define standby power and then measure it in a consistent, reliable fashion. Finally, in the absence of a labelling scheme and/or a publicly available data base of product-specific standby levels (except for Energy Star labels for some consumer electronics), it would be difficult for federal buyers to identify those products that complied with the FEMP criteria. These practical needs suggested the following multi-step process:

Step 1: Establish Definitions and a Test Method

FEMP initially proposed to define standby as "When a product is switched off or not performing its primary purpose." However, after several rounds of discussion with industry, FEMP changed to the simpler definition of standby, to be applied to all products: "Lowest power use while connected to the mains." This left the more complex issues of defining multiple low-power modes and functions, discussed above, to be addressed by R&D projects (Meier 2002) and by the continuing evolution of labelling programs like Energy Star.[9] This across-the-board definition of standby was also easier to explain to federal buyers in common-sense language: "Standby is when the user doesn't need the device and/or [tries to] shut it off." Also, FEMP provides information to federal customers about how to identify which products are likely to use standby power (e.g., products with an external power supply, remote control, digital display, soft-touch keypad, or rechargeable battery).

Finally, this approach allows FEMP to establish a single method for measuring standby for all products, rather than a product-specific test method. The FEMP testing guidelines, which are very similar to the IEC draft test method proposed as an international standard (IEC 2002), are at http://oahu.lbl.gov/measurement_guidelines.html. Manufacturers agreed to use this test method when voluntarily submitting data to FEMP.

Step 2: Target Product Types

There are potentially thousands of product categories and subcategories that could be considered for federal purchasing guidance under Executive Order 13221. FEMP decided early on that it was important to focus on a limited number of standby-using products that would provide significant energy savings, help leverage the larger, non-federal market, and ideally, stimulate manufacturers and product engineers to transfer the low-standby concept to other product lines. Through an iterative process involving both federal agencies and industry groups, FEMP narrowed down an initial list of 52 possible product types to a final group of 20, under three groups: consumer electronics, office equipment, and appliances ("white goods") – see **Table 1**. The criteria used to make this selection included:

1) *Is the product purchased in "significant volume" by federal agencies and/or in widespread use in federal facilities?* In general, there are very few data available on federal purchasing (especially for smaller items like most standby power devices). Thus, a fair degree of judgment was needed to determine which products were commonly purchased and used. It was also important to consider cases where an individual, not a federal agency, was the buyer/owner, but the device was used in a federal facility where the government pays the electricity bill.[10]

[9] EPA is currently updating its efficiency criteria for Energy Star monitors to include multiple low-power modes, including both sleep and off modes, using an average duty-cycle to define the number of hours spent in each mode.

[10] Examples include small consumer products or appliances owned by government employees or occupants of military base housing. Some agencies set policies limiting the employee- or tenant-owned products allowed on site.

2) *Are today's standby power levels typically above 1 W?* Those products with zero standby (i.e., hard-off switch in all cases) were by definition not of interest, while products already achieving low standby levels, at or very close to 1 W, may not be worth the effort.

3) *Is it feasible and cost-effective to reduce standby power to 1 W (or another low level)?* This judgment can be based on today's best-practice standby levels or on the availability of simple strategies like selecting a switch-mode power supply as a drop-in replacement. See the discussion, below, on setting standby levels.

4) *Is the product commercially available?* Only products that are mass-produced (not custom-designed) were of interest; this also excluded specialized devices intended for military or other relatively limited, government-only purposes (e.g., aviation control towers).

5) *Are there Energy Star labelled products with potential for (further) reductions in standby power?* Energy Star labelled products were of special interest, since federal agencies are already required to buy these products wherever feasible and cost-effective. However, among Energy Star products standby power is treated in different ways. In some cases, the efficiency criteria do not presently consider standby mode: office equipment criteria are based on sleep mode and appliance criteria are based on active mode. For consumer electronics, where Energy Star criteria do address standby, for several products the allowed level was above 1 W. In these cases, establishing a lower standby level for federal purchasing might speed the process of negotiating a revised, lower standby level with the Energy Star industry partners.

Examples of products excluded from the list (or deferred for later consideration) are:

- Powered computer speakers – already at relative low standby power and possibly headed lower, with new designs increasingly integrated with either a monitor or PC, or else connected through a low-power USB port.
- Consumer products estimated to have low federal purchase volume: cordless phones, answering machines, TV set-top decoder boxes, video games, kitchen convenience appliances, portable power tools (some use in shops and landscape maintenance), workout equipment with electronic controls (some use in military fitness centers).
- Installed equipment such as doorbells, alarm systems, exit sign battery chargers, garage door openers. FEMP decided early in the process to focus on plug-in equipment only, excluding equipment that is generally installed as part of a facilities construction or renovation process.

Step 3: Create a Public-Domain Data Base Serving Multiple Objectives

Except for Energy Star labelled consumer electronics, there was no readily available source of data on standby power for any of the products targeted by FEMP. Initially, such data were important to help FEMP set recommended standby levels based on the range of current practice. Equally important was the need for readily available, up-to-date, public-domain data to help federal buyers (and others) identify specific products, by brand and model number, that meet the federal low standby criteria.[11]

The short-term solution was for FEMP to create a new, on-line data base of low-standby products, with data submitted voluntarily by manufacturers who offer low-standby models and want to make this information available to federal buyers (see http://oahu.lbl.gov/index.html). At the same time, FEMP planned to use the initial data submissions to help inform their decisions about recommended standby power levels. By creating an open, public-domain data base, FEMP also hoped to stimulate a degree of competition among manufacturers that would reduce average standby levels over time, since listing products in order, from lowest to highest standby, highlights the most efficient models. Since the data base is available to all potential customers, both federal and non-federal, it will hopefully encourage more manufacturers to offer complying products once they see their competitors' models listed, leading over time to a "race to the bottom." Finally, openly publishing all data provides an important degree of transparency, as well as an opportunity for self-policing by the industry based on competitive interests.

By January 2002, six months after the Executive Order was signed, FEMP had identified the initial product types to be targeted for low-standby purchasing, defined a test method for standby power, reached agreement with manufacturers on a voluntary data reporting system, and created the on-line data base for manufacturers to submit product-specific data and federal buyers to view the information. At the beginning of 2002 there were 80 products in the database, representing 6 manufacturers and 9 product categories. By January 2003, one year later, this had grown to nearly 1500 products, submitted by 27 manufacturers and covering 15 product types. FEMP had also

[11] Other options for informing consumers could include either a mandatory product efficiency label, as exists in the US for many types of consumer appliances, or else an "endorsement label" for energy-efficient products (like Energy Star) using the same low standby power criteria as the federal purchasing recommendations. As noted below, FEMP's long-term objectives are to harmonize the federal 1-watt standby criteria with Energy Star labels, and to incorporate standby in the appliance efficiency labels. At this time, neither is the case.

made arrangements to download standby power data for Energy Star consumer electronics products directly into FEMP Website, so that those Energy Star models meeting the (lower) FEMP levels could be easily identified. These represented another 2660 data points by December 2002, of which about 40% complied with the FEMP standby criteria (see **Table 1**).[12] FEMP continues to send quarterly reminders to manufacturers to encourage them to update their product information.

Table 1. Low-Standby Product Data Submitted to FEMP

	FEMP Standby Level (W)	Products Meeting FEMP Standby Level (as of 2/01/03)		All Energy Star Products			
		Number of Models	Number of Manufac-turers	Number of Models	Number of Manufac-turers	Energy Star Req't (W)	Lowest Sleep Mode (W)[13]
Office Equipment							
Desktop Computer[14]	3	41	6	2040	101	15-30+	<2
Laptop Computer	1	302	10			15-30+	<1
Computer Monitor[14]	2	107	7	2825	137	8	<1
Printer	1	248	15	771	33	10-75	<1
Copier	1	130	6	386	24	5-20	<1
Fax[14]	4	52	8	400	33	10-15	1
Scanner	1	21	4	142	18	12	<3
Multi-function	1	80	8	313	21	25-105	<1
Workstation[15,16]	*2*	*(8)*	*(2)*	n/a	n/a	15-30	n/a
Integrated Computer[15]	*5*	*(6)*	*(1)*	n/a	n/a	35	n/a
Docking Station[15]	*1*	*(4)*	*(1)*	n/a	n/a	n/a	n/a
Subtotal		**999**	**--**	**6877**	**--**		
Consumer Electronics							
TV	1	371	12	1344	20	1-3	<1
VCR	2	169	10	567	16	2	<1
Combination TV-VCR	3	98	10	252	12	4	<2
DVD[15]	*(2)*	*(143)*	*(11)*	175	13	3	<1
Audio Product	2	287	8	282	8	2	<1
Converter/Set-top box	TBD	TBD	TBD	11	3	3-20	<7
Subtotal		**1068**	**--**	**2631**	**--**		
White Goods							
Room A/C	TBD	TBD	TBD	224	13	n/a	n/a
Microwaves	TBD	TBD	TBD	N/a	n/a	n/a	n/a
Dishwashers	TBD	TBD	TBD	407	14	n/a	n/a
Clothes Washers	TBD	TBD	TBD	114	16	n/a	n/a
Subtotal		**--**	**--**	**745**	**--**		
TOTAL		**2067**	**--**	**10,253**	**--**		

[12] While **Table 1** shows statistics only for low-standby products that meet the FEMP criteria; the on-line data base contains almost an equal number of products with somewhat higher standby levels. Many of these data were submitted by manufacturers prior to FEMP establishing a recommended standby level and were kept on the list at the manufacturers' request, perhaps in order to provide some customer visibility for products with standby levels slightly above the FEMP recommendations, but with other features that may meet a specific customer's needs.

[13] Energy Star data represent lowest standby power for consumer electronics and copiers, lowest "deep sleep" mode for monitors, and lowest sleep mode for all other office equipment.

[14] Beginning July 2003, FEMP standby level for desktops will be 2 W, for monitors 1 W, and for fax machines 2 W.

Because federal agencies are already required to buy only Energy Star labelled products, all low-standby products submitted to the FEMP database are also required to meet the Energy Star criteria, where applicable. In the near future, FEMP plans to incorporate all the data on low standby power into a new, consolidated Energy Star data base. This should eliminate the need to maintain a separate FEMP data base (except for a few non-Energy Star products, like microwave ovens). It will also streamline the process of data submittal for manufacturers, and allow federal and other purchasers to view all relevant energy performance data, including standby power, at one site.[17]

Step 4: Set Recommended Standby Levels for Federal Purchasing

The Executive Order calls for agencies to buy products with standby at 1 W or less, or the lowest available level, "…when life-cycle cost-effective and practicable and where the relevant product's utility and performance are not compromised as a result." FEMP used these criteria to recommend a standby level for purchases of each type of product. The initial task was to determine if products currently available with standby at or below 1 W were sufficiently diverse, in terms of features (TV or monitor screen size, fax/copier/printer speed, etc.), to meet the needs of federal customers and also to provide a choice among three or more suppliers. If not, the same question was applied to products with up to 2 W standby, and so forth. In a few cases, FEMP proposed a low standby level even before compiling data showing that a sufficient range of products were currently available – but only after extensive discussion with manufacturers and after allowing 6-12 months delay before the recommendation took effect for federal buyers. This was designed to give manufacturers time to incorporate low-standby features in their regular product design cycle.

By June 2002, FEMP had issued recommended standby levels for desktop and laptop PCs, monitors, printers, copiers, and faxes. By the end of 2002, FEMP standby recommendations had expanded to 12 product types in 3 major categories, with another 8 or so under consideration and in active discussion with industry (see **Table 1** and http://oahu.lbl.gov/level_summary.html).

As Table 1 shows, the FEMP standby criteria for office equipment are well below maximum power levels required by the Energy Star label for *sleep* mode. At the same time, the last column, labelled "Lowest Sleep Mode," shows that today's best-practice models generally offer *sleep* power levels at or below the FEMP recommendations for *standby* ("off"). This fact was important to FEMP in determining the standby levels for federal purchasing. Since some products were already achieving these very low power levels when automatically powering-down to sleep mode, it seemed logical that the same targets could also be easily met for a standby mode.[18] In the case of consumer electronics, Energy Star criteria are already based on standby (off) mode power, rather than sleep. The Table shows Energy Star requirements converging toward the FEMP levels; Energy Star has a goal to aim for 1 W standby for all of these products as soon as possible. While the FEMP-recommended standby levels also need to be re-evaluated periodically to keep pace with relevant changes in technology and markets, FEMP has no intent to go below 1 W for standby.

Step 5: Follow-on Activities

Experience with FEMP's other efforts to promote energy-efficient government purchasing show that issuing an Executive Order is an important starting point, but by itself is not enough to assure change in the way government does business. It is equally important to translate broad policies into the day-to-day regulations and practice, while bringing these requirements to the attention of literally thousands of federal buyers. Within the federal government, day-to-day purchasing is guided by the Federal Acquisition Regulations (FAR). These voluminous regulations already include specific directives about purchasing energy-efficient products in accordance with previous Executive Orders and energy efficiency provisions from a 1992 law (http://www.eren.doe.gov/femp/procurement/pdfs/far_rule1201.pdf). A pending update to the FAR will include specific requirements to buy low-standby products, consistent with the Executive Order.

With a continuing trend toward decentralized purchasing and the rising use of government-issued credit cards for many smaller purchases (up to several thousand US$), it is not a simple or one-time effort to get the word out to

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[15] Entries in italics indicate products for which FEMP has not yet recommended a low standby level; values in parentheses are proposed standby levels. Standby levels for workstations, integrated computers, and docking stations are planned to take effect in July 2003.

[16] A workstation is defined as any computer that can support more than one processor.

[17] Other lists of low-standby products are maintained by GEA (http://www.efficient-appliances.org/Home.htm), at http://www.standby.lbl.gov/DATA/1WProducts.html, and for Australia's 1-watt strategy (in development)

[18] Since FEMP defines standby as the lowest available power setting, this would be equal to or less than the Energy Star sleep mode.

federal buyers about the low-standby recommendations and where to find complying products. A multi-path approach is required, through FEMP's interagency working groups, newsletter articles and publications, agency briefings and conference presentations, existing buyer (and vendor) networks of the two federal supply agencies (General Services Administration, GSA and Defense Logistics Agency, DLA), and of course, the FEMP Website on standby power (http://www.eren.doe.gov/femp/procurement/standby_power.html). Statistics are not yet available on usage of this relatively new Website on low-standby purchasing. However, FEMP's closely related Web pages that include other recommendations for energy-efficient purchasing are among the most heavily-visited FEMP sites, averaging over 20,000 visits/month during 2002-3 – with one out of six visitors from outside the US.

Both GSA and DLA offer their own on-line catalogues for federal buyers. The two supply agencies are in the process of coding their product lists to indicate which models meet the low-standby power criteria (as well as qualifying for the Energy Star label or other FEMP efficiency recommendations). GSA is instructing its vendors to identify which of their models meet the FEMP efficiency and low-standby requirements, both in their on-line data submissions and, on a voluntary basis, in other sales literature.

Finally, there is an important opportunity to use the required training for federal credit card holders, including the monthly bills sent to credit card users, as a means of communicating these relatively new requirements for energy-efficient purchasing.

Potential Energy Savings – US Government and Economy-wide

Estimating the energy and cost savings to be achieved by federal purchasing of low-standby products requires data on the volume of federal purchases, differences in standby power, and utilization practices (i.e., typical hours per year in standby mode). Unfortunately, there are few hard data on any of these parameters, so we relied on judgmental estimates and inferences from other studies (mainly of standby in residential products and usage).

Lacking product-specific data on federal purchasing, we estimated these numbers from industry-published national sales data for each product, assuming that the federal sector accounts for about 5% of office equipment, 2% of white goods and video equipment, and 0.5% of other consumer electronics. For each product type, average power savings (W/unit) were multiplied by an estimated 60% duty cycle in standby (5256 hours/year). Separate scenarios were developed for federal compliance rates with the purchasing directives (rising from 20% now to 80% after 5 years), and for spillover effects on the larger market (rising from 10% to 50% during the first 5 years) as manufacturers redesign many of their products for lower standby.

The results are shown in **Table 2** and summarized graphically in **Figure 2**. As existing office equipment, consumer electronics, and appliances are replaced with FEMP-recommended low-standby products, direct energy savings to the federal government will be about 230 GWh/year[19] by the end of Year 5. This represents over US$14 million in annual cost savings to federal agencies (and taxpayers) at today's average federal cost of electricity (US$0.06/kWh).

However, even more significant is the indirect impact of federal purchasing on the overall US market. We estimate the total savings to all US consumers at almost 4000 GWh/year (worth about US$300 million/year) – or enough electricity to serve the total needs of about 350,000 US homes.[20]

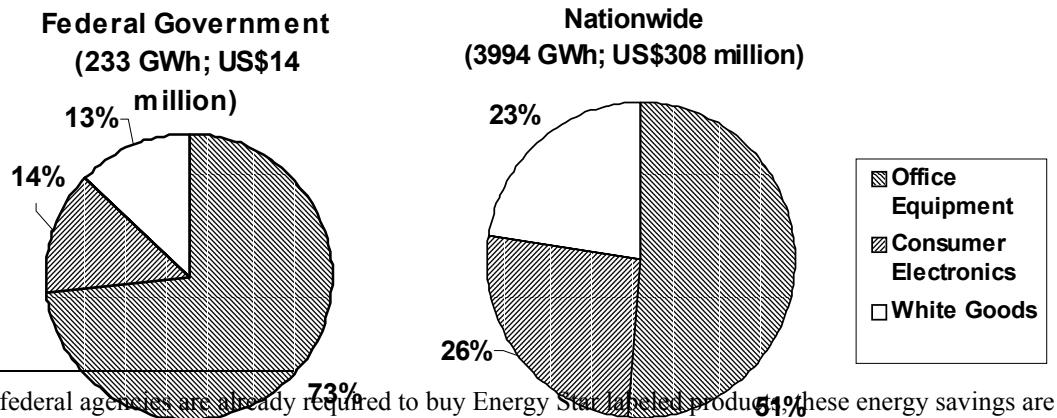

Figure 2. Annual Energy Savings in Year Five

[19] Since federal agencies are already required to buy Energy Star labeled products, these energy savings are in addition to those from low "sleep" mode for Energy Star office equipment and are in addiiton to savings from the (somewhat higher) Energy Star standby levels for consumer electronics.

[20] Note that these savings, a modest fraction of today's estimated 75,000 GWh of standby electricity (EES 2002), are calculated only for the 19 specific products now (or soon to be) covered by federal purchasing recommendations. Additional indirect impacts could be much larger, as the FEMP and Energy Star programs begin to influence the design and selection of components for many other products.

Table 2. Annual Energy Savings, Federal Government and Nationwide

	Average savings per unit (W)	Annual Savings in Year 5 (GWh/yr)	
		Federal Government	Nationwide
Office Equipment			
Desktop computers	2	56	671
Integrated desktops	2	3	32
Laptop computers	1	7	86
Monitors	2	48	577
Printers	1	22	259
Copiers	2	0.3	4
Fax machines	2	10	120
Multifunction devices	2	3	30
Scanners	3	22	270
Consumer Electronics			
Televisions	2	14	432
VCRs	2	12	364
TV/VCR combos	3	4	135
DVDs	1	1	113
Audio products	0[21]	0	0
White Goods			
Microwave ovens	3	10	307
Clothes washers	3	6	175
Dryers	3	5	154
Dishwashers	3	4	132
Room AC	3	4	132
Total	--	**233**	**3994**

Conclusion: Role of Government Purchasing in Market Transformation

A few previous programs, including the first Energy Star labels for office equipment, have demonstrated the important role that government purchasing can play, as part of a well-planned, multi-level strategy for transforming markets toward more energy-efficient products and services. The US government's efforts to use federal buying-power – and the symbolic value of government leadership – to encourage the manufacture and sale of lower-standby products represent the latest application of this market-driven approach. While the final results are not yet in, FEMP has made a good start in getting attention from the manufacturing community and their customers.

Manufacturers have begun responding to the Executive Order and the FEMP low-standby criteria with significant design changes that will dramatically improve the efficiency of electrical products used by all consumers. As one example, Dell has committed to reducing standby power to FEMP levels in all its desktop computers. According to Bob McFarland, Vice President for Government Relations:

> "Dell Computer Corporation's direct relationships with its customers provide us unique insights for the development of our products and services. As an important Dell customer, the Federal government also plays a distinct role in this process. Dell recently responded to proposed Federal energy standards [E.O. 13221] by committing itself to designing its mainstream desktop computers to consume less than 1 watt in standby power – an energy saving improvement that not only meets the needs of the U.S. government, but also benefits Dell's customers throughout the world."

Other manufacturers are also planning to incorporate low-standby features as they roll out new designs. Most importantly, the technologies that enable low standby power are becoming widely discussed, accepted, and used.

Just as the other FEMP and Energy Star efficiency criteria are beginning to be used in purchasing specifications by other levels of government, FEMP hopes that the new federal criteria for low-standby power will offer a practical guideline for other institutional, corporate, and individual buyers. In some cases, federal purchasing alone may be

[21] FEMP standby levels are the same as for Energy Star, so no incremental savings is assumed.

sufficient to provide a low-risk entry market for those manufacturers seeking technology leadership in low standby products – provided that the federal commitment to buy these products is widely perceived as firm, credible, and sustained.

For FEMP, a key to this overall strategy has been close working relationships with other federal agencies and programs, as well as effective communication with the affected industry groups. The relationship with Energy Star has been discussed at length. One other important program link is with the appliance testing and labelling program managed by another office in DOE. Through a series of discussions, it was decided that the DOE criteria for mandated testing and reporting of energy efficiency for certain white goods, including dishwashers, clothes washers, and air conditioners, would be changed to reflect not only the duty-cycle energy use (when washing, or cooling) but also their annual energy use in standby mode.[22] A new test procedure is already proposed for dishwashers. Once these new test methods are in place, reflected in the mandatory energy efficiency labels, and eventually incorporated into DOE's mandatory efficiency standards (at their next update cycle), manufacturers will have even more incentive to look at ways to minimize standby power.

The President's Executive Order demonstrates how public-private partnerships can bring about real change that benefits all consumers, and how the federal government can lead by example. The Department of Energy's FEMP program has developed a cooperative working relationship with industry leaders to lower standby power in office equipment and other products, as they roll out new designs reflecting the latest technical advances and consumer-desired features. These companies provide a great example of how innovation can help us save energy without sacrificing the performance or quality of our products.

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