The European Strategy for Reducing Stand-By Losses in Consumer Electronics: Status and Results

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ABSTRACT

The European Commission has implemented a comprehensive strategy for the reduction of stand-by losses of consumer electronic. It is estimated that if adequate policies and programmes are implemented at European level, savings of 39TWh (and CO_2 emission reduction of 21 M tonnes) per year can be achieved by 2012.

The strategy was presented in the Commission Policy Paper on Stand-by losses. During the discussion in the European Council great appreciation for the Commission Paper was expressed by energy ministers together with strong support for the proposed actions. The paper succeeded in raising awareness among EU ministers for the urgent need to reduce stand-by losses.

Among the policy instruments used for market transformation (minimum efficiency requirements through legislation, labelling and consumer information, negotiated agreements, technology procurements), the Commission believes that voluntary agreements are the most effective instruments to reduce stand-by losses. However a series of requirements, including well defined and ambitious efficiency targets, have to be met. Three agreements (TV's, VCRs and audio equipment) are already concluded and operational; agreements for external power supplies and set top boxes will be concluded by the end of the year. Moreover strengthening consumer information, and in particular the use of energy labelling is also recommended. This is the approach chosen for office equipment, for which the EU will soon launch the Energy Star Programme.

The paper describes the results so far achieved, and in particular the barriers and the technical details for the agreements on set top boxes and power supplies. This because these types of equipment are particularly difficult to address with conventional policy instruments.

Introduction

Energy efficiency is one of the most important policy areas in attaining the European Union (EU) objective of reducing CO_2 emissions. In particular, there is a need to reinforce the action to promote the efficient use of electricity, which is responsible for about 30 % of total CO_2 emissions. In recent years it has been brought to the attention of policy makers that stand-by losses of consumer electronic equipment are responsible for a considerable amount of electricity, that this is rapidly increasing, and that this electricity represents a waste of resources.

Consumer electronic equipment and other domestic and commercial appliances consume a considerable amount of energy when they are in stand-by.[1] Energy consumption of consumer electronic equipment has steadily increased over recent years, due to the increased penetration rate of existing devices (e.g. Televisions (TVs) and Video Cassette Recorders (VCRs), etc.), the introduction of new entertainment equipment (e.g. Integrated Receiver Decoders (Set-top boxes), Digital Video Disk (DVD) players, etc.), and, last but not least, the use of more battery chargers for battery powered equipment (e.g. portable telephones, portable drills, portable vacuum cleaners, etc.). Recent studies (Molinder 1997) and in situ measurement campaigns (Sidler 2000) have indicated that in the average EU household, between 5 and 10% of its total yearly electricity consumption is due to the stand-by mode of consumer electronic equipment and other devices, and this is due to increase in the next decade.

The total EU domestic power consumption of consumer electronic equipment in stand-by mode has been estimated to be around 36 TWh and is predicted to increase to 62 TWh by year 2010 (Molinder 1997). (The energy consumption quoted does not include stand-by losses of conventional white goods, e.g. electric storage water heaters and office equipment.) A comprehensive list of domestic consumer electronic equipment is given in Table1. This represents wasted energy, because the equipment consumes electricity while not performing its main function. Recent technological development has demonstrated that is feasible and cost-effective to substantially reduce this wasted electricity without reducing the functionality of consumer electronic equipment. Technical solutions exist to reduce stand-by consumption to less than 1 Watt in power supplies, TVs, and other equipment. Equipment with very low power consumption has been introduced into the market at no or very little extra costs. However market, financial, and information barriers prevent the widespread adoption of these technologies. An example of an information barrier is the lack of knowledge by consumers and retailers on the stand-by consumption of TVs and VCRs. Therefore it is important that energy efficiency policies and programmes are implemented without delay, in order to overcome these barriers and stop the associated waste of electricity. If the EU and Member States adopt adequate policies and programmes, it is reasonable to assume that 39 TWh (or about 60% of the forecasted consumption in a "business as usual scenario") and 21 MT CO_2 per year can be saved in the EU by year 2010 (European Commission 1999). This would be facilitated if other international actors and institutions would also adopt similar policies and programmes.

Background

Energy consumption of consumer electronic equipment is characterised by several modes of operation. In a simplified analysis three main modes of operation can be identified: the on-mode when the device is performing its main function (the TV is displaying the picture, the battery charger is charging the battery, etc.), the stand-by mode when the equipment is powered but is not performing its main action (the TV is waiting for a remote control signal to be turned on) and the off-mode when no task is performed (and in principle the equipment should be disconnected from the AC grid) . Although it is logical to expect that in the off-mode the electricity consumption is zero, several types of consumer electronic

[1] From now on, the off-mode consumption will be considered to be included in the definition of stand-by consumption.

equipment do not have an on-off switch; the equipment is always connected to the grid and a few components are always powered, therefore the equipment is consuming a few Watts or less even when the equipment seems to be (or should be) off.

The table below gives an overview of the present range in stand-by consumption (and/or off mode consumption) of domestic equipment with stand-by losses.

Table 1. Typical Standby or Off-Mode Power for Domestic Equipment in the EU

Equipment	**Off or Standby Power**
TV Set	1 to 13 W
VCR	2 to 19 w
Compact Audio	0 to 18 W
Set-top boxes	8 to 20 W
Clock Radio	1 to 3 W
Microwave Oven	2 to 6 W
Battery Charger	2 to 4 W
Answering Machine	2 to 4 W
Cordless and Cellular Phones	0.5 to 7 W
Hi-fi System	0 to 12 W
Audio Portable	0 to 5 W
Plug-in Power Supply	0.5 to 3 W

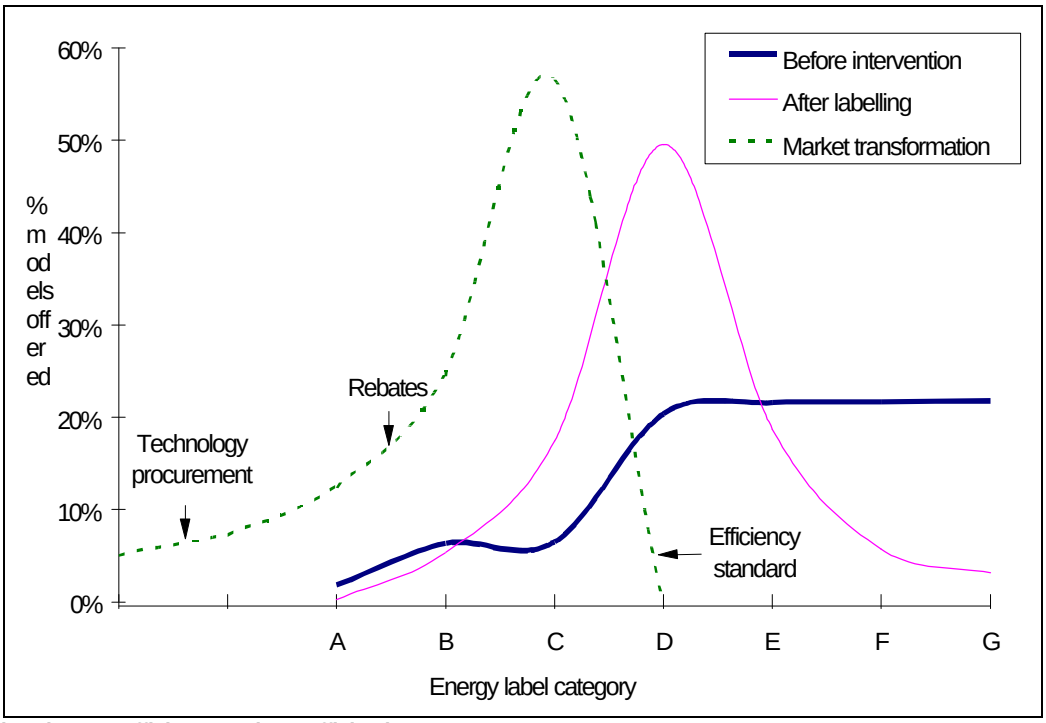
In the coming years there will be new types of consumer electronic equipment entering the market, equipment merging and/or becoming multifunctional (for example TVs and Set-top boxes are already being integrated). In fact an extremely fast technology change and very rapid market penetration, once successfully launched on the market (for example digital TV), characterise consumer electronic equipment. Consumer electronic equipment tends to be standardised at least at the EU level, and sometimes even at a world-wide level. Manufacturers tend to be more and more global players. The above considerations have major consequences for energy efficiency policies and programmes. First of all, energy efficiency policies and programmes must be able to adapt to quick technological changes and they have to be able to cover newly introduced equipment types and/or technologies (changes both in hardware and software). Secondly, energy efficiency policies and programmes tend to be more effective if they are established at the EU level, and perhaps even co-ordinated with other major commercial partners (e.g. USA, Japan, and other Asian economies).

Another important consideration in designing policies is that the annual energy consumption in stand-by mode of any individual consumer electronic equipment might not be a sufficient amount to draw the attention of any “conscious” buyer to energy efficiency (for example, a VCR has a typical stand-by consumption of about 8 W; this results in about 60 KWh per year, which in turn costs about 6 Euros at present electricity prices). There are many features and quality issues that might have a higher priority in the final purchase decision. Last but not least, some types of equipment are not selected by the final user; rather they come in a package with the main equipment (for example, battery chargers for portable

telephones) or the equipment is needed for receiving a specific service. In this case the technical specifications are set by the service provider (for example, Set-top boxes are specified by the service providers; Set-top boxes are often provided to users either on loan or at promotional prices).

Policies to Reduce Stand-By Consumption of Consumer Electronic Equipment

To enhance the average efficiency of domestic appliances present today on the market, a range of different policies and programmes is needed in order to exploit the full energy efficiency potential of the available technology. Market transformation in terms of energy performance is the goal of any energy efficiency action for appliances. The various instruments (minimum efficiency performance standards (MEPS), voluntary agreements, labelling, quality marks, incentives, tax rebates, procurement, etc.) are intended to interact and influence the market. The interaction between the various instruments is illustrated in the figure below.



("A" is most efficient; "G" least efficient)

Figure 1. Interaction of Policy Instruments to Achieve Market Transformation

Labelling actions (either through a mandatory energy label in the framework of European Commission Directive 92/75, or through a quality mark, e.g. the Energy Star), focus customers' attention on operating costs and other environmental aspects of the equipment, thus enlarging the market share of efficient equipment. To eliminate the "bad" equipment from the market, MEPS, which set the lowest acceptable performance level, are a well known and tried instrument. Recently negotiated agreements have been used in the EU as an alternative to MEPS introduced through legislation (Directives). Technology procurement (i.e., the process of

aggregating purchase power in order to specify new, highly efficient equipment) acts on the higher end of the market by accelerating and expanding the penetration of new and more efficient products into the marketplace. Incentives, provided by demand-side management (DSM) activities of utilities or by energy saving trusts, have been successfully used in the past to promote, for example, efficient lighting (e.g. compact fluorescent lamps), and white goods (e.g. refrigerators). Tax rebates (for example reducing the VAT on efficient products) could also be effective to achieve market transformation.

Moreover, common measurement methods must be adopted in order to introduce any of the above polices. To that end, the European Commission has issued a mandate to the European Standardisation Bodies, CEN/CENELEC, to define the operational modes of the main consumer electronic equipment (TVs, VCRs, Satellite Receivers, Decoders and hi-fi) and the methods to measure the energy consumption in each of the operational modes.

At the EU level, the approach followed to achieve market transformation for white goods consists of mandatory energy labelling, carried out in the framework of Directive 92/75 and the subsequent application Directives; and MEPS introduced either through Directives (e.g. for refrigerators and freezers) or through negotiated agreements (e.g. for washing machines). This approach has proved to be effective in achieving market transformation for white goods and in particular for refrigerators and washing machines. The efficiency of average washing machines present on the market has been improved by 20% in the period 1994 to 1999, while in the case of refrigerators it is expected that with the entry into force of the Directive in September 1999 the average efficiency improvement will be about 25% compared to 1992 models.

However, not all the policy instruments described above would be effective in promoting more efficient consumer electronic equipment. As already indicated, consumer awareness for stand-by consumption is very low and the stand-by consumption might account for a limited amount of the total life cycle cost. Several other purchase criteria have a higher priority in consumers' choices (product quality, features, brand, and price). Therefore in principle regulatory actions directed towards manufacturers, such as efficiency standards, will be more effective. To that end, establishing maximum power consumption in stand-by mode (and other modes) will certainly have a positive impact on the average consumption. Moreover, to avoid creating barriers to trade any such requirements must be adopted at the EU level. However, as experienced with the "Refrigerators and Freezers" Directive introducing efficiency requirements, the adoption of a Directive is a rather long process; the same would apply to eventual amendments to follow technological development. In the case of TVs and VCRs the conclusion of a negotiated agreement between public authorities (in this case the Commission) and manufacturers was the preferred solution. It is also clear that industry prefers this type of approach; in particular, industry is keen to avoid the introduction of mandatory minimum efficiency requirements. It is indeed the threat of mandatory minimum efficiency requirements which allows the conclusion of meaningful agreements.

As shown by one of us in a previous paper (Bertoldi 1998), negotiated agreements might offer advantages, in that they can be more flexible and quicker to implement than regulation. In addition, negotiated agreements are easier and quicker to update than legislation, allowing them to follow technological evolution and market changes. Moreover, manufacturers can use the extra flexibility to identify cost-effective solutions, which might lead to higher efficiency improvements than a simple cut-off line as in the case of regulation. In fact, in the EU directives on mandatory efficiency requirements can only be formulated as

minimum allowed values, not as "fleet averages." The TVs and VCRs agreement contains both average values to be met by individual manufacturers and a minimum allowed value.

Consumer electronics manufacturers have expressed their willingness to conclude negotiated agreements to achieve energy savings targets. According to manufacturers, negotiated agreements give them more freedom in reaching the target, either by selling more high efficiency products or by having flexibility to decide when to phase out low efficiency units and therefore maximise their profits while achieving overall energy efficiency improvements. In addition, manufacturers have highlighted the advantages of having a flexible and negotiated approach, which would favour cost-effective solutions and allow manufacturers to have a pro-active role in setting quantitative criteria, implementing the measures, and achieving the results. This is a clear advantage in a very competitive market like that for consumer electronic equipment. In addition, by co-operation on energy efficiency improvements, public authorities and industry can share responsibility in setting ambitious targets, which are at the same time realistic and achievable.

A Strategy to Reduce Stand-By Consumption of Consumer Electronic Equipment

Wider Use of Negotiated Agreements

As already indicated, the TVs and VCRs negotiated agreement proved that this instrument can be a serious alternative to MEPS. I In particular, the mandatory annual reports show that the agreement is on track to meet the target efficiency improvement. The agreement target was to have an average stand-by consumption for each manufacturer below 6 W both for TVs and VCRs. The agreement was concluded at the end of 1996, based on 1995 data when the average stand-by consumption of new equipment was about 7.5 W for both TVs and VCRs.

Given the need to have flexible policy instruments, negotiated agreements are the preferred policy option for other consumer electronic equipment (e.g. Set-top boxes, power supplies, hi-fi, etc.). To this end, the Commission has concluded the negotiation with EACEM (the European Association of Consumer Electronics Manufacturers) for a negotiated agreement for audio equipment (hi-fi, etc.). It is expected that manufacturers during the first part of 2000 will sign this agreement.

The targets for this agreement are as follows:

- First step: maximum allowed stand-by consumption of 5 W for all equipment marketed after 1/1/2001
- Second step: maximum allowed stand-by consumption of 3 W for all equipment marketed after 1/1/2004
- Third step: maximum allowed stand-by consumption of 1 W for all equipment marketed after 1/1/2007

For this type of equipment, it was agreed that a cut-off line was enough to achieve the target and there was no need to introduce fleet consumption targets. Discussions with manufacturers have also been started for Set-top boxes and power supplies. However, for these two types of consumer electronic equipment there are some additional difficulties.

Set-top boxes are produced by manufacturers according to service providers' specifications; the latter have no specific interest or benefit in requiring low stand-by

consumption. In fact some service providers require the equipment to be permanently on for remote access of the equipment at any time to download new software and perform other tasks. Moreover, Set-top boxes change rather quickly and new generations with additional features are introduced every year. Set-top boxes have a rather high stand-by consumption and although today they have still a limited market penetration, this is predicted to increase rapidly in the coming years as Set-top boxes are linked to digital TV and to the provision of new services (e.g. tele-shopping, internet, etc.). Therefore it is very important to take action on Set-top boxes before they penetrate further EU households. This would avoid the need to wait, as for other appliances, about ten years (i.e., the time needed to replace the installed stock) in order to feel the full effect of the policy action. A pan-European organisation, Digital Video Broadcasting (DVB), has been set up to define all the requirements and provisions of digital TV and Multimedia Home Platform, including Set-top boxes. DVB groups all the interested parties (hardware, software, equipment manufacturers, service providers, telecom companies, etc.). Recently the Commission has prepared a Code of Conduct to reduce stand-by consumption of Set-top boxes; this paper (European Commission 1, 2000) has already been presented to and discussed by all interested parties, including DVB.

The Commission has invited all concerned parties (hardware, software, equipment manufacturers, service providers, telecom companies, etc.) to sign the Code of Conduct and to commit themselves to implementing the necessary actions to achieve efficiency improvement. However, Set-top manufacturers are rather reluctant to sign the Code of Conduct, until the service providers also agree to sign it. This is because the service providers set the technical rules, which might require that the equipment is kept in the on-mode all the time and cannot have a stand-by mode. The proposed levels set maximum consumption in the active stand-by mode from 1/2003 through 12/2004:

- Set-top boxes (IRD) 9.0 W
- Digital TVs with built-in IRD 10.0 W

These levels represent a substantial improvement in the stand-by consumption and on-mode of current models (on average, about 16W for stand-by and 25W for on-mode). If, in the end, agreement cannot be reached on these values, negotiated between the Commission, national experts, and industry, then the Commission will come forward with a legislative proposal for minimum efficiency standards.

Power supplies are widely used, both inside all consumer electronic equipment and as stand-alone equipment to charge batteries or to provide DC voltage to some consumer electronic equipment. Several power supplies are present in each household. Poor design and the need to limit the power supply cost result in off-mode consumption of a few Watts. As already indicated, technical solutions exist to limit the off-mode consumption to less than 1 W. However, the implementation of policies is again not straightforward. Power supplies are produced in large quantity and supplied to Original Equipment Manufacturers (OEMs), for example, mobile telephone suppliers. Again, OEMs have no interest or incentives to reduce stand-by consumption. Recently the Commission has prepared a Code of Conduct to reduce stand-by consumption of power supplies (European Commission 2, 2000). This Code of Conduct has already been presented and discussed with all interested parties. In the case of power supplies, the technological change is moderate. Moreover, since large quantities of power supplies are produced in the Far East and imported into the EU, there is the need for further investigations about the feasibility of negotiated agreements as a viable policy tool for this equipment.

From preliminary discussions with interested parties it looks as if the proposed targets (see Table 2) can be achieved; however, they are not acceptable for all equipment that uses external power supplies. This is because there is an additional cost associated with more efficient power supplies which use switch mode technology. This cost can represent a price increase of 1% for some products, and up to 10% for other products. The only sector which has declared its willingness to sign the Code of Conduct are the producers of power supplies for battery chargers for mobile telephones, and the mobile telephone manufacturers themselves. This because these manufacturers are already using the switch mode technology and the price increase to comply with the target is rather limited (below 1%).

If a negotiated agreement would be possible for this type of power supply, then it could be extended to battery chargers for other types of equipment, mainly for information technology equipment and consumer electronic equipment (e.g. Walkman).

Table 2. Proposed Standby (No-Load) Targets for External for 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**
$\geq$ 0.3 W and < 15 W	1.0 W	0.75 W	0.30 W
$\geq$ 15 W and < 50 W	1.0 W	0.75 W	0.50 W
$\geq$ 50 W and < 75 W	1.0 W	0.75 W	0.75 W

EU Energy Efficiency Labelling for Consumer Electronic Equipment

Labelling is certainly a policy option to be seriously considered. However, there are a number of issues to be considered before setting up a labelling scheme for consumer electronic equipment. First of all, consumer electronic equipment does not have a big variation of efficiency to justify an "A to G" type classification, as with other appliances labelled under the EU scheme. In addition, it is desirable (and feasible) that in a reasonably short time all manufacturers would offer products only in the high efficiency range (e.g. less than 1 Watt in off or stand-by mode for all power supplies).

Given the above considerations, for consumer electronic equipment it would more useful to have a voluntary quality mark to indicate the best appliances on the market, rather than an "A to G" scale. The only case in which a "traditional A to G" could be useful is for TVs where there are two modes of consumption (i.e. on-mode and stand-by) and an annual energy consumption based on a duty cycle could be indicated on the label. For some end-use equipment, the introduction of a quality mark to identify the most efficient products on the market is a policy option to achieve market transformation (for example the US EPA Energy Star Programme for office equipment). The criteria underlying the quality mark can be changed to follow technological development. To this end, a voluntary labelling programme would present several advantages.

This could perhaps be complemented by a mandatory energy consumption declaration implemented in the framework of EC Directive 92/75, to oblige all manufacturers to supply some information on the stand-by (and off-mode) losses of the equipment that they produce.

As for other products, there are already a number of voluntary quality marks for efficient products appearing on the EU market. One good example of a voluntary quality mark in some Member States is the GEA quality mark (Group for Efficient Appliances is an initiative of 6 European national energy agencies to promote voluntary consumer information.

In addition, there are also eco-labels that cover energy efficiency, among other environmental attributes. In particular, the EU Eco-label scheme has been used for some white goods and in principle can be extended to consumer electronic equipment.

To avoid sending conflicting messages to industry and creating potential barriers to trade, it is advisable to try to harmonise these initiatives, at least at the EU level. One possible solution would be to build on the success of the US Energy Star programme, which in the USA covers consumer electronic equipment among other products. Pending the successful conclusion of the negotiation between the EU and the USA for an agreement on co-ordination of labelling programmes for office equipment, it is worth exploring the advantages/disadvantages of extending the agreement to also cover consumer electronic equipment. The main issues to explore before an agreement can be established by the two parties (the USA and the European Community) on the use of the Energy Star label are: (1) the similarity of the equipment (at first look, the Energy Star levels appear high for power supplies and low for Set-top boxes), and (2) the need for a quality mark/label to be physically placed on products (the Commission believes that there is little advantage in labelling external power supplies or power adapter, which are never chosen by the final user, but are supplied with the equipment, e.g., a power tool).

Other Possible Policy Actions

Technology procurement has been used with great success for promoting highly efficient white goods and electronic ballasts (Westling 1999). Some investigations have been made to use technology procurement for consumer electronic equipment, such as TVs. This investigation did not lead to any action, given the difficulty to find (at least in Europe) suitable large-volume buyers. Perhaps this would work better for other types of equipment such as power supplies procured by OEMs to be sold with their equipment. It is worth pursuing this investigation and pilot testing this policy instrument, which can be complementary to the negotiated agreement. Other instruments, such as Demand-Side Management activities and incentives, tax rebates, etc., are also important to achieve market transformation and therefore worth pursuing. Finally, it is worth exploring how best to raise consumer awareness of the issue of stand-by losses and to encourage them to opt for energy-efficient options. Specific steps could include information campaigns and the involvement of consumer organisations in the actions proposed to achieve efficiency improvement.

Conclusions

It is important that appropriate policies are implemented to reduce the fast-rising energy consumption of consumer electronic equipment in stand-by and off-mode. Among the policy options presented above, the Commission is of the opinion that negotiated agreements with the manufacturers of consumer electronic equipment are a promising instrument that needs to be explored further with a view to covering more types of equipment. The option of regulation should not be excluded if voluntary agreements for some products do not look promising, and in any case the possibility of introducing mandatory standards is what makes

industry conclude agreements. The introduction of a labelling initiative for energy-efficient consumer electronic equipment might also help reduce the energy consumption of such equipment; in particular, it is worth exploring the possibility to extend the agreement between the US and the EU on use of the Energy Star Programme from office equipment to consumer electronics, as well.

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