One Watt Initiative : a Global Effort to Reduce Leaking Electricity

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1 - SYNOPSYS

The 1 Watt initiative describes an International effort to reduce standby power waste of electric equipment.

2 - ABSTRACT

Many domestic appliances and commercial equipment consume some electric power when they are switched off or not performing their primary purpose. The typical loss per appliance is low (from 1 to 25 W) but, when multiplied by the billions of appliances in houses and in commercial buildings, standby losses represent a significant fraction of total electricity use. Several initiatives to reduce standby losses have appeared in different parts of the world. One proposal, the 1-watt plan, seeks to harmonize these initiatives by establishing a single target for all appliances. This paper explains the background to the 1-watt plan, identifies some unresolved aspects, and gives some estimates of energy savings.

3 - INTRODUCTION

In a context where governments are trying to find ways to reduce their CO_2 emissions in a cost-effective way, eliminating unnecessary electricity losses from standby consumption represents an interesting avenue. Moreover, the proliferation of new electronic equipment will continue to grow, leading to leaking electricity representing an even bigger share of electricity use. The electricity savings and the related CO_2 emissions at the scale of an economy could be significant but individual transaction costs are large compared to the potential saving of individual devices. Moreover, electronic devices are traded internationally and it could be difficult and costly for a government to make the necessary effort to limit leaking electricity domestically. Therefore, there is a need for concerted efforts in order to find solutions that will be more cost-effective.

4 - THE ORIGINAL 1 WATT PLAN

The original 1-watt plan proposed by Meier (Meier 1998) consisted of the following elements:

- Manufacturers would reduce standby losses in appliances to 1 watt or less
- All appliances would comply by 2010 and 50% by 2005
- Each country would select its own strategy to achieve compliance within the framework of the above goals
- International bodies would develop appropriate test procedures and definitions

It is estimated that, if implemented, leaking electricity would be cut by as much as 75% when the existing stock of appliances is replaced. Further savings would occur as the number of appliances with standby losses increases.

The virtue of this approach is its simplicity. Unfortunately, it has practical drawbacks related to implementation. These will be discussed below after reviewing the major energy-saving programs affecting standby losses.

5 - BACKGROUND: A SIGNIFICANT WASTE OF ELECTRICAL ENERGY

Each Watt necessary for standby mode results in a consumption of 9 kWh per annum, and costs one Euro of electricity on average throughout European countries. In a typical Japanese home, standby losses correspond to 10% of total residential electrical consumption, while in the United States, standby losses account for about 5% (or about 50 Watts per home). Estimates of standby losses in the European Union lie between 5 to 10% of total residential electrical consumption.

In Germany, the average standby consumption in the residential sector is estimated to be 45 W per household. Combined with the losses found in the commercial sector, the standby consumption of equipment is more than 20 TWh a year (4% of national consumption), which generates 14 million tons of carbon dioxide emissions (1.6% of national CO_2 emissions) (Rath 1997). Therefore, the waste of electricity associated with standby losses and its associated CO_2 emissions is significant and merits some attention.

6 - EXISTING PROGRAMS TO REDUCE STANDBY LOSSES

Several countries have already taken action to reduce standby losses in appliances. In some cases, the programs have targeted standby losses, while others have sought to reduce the appliance's total energy use, where standby losses are just one component. These programs are both voluntary and mandatory. Some have been underway for several years, while others are just beginning. The most significant programs are:

Energy Star. This program is jointly administered by the United States Environmental Protection Agency (USEPA) and the Department of Energy (USDOE). It is the largest voluntary program and the most influential. Consumers can identify qualifying products by an Energy Star logo. Energy Star programs apply to TVs, VCRs, DVDs, and most domestic consumer audio equipment. It also covers computers and monitors. Energy Star levels for TVs and VCRs covered are well above 1 W; however, actual consumption of complying units is considerably below the levels. (See table) Moreover, a new level will be introduced shortly and it is expected to be very close to 1 W. Energy Star levels for most audio equipment is presently 2 W but will be lowered to 1 W in 2002. (see table 1)

Table 1

	Energy Star® Level	**Average of Complying Units in Late 1998**
TVs	3 Watts	1.7 Watts
VCRs	4 Watts	3.0 Watts
TV/VCR combos	6 Watts	4.7 Watts

Table 2

	Phase 1	**Phase 2 (2002 onwards)**
Audio equipment, including all sorts of receivers, boom boxes, etc.	2 Watts	1 Watt
DVDs	3 Watt	1 Watt

The Energy Star program will soon cover other consumer electronics, including telephony and set-top boxes. When these are included, it will address the appliances representing the largest existing sources of standby losses. Several countries have arranged (or are now negotiating) bilateral agreements to use Energy Star levels and labels.

USDOE Efficiency Standards (USA). The United States Department of Energy has minimum energy efficiency

regulations for the most important white goods. With the exception of refrigerators, none address standby losses. However, the test procedures are now being changed to include off-cycle energy consumption. In this way, manufacturers will have an incentive to reduce standby losses.

In Switzerland, maximum values of standby consumption have been discussed and agreed upon between the Federal Government and the manufacturers and importers of electric appliances. A strict calendar is observed and target values are revised downwards at regular interval.

In May 1998, the European Commission signed with manufacturers of televisions and video recorders a voluntary agreement to limit the standby consumption of this equipment to 10 W after January 2000. On February 1999, the European Commission issued a "Communication to the Council and the European Parliament on Policy Instrument to Reduce Stand-by losses of Consumer Electronic Equipment"(European Commission 1999, Europe Energy 1999). This Communication aims to raise public awareness about the considerable energy consumption of consumer electronics in standby mode. The EU Commission proposes two strategy papers: one deals with wall packs and chargers, the other one on Integrated Receiver Decoders (IRDs). Table 3 displays the proposed no-load power consumption targets for Wall Packs and Small Batteries Chargers. EU Energy Ministers will be asked to validate the Commission's suggested approach at their next Council in May 1999.

Table 3: Proposed EU no-load power consumption for Wall Packs and Chargers

	1-1-2001	1-1-2003
No-load power consumption equal or less than	0.5 Watts	0.1 Watt

A consortium of state energy agencies in seven European countries has created the Group for Efficient Appliance with the objective of promoting energy efficient televisions, VCRs and personal computers.

In Germany, Switzerland and the Netherlands, some local electric utilities carry out information and motivation campaigns to raise consumers' awareness and encourage the purchase of equipment with reduced standby consumption.

Japan (MITI). The Japanese government has urged major consumer electronics manufacturers to reduce standby losses of all products to 1-watt. The program has no specific name and appears only in the form of administrative guidance.

Top Runner (Japan). The Top Runner scheme establishes minimum efficiencies for TVs, VCRs, air conditioners, copiers, refrigerators, and other several appliances. As the manufacturers seek to reduce overall energy use, they are expected to reduce standby losses. These regulations came into force during 1998 and 1999.

Power Supply Rebate. This plan (initially proposed by Professor Arthur Rosenfeld from the US DOE) involves government rebates to manufacturers that switch from conventional to high-efficiency power supplies. The buy-down program exploits the fact that $0.25 rebate per power supply results in consumer savings about one hundred times larger. The program is now under consideration in the United States.

The International Energy Agency (IEA) has recently initiated a programme called "International Action to Reduce Standby Power Waste from Electrical Equipment" (IEA 1999). A first workshop was organised with the following objectives:

- To measure the size of the problem of leaking electricity in IEA Member countries;
- To take stock of current initiatives at regional and international basis;
- To examine the feasibility of working on a more international basis; and
- To develop an plan of action as well as a timetable

The presentations and discussions at the workshop confirmed the benefits of a co-ordinated effort to reduce

standby power waste in IEA member countries. It also highlighted the lack of definition and terminology to efficiently address the issues.

Many actions are underway to address standby losses in what are now the largest sources of standby losses, that is, in TVs and VCRs. But fewer countries have addressed the other appliances. In terms of aggregate energy use, TVs and VCRs together are responsible for as much as 25% of total standby losses. Hundreds of other appliances are being redesigned each year to include microprocessors or electronic controls (white goods is one example). As a result, perhaps only 10% of the total number of leaking appliances are being targeted. Further growth in leaking electricity is likely to occur in these appliances rather than TVs and VCRs. The approach used for TVs and VCRs–voluntary targets developed in co-operation with manufacturers– works well for a single well-defined product. However, this strategy is unlikely to be as effective where there are thousands of different products with equally diverse functions and hundreds of manufacturers.

Many other countries, notably China and India, have not been active in that field, so some of the largest emerging markets are not yet benefiting from global harmonisation.

7 - STANDBY LOSSES OR LEAKING ELECTRICITY

Discussion of leaking electricity is greatly hampered by the absence of accepted definitions. Perhaps the best example is the use of the term "leaking electricity". This term is intensely disliked by manufacturers–who prefer "standby losses"– because it suggests that the device is broken; nevertheless, leaking electricity has gained international acceptance by those involved in the subject. It is also the literal translation of the Swedish term for "standby losses"[1]. The world can probably survive with both terms as long as everybody agrees on what it is, but possibly switching to a technically more precise term (discussed later) when needed. Some progress has been made towards defining the boundaries of the problem and the terms to describe it. The first problem is to define the appliances and situations covered. We found that it is easiest to begin by *excluding* certain categories.

The terms “standby power” and "standby losses" often apply to a mode found in a broad category of home appliances. Gas-fired appliances, such as water heaters in North America, have standby losses from their "standing" pilot lights. Other gas appliances, including furnaces, boilers, and stoves, also have pilot lights. The energy wasted in these kinds of standby losses are large (as are the savings potential) but the nature and technology of gas standby seems inherently different from that found in electronic devices. The global effort will probably be solely directed at leaking "electricity" rather than including leaking "gas".

The electricity used to continually generate heat is often considered to be a standby loss. Electric storage water heaters have a heating element that operates to offset constant jacket losses. Many air conditioners have crankcase heaters to stop migration of refrigerant and permit safe starting at low temperatures. These operate continuously and draw as much as 75 watts. Recently, heated toilet seats have become very popular in Japan. These consume as much as 50 watts all winter. Many refrigerators use electric heaters to prevent condensation at critical locations and to defrost the evaporator. All of these applications are called standby losses and consume large amounts of electricity, yet they too seem inherently different from leaking electricity and should probably be excluded from this effort.

These two recommendations exclude devices responsible for a huge amount of energy. Nevertheless, the remainder is a more homogeneous collection of devices. Note also that the remainder consists almost exclusively of devices using direct current (DC). This suggests a common characteristic of leaking electricity: it is the electricity consumed in the form of direct current and by the transformer responsible for the conversion from AC to DC.

There is no consensus on the extent to which the 1-watt target should apply to equipment used in the commercial

1 In this paper, we use leaking electricity for the general phenomenon and standby losses for a specific device.

sector in addition to the domestic sector. Clearly many devices have standby losses and seem like reasonable candidates (indeed, the Japanese Top Runner program is targeting some of them). On the other hand, should infrastructure items, such as elevators, also be included? What about mainframe computers and whole-building security systems? No concrete proposals have addressed the commercial sector. One possibility is limiting the international coordination to devices operating on the lowest standard voltages (that is, 220 V in Europe, 115 V in the USA, and 100 volts in Japan).

8 - A DEFINITION OF LEAKING ELECTRICITY

The 1-watt plan requires a clear and technically workable definition of leaking electricity. Leaking electricity is often described as the electricity consumed by appliances when not performing their primary purpose. The function-based approach has been described in detail by Siderius (Siderius 1999). The function-based definition is attractive because it is flexible; i.e., it can cover a variety of inefficient appliance modes. Some appliance modes that people might consider adding to the standby definition are listed in Table 4.

Table 4 : Appliance modes that might be considered in the definition of standby power

Mode	Definition
No-Load	state of the power supply when no power is being provided to the rest of the appliance
Off	the appliance is switched off and has no remote capability
Passive Standby	the appliance is off, but can be powered up remotely
Active Standby	the appliance is on, but is not providing a primary function
Low-Power mode	mode entered after a short period of inactivity
Deep-Sleep Mode	mode entered after a long period of inactivity

This definition is attractive but sometimes fails when rigorously applied. Many new appliances–especially those with communications functions–have as many as ten modes, several of which could be considered as "leaking" modes. What is the procedure for identifying the 1-watt mode? Furthermore, there are problems of consistency and subjectivity. One appliance's primary function might be considered non-primary in another application. For example, a digital clock display might be treated as the primary function when it is in a digital clock but not when the same display resides in a VCR.

An alternative approach is to define the minimum power mode as the leaking mode (and subject to the 1-watt target). This approach is attractive because the minimum power mode is objective and easy to identify. It also has major drawback: the appliance may operate most of the time in other modes (such as those described in Table 1) so the minimum power may not be relevant.

In the end, the definition of leaking electricity will probably consist of two parts. For most devices, the minimum power consumption will be sufficient. This will apply to perhaps as many of 90% of all devices with standby losses. On the other hand, the remaining 10% of the devices may require more complicated definitions based on their functions. International agreements between governments and manufacturers (such as those already negotiated by Energy Star) will be necessary for those appliances where the minimum power definition is not appropriate.

The problems of definition may appear academic but they are in fact a major obstacle to progress on reducing leaking electricity. A test procedure cannot be developed until suitable definitions of leaking electricity are established. And a target cannot be established until a test procedure exists.

9 – 1 WATT : SYMBOL VERSUS SUBSTANCE

The above discussion suggests that, in a technical sense, the 1-watt plan is premature. There is no consensus on the range of appliances covered or even how to measure appliances to determine if they comply with the 1-watt target. As people begin to understand the technical dimensions of the problem, the 1-watt plan has evolved into more of a symbolic goal rather than a rigid target. The components of the symbolic 1-watt plan now appear to be:

- Recognition that a large reduction in standby losses is technically feasible, economically reasonable, and environmentally beneficial.
- Establishing a goal to reduce standby losses for most appliances to about 1-watt, though some will surely be less and some will surely be more. It is best to view 1-watt as something closer to a fleet average rather than a single target for all devices.
- Recognition that international coordination, including a timetable for implementation, will result in broader application, lower costs to manufacturers, and hasten implementation.

These goals are considerably "fuzzier" than the original 1-watt plan, yet they allow for substantial progress to be made even before some of the details are worked out.

Regardless of the exact formulation of the 1-watt plan, the major, international manufacturers of consumer electronics have received the message and are working towards 1-watt. Some success can already be claimed as indeed more and more equipment presenting less than 1 Watt in standby are now being introduced on the market in Europe, Japan and North-America. On the other hand, the message has not been heard by smaller manufacturers, those concerned with appliances where electronic controls are a minor component, or those in less developed countries.

10 - BEYOND 1 WATT

Is the 1-watt plan simply a stepping stone to further proposals for reductions in leaking electricity? We suspect that no further international efforts will be established for several reasons. First, the economics of reducing standby losses become increasingly unfavorable below one watt. The present value of energy costs from 1 watt are roughly 5 Euros. Thus, the manufacturer cannot raise the retail price of a product by more than 5 Euros in order to pay for improvements. The economics of moving from 5 watts to 1 watt are almost always favorable, but are less certain when moving from 1 watt to 0.25 watt. There may be opportunities, but they will probably be limited to certain categories of appliances. For example, a rebate program to encourage use of high efficiency power supplies may still pay.

11 - CONCLUSION

If successful, the 1-watt plan may become a model for future international coordination on energy efficiency programs. Next candidates could be for instance, lighting or automobile. Also, the ultimate phase for the proposed 1-Watt scheme is to become progressively, but fully, part of existing norms covering electrical equipment. This means that in the future and by default, any new appliance being brought on any market should not consume more than “1 Watt” when being OFF or on standby. The challenge may appear as ambitious to some parties, but the benefits can be as important as savings 1% of today’ s world CO_2 emissions.

12 - REFERENCES

Meier Alan. 1998 "*1 Watt Plan*" Lawrence Berkeley National Laboratory - Leaking Electricity Web Site http://EETD.lbl.gov/Leaking/1-WATT.taf

Rath Ursula & Mordziol Christoph 1997. "*Klimaschutz durch Minderung von Leerlaufverlusten bei Elektrogeräten. – Sachstand/Projektionen/CO2-Minderungspotentiale*". Texte 45/97. Umwelt BundesAmt. Germany.

European Commission 1999 "*Communication to the Council and the European Parliament on Policy Instrument to Reduce Stand-by losses of Consumer Electronic Equipment*" 19.02.99.

Europe Energy 1999 "*Energy Savings: Commission proposed strategy to reduce Energy Loss in Stand-by mode*" 26.03.99.

International Energy Agency 1999 "*Workshop on International Action to Reduce Standby Power Waste of Electrical Equipment*" Proceedings on www.iea.org/standby/. 18 & 19 .01.99

Siderius Hans-Paul, 1999 "*Elements regarding the test procedures for reducing standby power waste*", presented at the IEA Workshop on International Action to Reduce Standby Power Waste of Electrical Equipment. www.iea.org/standby/siderius/index.htm. 18 & 19 .01.99