Standby: The Next Generation

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Abstract
Measurements reveal that about 4% to 11% of residential electricity consumption is due to standby. Organised efforts to measure and reduce standby power consumption have been under way for more than a decade. However, the nature of standby and the policies to address standby power consumption need to change. With regard to policies, it has been the assumption for many years that a voluntary approach is faster, more flexible and less costly than a regulatory approach. However, experiences with voluntary agreements have not always lived up to expectations and revealed drawbacks with voluntary agreements which aim to reduce standby power. Regarding the nature of standby, fewer products now have a single simple standby mode, (e.g. the remote control of a TV) as the advent of advanced electronics and complex control systems now means that there are often several more complex modes where the functionality can change in real time.

This paper describes the next generation of approaches to deal with standby power: on one hand the horizontal approach, which targets the simple standby mode for as many products as possible. On the other hand the power management approach tries to deal with complex standby situations to ensure that the product moves into the lowest power consumption state possible for the required task.

Both approaches will be illustrated with examples, from the EU ecodesign framework directive, which is being considered for use as a regulatory framework for a horizontal measure on standby, and from the EU Code of Conduct for Digital TV Services Systems which is a voluntary measure for a more complex product.

Introduction

It is well known that standby power consumption in European homes is about 60 W per home [1], which corresponds to about 10% of residential electricity use. Although a qualifying caveat should be noted in that such estimates tend to be based on the measured standby power requirement of household appliances and generalized usage pattern surveys. Large scale, pan European surveys measuring the actual duty cycle of each household appliance are rare. Estimates of household standby power consumption tend to assume that the appliances are selected to standby or off by the user when the main function is finished. Ad hoc surveys on specific devices such as set top boxes, DVD players, washing machines, dishwashers etc. show that this assumption may be very misleading in the context of estimates of energy wasted when appliances are not performing their main function.

In this paper we will present and discuss three issues that are important for keeping a grip on standby consumption;

- The first issue is the nature of standby. The nature of standby has evolved from one simple standby mode, e.g. the remote control of a television, to the very complex standby modes of e.g. personal computers and set-top boxes. In more complex products the focus needs to be on reducing duty cycle power consumption through power management mechanisms that automatically control device power to the minimum needed to sustain the functions required at a given time. This discussion also puts various definitions of standby, e.g. by IEC62301, in perspective.
- The second is the issue of the approaches needed to address standby. It will be argued that for the simple standby mode a horizontal approach targeting as many products as possible is appropriate, whereas the power management approach should mainly deal with complex standby situations, but may also have an essential basic application in ensuring that simple standby is automatically achieved wherever possible.
- The third issue builds on the foregoing items and discusses which policy approach is appropriate: mandatory or voluntary. Both policies will be illustrated with examples. Finally conclusions and recommendations are presented.

The evolving nature of standby; or why standby consumption will increase

In order to illustrate the evolving nature of standby the following simple typology of products is used [2]: the “on/off” product, the “standby” product and the “networked” product.

The “on/off” product

The “on/off” product is the most simple case: either the product is off (performing no function except for being there and heating the room if energy is dissipated) or the product is on (performing one of the main functions). However, even this simple case immediately raises one of the pitfalls for policy makers: the description of the states “off” and “on” in general does not indicate anything about whether a specific product has an off mode (e.g. hardwired smoke detectors do not have an off mode), nor the time that a product spends in the on mode (e.g. electrical (alarm) clocks in the on-mode all the time)[1].

Despite the trends identified in the next sections, a significant number of household products can be classified as on/off products: vacuum cleaners, lighting, cold appliances, storage water heaters. Furthermore, products with a standby mode and even networked products can have an off mode. From an energy saving perspective these products are interesting for policy makers if they spend time in the off mode and if the off mode has a power consumption > 0 Watt. An example are halogen lamps with a transformer where the on/off switch is on the secondary side. On the other hand, cold appliances and storage water heaters are always on[2] and do not spend time in the off mode.

The “standby” product

The “standby” product denotes the classical standby situation, where the product is performing some function(s) not being one of the main functions of the product, e.g. enabling (remote) control, waiting for a user command, internal timer/clock, clock display or other indicator. Also in this situation the “functionality” perspective offers guidance to distinguish whether a product is in standby or in on mode. Compare e.g. an alarm system with a garage door opener. At a first glance it would seem that both products are most of the time in standby because they are waiting for “input”, e.g. from a motion detector, respective a user command to open the garage door. However, in case of the alarm system providing security is the main function and therefore the system is always on, whereas in case of the garage door opener the main function is opening the door and therefore the product is mostly in standby, waiting for a user command[3].

Sometimes the “standby” products may also have an off switch, i.e. meaning that they can be switched into the off mode (performing no function). The classical example is the (European) CRT television which has both a remote control and an on/off switch. However there are few products with these three simple modes these days.

This type of standby could be denoted as “simple” standby, because the procedure to enter (one of) the standby mode(s) or to switch the product from (one of) the standby mode(s) to the on mode is simple, i.e. can be determined internally and needs only recognize one type of (user) input.

This type of standby has evolved from a few products in the 80s to many products nowadays. Not only consumer electronics, office equipment and microwave ovens, but also washing machines, driers, dishwashers, rice cookers, garage door openers, etc.

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[1] Not to mention the philosophical debate whether a product should do something “useful” in the on-mode; and that if a product is not used by anybody it is not on and therefore it’s power consumption should be (near) zero.

[2] Since we have defined “on” in a functional way, i.e. providing one of the main services that the product is acquired for, cold appliances and storage water heaters are always on, even though their power consumption in on mode will vary greatly because of components (compressor, heating element) are turned off and on as a result of temperature controls.

[3] From this example it does not follow that efficiency improvement in alarm systems are not useful.

The "networked" product

The "networked" product could be called an extension[4] of the standby product, because:

a) the product not only can be controlled by the user, but also by other external sources, e.g. a service provider of other products in the network, and

b) the product can communicate with external sources, e.g. a central heating boiler calling a repair service.

Because this type of product is – by definition – connected to a network, the network protocol is an important technical issue.

The consequences of the network connection is that the product becomes more complex in several ways. Firstly, networked products can be controlled from various sources, not only the user but also other appliances and network providers. Secondly, the software can be upgraded through the network which means that the functionality of the product can change during product life. New hardware architectures take full advantage of these features. Thirdly, data needed for the functioning of the product can be updated through the network or is not stored at the product at all but in a network attached storage.

This complexity also strengthens the dependency upon the network connection, which in turn focuses the attention of appliance and network manufacturers and service providers to provide faster and more reliable network connections. In the case of PCs this has lead to the concept of "server based computing" where the PC can't function (i.e. provide functions like word processing, spreadsheets and e-mail) without a network connection. This concept was established for a long time, but the practical application depended on the availability of network connections with sufficient speed, e.g. DSL.

While these products are still limited in number in the typical household at this stage, this is certainly a trend that is likely to be ubiquitous in the future and hence it is critical to set up measures to ensure that energy management becomes an integral part of these products in the future.

Overview of products and consequences

The table below provides some examples of products in the 3 categories and some trends.

Overview of products (examples and trends)

<table>
<tr><th>on/off</th><th>standby</th><th>networked</th></tr>
<tr><td>external power supply</td><td></td><td rowspan="2"></td></tr>
<tr><td>lighting</td><td>lighting with remote control</td></tr>
<tr><td>white goods</td><td>white goods with remote control</td><td>cold appliances with display and network connection</td></tr>
<tr><td>vacuum cleaners</td><td>robotized vacuum cleaners</td><td></td></tr>
<tr><td rowspan="10"></td><td>televisions</td><td>televisions with integrated set-top boxes (decoders)</td></tr>
<tr><td>VCR, DVD recorders</td><td>DVD recorders with internet connection</td></tr>
<tr><td>digital television adapters</td><td>set-top boxes</td></tr>
<tr><td colspan="2">personal computers</td></tr>
<tr><td>stereo equipment</td><td>streaming clients (internet)</td></tr>
<tr><td>printers</td><td rowspan="5"></td></tr>
<tr><td>monitors</td></tr>
<tr><td>stoves with clock</td></tr>
<tr><td>cordless phones</td></tr>
<tr><td>garage door openers</td></tr>
</table>

[4] And as such it *can* also have an off mode and/or simple standby mode(s).

From the table above it can be concluded that the classical standby product is going to disappear from the market, or at least will become of less importance, because these products will be replaced by networked products. Networked products are the next generation products. However, traditional policy instruments fail with these type of products. Firstly because a single standby mode cannot be defined and if it could be defined, it is doubtful whether the product will spend any time in it. Finally, these products might not have a standby mode at all and they may be in on mode all the time. More probably there will be a sliding scale from off to fully-functional on where it is a question of definition when the appliance is going from a standby to on mode. I.e. how much "on" should the appliance be before it is defined as "on". The target is to have the minimum energy consumption possible in all the modes as a result of good power management.

Finally the discussion in this section provides clearance on the ongoing discussion on the definition of standby. First it is clear from the foregoing that no single definition of standby mode exists that captures all the modes discussed in the typology above. Second, the definition of standby in IEC62301[5] is ambiguous. For some products it will be the off mode, whereas for other products it will be the stanby mode (with the lowest power consumption). Furthermore, this definion captures – deliberately – only one mode, whereas we have seen that several modes can be important. Third, from an energy efficiency policy perspective it is important that all modes (off, standby and on) are covered and that policy is not restricted by definitions.

Approaches to deal with standby

From the analysis in the foregoing section we conclude that approaches to deal with standby need to match the type of product. In this section we present approaches to deal with the different product types. The emphasis in this section will be on technical solutions regarding the product. It is our opinion that behavioral solutions to the standby problem, e.g. asking consumers to switch off the appliance, are at least less effective than technical solutions. The reasons for the product types are the following.

For those on/off products where switching off is an option, the off mode power consumption can not be influenced by the user unless the user unplugs the external power source of the product or an (extra) hard switch is added which performs the same function. Given the fact that this applies to many dozens of products in the home (e.g. all products with external power supplies), it is in our opinion too optimistic to expect users to users to unplug all devices when not in use. Moreover, technical solutions are possible that reduce off mode consumption to 0.1 W or lower and therefore the behaviour of the user is irrelevant from an energy efficiency point of view.

For classical standby products which can be switched off by the user, it has already been remarked that this action negates the standby function. Although some consumers may not mind this, it is not an acceptable option in terms of functionality in some cases. Furthermore, if such products are (gradually) disappearing from the market, a behavioral solution will become less important.

Because the networked product is dependant on the network connection and given that the network connection is lost when switching off the product, a behavioral approach for networked products is not a viable solution. Furthermore, the consumer does not always know whether a product can be switched off or to standby, because other products might need the services of the product.

Dealing with the off mode

For products that have an off mode, the off mode power consumption should be minimized and close to 0 W. The rationale for this goal is simple: avoid wasting energy. If the product is in the off mode and – by definition – is performing no function, it should also use no energy. Note that this does not indicate anything about how long the product is in the off mode, nor that the product should have an off mode.

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[5] Clause 3.1: Standby mode: lowest power consumption mode which cannot be switched off (influenced) by the user and that may persist for an indefinite time when an appliance is connected to the main electricity supply and used in accordance with the manufacturer's instructions.

From a technical point of view, the reason for power consumption in the off mode is the on/off switch of the product being on the secondary side of the power supply, or the product having an external power supply that can be disconnected from the product while the power supply is still connected to the mains (e.g. mobile phones). In both cases the off mode consumption consists of losses in the power supply. Technical solutions exist to reduce the off mode power consumption to 0.1 W or less.

Minimal standby power consumption

First it should be noted that "standby" mode generally offers some level of functionality to the user. So equipping a product with an on/off switch is not considered to be a solution towards minimal standby power consumption because in the off mode the standby functionality is lost. This does not mean that “standby” products could not have an on/off switch, but with a standby power consumption of 1 W or less, the rationale for having an on/off switch is less clear.

Solutions for standby mode should minimize standby power consumption. In general the following options exist: decrease the number of components that are powered, increase the efficiency of the components that are needed for the standby function(s), and add special “standby” components, e.g. a small efficient standby power supply for sensors or clock functions.

For simple standby functionality that applies to the typical “standby” product, e.g. a clock display or waiting for a signal from the remote control, solutions that require 1 W or less are available (technical solutions to less than 0.1W are available in many cases). However, this depends on the level of functionality required and whether there are other functions such as battery charging etc.

Power management for the networked product

For the networked product the goal is to optimize/minimize total energy consumption. In many cases the solution is to introduce one or several modes (with different levels of functionality) and power management. Like the standby product, equipping a networked product with an on/off switch is not considered to be a acceptable solution for the users, because in the off mode the standby functionality (including network connection) is lost. However, if the lowest level of standby power for networked products that is likely to persist for long periods is going to be higher than the 1 Watt level, an on/off switch may be a good option for those consumers that do not always need the functionality of the networked product and therefore want to switch off the product at their discretion (although in reality this may be rarely used in many installations).

Power management is the key feature to optimize total energy consumption of networked products. Power management can be defined as a function of a product that ensures – without user interference – that the product is always in the state with the lowest power consumption related to the required functionality[6]. Technically speaking this means that if the product is not or only partly used, unused parts are powered down as far as possible, and only those parts are powered that are needed to detect the need for an increased level of functionality for the product. This requires the following activities from the product:

- monitoring activity levels of parts of the equipment (devices)
- decision rules to enter a certain state: demands for a higher state, falling to a lower state where current level of functionality is not required
- execute state transitions and monitor the result

Power management is a concept that is broader than standby, because also in the on mode power management can be beneficial. Examples of power management are the cd-player that switches into standby after the disc is finished (and unless the user has activated a repeat function) or the digital television that switches from a low standby mode to a mode where it can update electronic programme guide data and switches back afterwards.

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[6] Although power management is discussed here with regard to networked products, it can be also useful to optimize energy consumption of other types of products.

Standby: the next generation policies are needed

In this section we will translate the approaches of the foregoing section into policies. In general, a variety of policies exist for increasing energy efficiency of appliances: financial instruments (subsidies, tax rebates), informational instruments (labelling, product information via internet) and "product" instruments (e.g. minimum efficiency standards). Regarding standby we will focus in this paper on product instruments, where – either voluntary or mandatory – products that do not meet certain standards or rules are not brought on the market. The reason for this restriction is the following. In general standby consumption of a single product is relatively low compared to the total energy consumption of a television or washing machine. The impact of standby originates from the total *volume* of products that have standby consumption. An example: 45 million DECT cordless phone kits with on average 2 handsets per kit in Europe have an associated 90 million linear external power supplies. One power supply uses more than 1.5W in standby, this could viably be less than 0.3W, so cumulatively more than 1TWh of energy is wasted per annum. This means that informational instruments (directed at the buyers/consumers) will have only limited impact, while bearing the full cost of them. A typical home may have 50 to 100 products which may potentially have some power consumption in other than on mode - in most cases the amounts of power are small and the transaction costs of obtaining comparative information on differences in standby and taking this into account during the product purchase is not viable. Also financial instruments targeted at buyers would be restricted to relatively small amounts (because relative to the savings) and therefore have little effect. An alternative could be financial instruments targeted at manufacturers, which may be a problem when manufacture also or mainly occurs outside the territory which is financing the measure. Therefore in this section we will consider only (voluntary and mandatory) product instruments.

Voluntary versus mandatory instruments

To date in Europe a voluntary approach has been implemented to reduce off mode and standby mode power consumption of selected products, starting with the official communication from the Commission in 1999 [4]. It was assumed that a voluntary approach was faster, more flexible and less costly. In previous years several voluntary agreements have been negotiated with industry, most notably on consumer electronics and external power supplies[7]. Furthermore, the ecodesign directive which was passed in 2005 [3] now explicitly opens the future possibility for voluntary initiatives as an option to forestall (mandatory) implementing measures.

Experiences so far with self-regulation regarding energy efficiency of products in Europe reveal that the advantages mentioned above need to be put into perspective. The following table describes a number of self-regulation initiatives.

Overview of self-regulation in Europe

Self-regulation	Products covered	Level 2008 (lowest standby mode)	Representativeness (market coverage)
Code of conduct external power supplies	Single (output) voltage external ac-dc and ac-ac power supplies in the range between 0.3 W and 150 W.	0.3 W – 0.5 W	< 50 % (coverage is good for mobile telephones and laptop computers)
Code of conduct Digital TV Service Systems	Set-top boxes, adapter boxes, IDTV	2 W – 6 W	?
Code of conduct broadband equipment (planned)	Broadband equipment	not yet decided	n.a.
Industry Self-Commitment to improve the energy performance of household consumer electronic products sold	CRT-TVs non CRT-TVs DVD-players	1 W 1 W 1 W	70 % 50 % 50 %

[7] Energy Star programme for office equipment.

Self-regulation	Products covered	Level 2008 (lowest standby mode)	Representativeness (market coverage)
in the EU (EICTA)			
Energy Star (* planned in new specifications)	System units (PCs)* monitors printers* copiers*	2 W 1 W 1 W 1 W	currently >80 % new specifications: > 60 %
CECED Unilateral Industry Commitments	cold appliances washing machines dishwashers	covered by duty cycle not covered not covered	>80 % n.a. n.a.

From this table we draw the following conclusions.

- Not all products groups are covered by self-regulation.
- For those products where a voluntary agreement has been developed, market coverage is generally much less then 100 %. A reason for the incomplete market coverage is that for some products (most) manufacturers are outside the EU; these manufacturers might be not aware of the voluntary agreements or might not care. If the share of manufacturers outside the agreement is (too) large, then other manufacturers are less or not willing to sign up because it provides them a small disadvantage, which is relevant for products where every € cent counts. Thus, voluntary measures do not create a “level playing field”.
- Finally, voluntary initiatives are re-active, i.e. negotiations only start when the new product variant has been on the market for some time.

Regarding the on/off product and the standby type of product mandatory measures are preferable. Learning from the experience with current voluntary agreements, a pro-active and horizontal mandatory approach should be followed, meaning that a measure should include as many product groups as possible. Since standby is a basic feature and independent of the functionality of the product in other modes, mandatory measures can be pro-active. This means that the measures should also apply to product variations that at the time of the measure coming into force were not (yet) on the market. TVs provide a good example: a mandatory standby level for CRT TVs can also be used for LCD and Plasma TVs. A pro-active approach provides a clear guideline for product development at manufacturers, because whatever product they develop it should comply with the standard.

However such an approach can not yet be used for networked products. The two main reasons are that no general applicable standby modes can be defined for these type of products, or the (simple) standby mode that could be defined is not relevant[8]. Secondly, the concept of power management as such is still too general to be put into law. In the next sections the mandatory approach is elaborated upon by the example of a horizontal implementing measure for standby in the framework of the ecodesign directive [3], whereas the voluntary approach for networked products is illustrated by the EU Code of Conduct for Digital TV Service Systems [5].

Simple standby and off: a horizontal implementing measure

Standby is one of the priority items regarding energy efficiency and explicitly mentioned in the ecodesign directive, to be covered by an implementing measure. However, an implementing measure on standby differs in a number of aspects from an implementing measure on a specific product. In this section first several specific aspects regarding standby related to the ecodesign directive will be discussed. Then will follow considerations in preparing a draft implementing measure and criteria for an implementing measure.

[8] However, because of the horizontal approach mandatory measures will also cover networked products. So in case (some of) these products have a simple standby mode they should comply with these measures.

Specific aspects regarding standby

Standby consumption is a specific ecodesign requirement. Standby consumption is not an Energy using Product (EuP) itself, but a characteristic of an EuP. In relation to an implementing measure for standby, two questions have to be answered:

a) Is a horizontal implementing measure, i.e. an implementing measure covering one (or more) requirement(s) for – in principle – all EuPs, possible within the current framework directive?
b) Once a horizontal implementing measure is adopted, are other (horizontal) implementing measures allowed for the EuPs for which the horizontal measure is adopted?

re a): According to Annex VII, article 1, the implementing measure can specify more than one type of EuP. Article 2 of the Annex VII leaves the choice to specify one or more specific ecodesign requirements. However, the criteria for EuP, the considerations whether to prepare a draft implementing measure, the rules for preparing a draft implementing measure and criteria for implementing measures require analysis per EuP.

re b): The framework directive does not forbid several implementing measures for the same EuP, so we assume that other implementing measures are allowed.

The purpose of having a horizontal measure on standby is to reduce the energy input in the standby mode. However, product definition plays an important in various criteria, e.g. the volume of sales and trade. Annex VII, article 1, requires the exact definition of the types of EuPs covered. How exactly should this be defined? For a horizontal measure on standby it seems reasonable that the definition only discriminates between product types where different standby behaviour is defined.

So, in principle the products covered are defined by the type of standby consumption they have (ie the functionality of the modes). A horizontal implementing measure on standby should cover both the following modes[9]:

- the "off" mode (the product is connected to the mains, no user function is fulfilled)
- the simple or lowest power "standby" mode (product is connected to the mains, is not in the off mode and not in a main functional mode)

Criteria Energy using Products; preparing a draft.

A horizontal measure on standby could cover in principle all electrical products in homes and offices that have standby consumption. Article 15(2) provides the criteria that have to be met for an EuP to be covered by an implementing measure:

a) volume of sales and trade of more than 200 000 units a year
b) significant environmental impact, considering the quantities placed on the market
c) significant potential for improvement without entailing excessive costs; subcriteria:
    - absence of other relevant EU legislation
    - failure of market forces to address the issue
    - a wide disparity in the environmental performance of EuP available on the market

In conclusion this means that implementing measures will be put in place for mass produced energy using products that have a significant environmental impact and a significant potential for improvement not yet targeted by other measures.

Both environmental issues and current relevant self-regulation lead to the conclusion that an implementing measure is needed. The environmental argument points to standby as one of the priorities to deal with. Analysing current self-regulation reveals that the estimated market coverage is on average roughly 50% and therefore is not complying with the criterion of representativeness as specified in Annex VIII of the Ecodesign directive. The wide disparity must be seen in the perspective of the low power levels of standby consumption: from 2 W to 1 W is a 50% improvement. The impact results from the large quantity of products on the market, not from the absolute value of the savings per product.

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[9] If applicable. As indicated before not all products have both an off mode and a standby mode. The definition of the "lowest power standby" is inspired by IEC63201 and provides a solution for products that have more than 1 standby mode.

Since the implementing measure on reduction of standby power consumption is a specific ecodesign requirement (and a horizontal program measure), a general life cycle analysis would be sufficient. The rationale for having a horizontal measure for standby power consumption results from the possible improvements in energy efficiency for this mode in general, and not on decisions regarding each product based on an life cycle analysis.

It might be sufficient here to state that standby consumption in general can be reduced while other environmental aspects are not affected – or even improved (e.g. less material use in case of switch mode power supplies).

Criteria for an implementing measure (Article 15(5))

Implementing measures shall meet all the following criteria:

a) there shall be no significant negative impact on the functionality of the product, from the perspective of the user;
b) health, safety and the environment shall not be adversely affected;
c) there shall be no significant negative impact on consumers in particular as regards the affordability and the life cycle cost of the product;
d) there shall be no significant negative impact on industry's competitiveness;
e) in principle, the setting of an ecodesign requirement shall not have the consequence of imposing proprietary technology on manufacturers;
f) no excessive administrative burden shall be imposed on manufacturers.

In general the environment and consumers benefit from lower power consumption and thus lower energy consumption and – in most cases – lower carbon dioxide emissions. Studies show that reduction of standby power in general can be achieved at no or little extra costs, e.g. a maximum of € 1 per product (consumer price). With a reduction of 0.5 W to 1 W in standby power consumption, these costs can be recovered 2 to 4 years (assuming an average electricity price of 0,10 €/kWh). In practice the costs for consumers will be (near) zero, since they will be "absorbed" in the redesign of the product.

The impact on competitiveness requires special attention. In the foregoing section a remark was made on impact on costs. Many – or maybe most – of the products or components (e.g. power supplies) that would be affected by a horizontal implementing measure on standby are produced outside the EU. In that case the factor of competitiveness is less of a problem for EU industry because only a small number of manufacturers may be involved. Because an implementing measure is mandatory for every product, it creates a level playing field; in fact minimum efficiency levels could foster innovation and provide competitive advantages for those manufacturers that find clever ways to meet the criteria with less costs.

Since for the EU a level playing field would be created, the question of competitiveness is related to the question whether other parts of the world have mandatory measures for standby. In several other parts of the world (Australia, Korea) mandatory measure are in place or planned. If other parts in the world do not have mandatory measures, either – depending on the costs – manufacturers will run specific lines for products that meet the EU implementing measure (and which may cost slightly more) or manufacturers will change all of their production. In the first situation Europe will benefit from the efficient products, where other parts of the world may get the balance of non-complying (cheaper) products. In the other case – when other parts in the world have mandatory measures – it could be the other way around: Europe will get the less efficient (cheaper) products. Therefore, where other parts of the world have mandatory measures, an EU implementing measure is an important protective measure.

Several techniques exist to achieve a one Watt standby solution, so no proprietary technology is imposed on manufacturers. For power supplies see e.g. the websites of several manufacturers of (components of) power supplies. In fact, in most cases technical solutions to reduce standby to a fraction of a Watt are possible.

The administrative burden for manufacturers depends on the way the conformity check is organized. Since the ecodesign requirements are integrated into the CE marking process, the administrative burden should be minimal.

Conclusion

The ecodesign directive can be used to make an implementing measure on standby (and off mode) mode consumption for various product groups of energy using products.

Networked products: EU Code of Conduct for Digital TV Service Systems

The Television Broadcasting sector of consumer electronics is currently undergoing radical changes. The rapid development of a major communication network to support digital television is complemented by continuous developments in the functionality of the reception hardware, giving the consumer:

- Major improvements in the quality of the audiovisual presentation of broadcast services.
- For the first time, full interactivity with the content and source of the signals.
- A combined entertainment and communication platform with access to the full Internet or to “walled garden” information services. So digital television finally closes the perceived gap between the “lean forward” solo-working tool of the PC and the “lean back” group entertainment device of the TV. This convergence will be the catalyst for significant lifestyle changes in all levels of society, not just the information rich.

The technology supporting these changes is developing at an unprecedented rate. One consequence of this is that the relatively slow and costly, manufacturing and marketing cycle of the mass-produced TV cannot viably accommodate the accompanying rapid changes in the technical specification of the hardware. An independent signal interface and data processing platform, the STB (Set Top Box) has been the preferred manufacturing and market distribution solution. This device readily interfaces with existing and developing TVs and display systems and allows the rapid modification of functionality specifications in high volume production. The STB is an good example of a networked product because it is connected to a network and not only the user but also the service provider need to control the box, e.g. for software updates and security reasons.

The downside of this solution is that the existing voluntary agreement and labelling mechanisms for energy efficient domestic electronic products are too slow to keep up with STB development and could potentially hamper that development. In 1997 a European Commission working group identified the digital service system STB as the domestic electronic device with the largest potential to increase the energy consumption requirements of European Households [6]. Research into proposed development showed that by 2010, the STB could push domestic electronic energy consumption in Europe above that of fridges and freezers (especially as these are decreasing over time as a result of energy labelling and efficiency standards programs). With 150 million of these boxes across the EU - equivalent to one per household – the annual electricity requirement for digital service systems could be around 60 TWh (close to the total electricity consumption of Denmark for all sectors). This electricity would also release 24 $MtCO_2$, which would have a significant impact on the EU’s ability to meet its overall Kyoto CO_2 reduction target.

To challenge and resolve this problem the European Commission set up a working group of the key stakeholders in digital service system development – manufacturers, silicon providers, service providers – and energy agency specialists to discuss and specify a (voluntary) Code of Conduct that, amongst others, contains power consumption targets for various types of STB.

This activity has become an excellent example of a product policy initiative that united stakeholders early enough to impact the design process *before* the product became ubiquitous. Furthermore the Code of Conduct has inspired other parts of the world to set efficiency standards for STB; to support international cooperation a “community of practice” has been set up by the Australian Greenhouse Office.

The Content of the Code of Conduct

The principal aim of the working group is to reduce the energy consumption of the STB through the setting of agreed, practicable power requirement targets in a defined development timescale. To that end, a voluntary agreement or Code of Conduct was devised which Europe's principal STB and TV manufacturers and a major Service Provider, B-Sky-B currently support[10].

The Signatories of this Code of Conduct would make all reasonable efforts to:

- Achieve the power consumption targets set out in bi-annualy reviewed tables for new stand-alone products and for digital TVs with built-in IRD placed on the market after agreed dates.
- Support and contribute to the development and acceptance through an ad-hoc Task Force of the Common Power Management Guidelines.
- Co-operate with the European Commission and Member State authorities in an annual review of the scope of the Code of Conduct and the power consumption targets for two years ahead.
- Facilitate and encourage consumers to adopt energy efficient practices in connection with the use of digital TV services.
- Co-operate with the European Commission and Member States in monitoring the effectiveness of this Code of Conduct.
- Ensure that procurement specifications for digital TV services, systems, equipment and components are compliant with this Code of Conduct.

In this context, the Code of Conduct identifies a key tool to the achievement of significant energy efficiency targets in digital service system platforms: the development of effective power management in the silicon for the principal functional blocks.

Service Provider Needs and STB Power Architecture; Power Management

Effective power management to maximise energy efficiency can only be achieved after consideration of the permitted operating modes. The user may only be aware of the states on and standby but the functionality in these states may vary greatly depending on the requirements of the service provider and the delivery medium - cable, satellite, terrestrial or DSL.

In the on state, digital set top boxes provide the basic function of decoding of television pictures and many have on-screen, interactive information services. Other services such as electronic shopping, e-mail delivery, Internet access, games and software download may also be available. As the digital TV market develops, service providers are keen to offer further premium services which place additional demands on the hardware and increase power consumption. These services could include TV recording, video on demand, telephony, home networking and automation with wireless interface to peripheral devices. Broadband platforms for new broadcast and communication networks based on wired and wireless LAN (Local Area Network) will add to this energy requirement load. To counteract the resulting increased energy demand and follow the Code of Conduct, close attention needs to be given to efficient power conversion, distribution and the management of power usage depending on the function required. More specific designers and stakeholders should:

- Choose the lowest power standby mode consistent with service provider requirements. Decide whether adequate power management of each circuit block can be achieved by control of the silicon/software itself or if switching of power rails is needed.

- Consider power consumption and in-built power management features when choosing silicon. Involve software designers from the outset so that energy efficient software architecture and power management are incorporated in the early design. Check if any third-party software, which may be used for the operating system or conditional access, supports power management.

- Ensure that power to peripheral ports and devices can be turned off when not required.

- Encourage the rapid standardisation of "intelligent" interconnectivity to ensure that any component in the home entertainment and communication network automatically adopts the lowest power requirement for the level of activity required.

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[10] For a full list of signatories see: http://energyefficiency.jrc.cec.eu.int/html/standby_initiative.htm

Results of the Code of Conduct; relation with ecodesign

The EU Code of Conduct is an important platform for promoting energy efficiency in digital TV services in Europe. The Code of Conduct has already reduced the energy consumption of STBs, even if these offer many more features and services. (see figure 1).

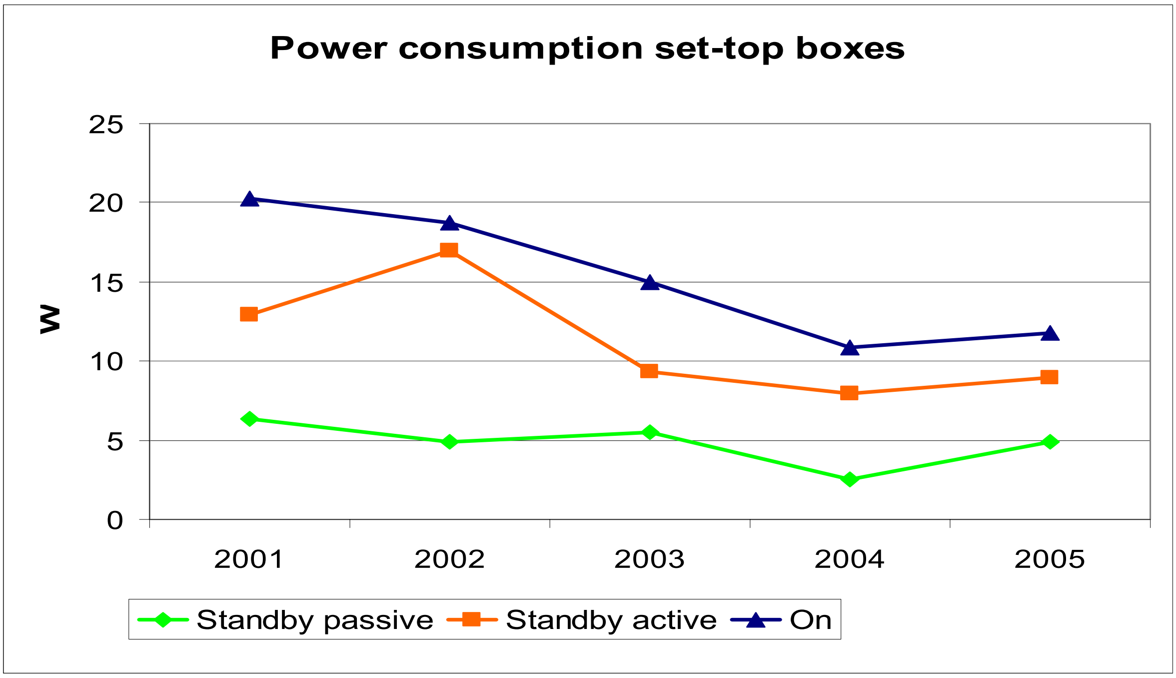

Figure 1 Power consumption STB (as reported by signatories of the Code of Conduct)

However, up to now the Code of Conduct fails to address manufacturers of simple, low cost STB, so called digital TV adapters for legacy analogue TVs and VCRs. In many cases there products do not have an off mode and the power consumption in the standby mode is almost equal to the power consumption in the on mode, due to poor power management. Since the standby mode in these adapters is of the simple type, a mandatory implementing measure within the framework of the ecodesign directive could be used to regulate the digital TV adapter. The same measure should also target the on mode consumption, since it can be expected that in many cases the adapter is left on, e.g. because it is also needed when recording programmed broadcasts with a VCR.

Conclusions and discussion

In this paper we have argued why standby consumption is no longer a simple issue for many products and will become even more complex in the (near) future where more products will evolve into networked products. In our opinion this will be the case for many of the current "classical" standby products, e.g. televisions, video recording appliances, but also for new standby products, e.g. fridges with a screen and internet connection, central heating boilers that call the service centre if maintenance is needed. On the other hand simple standby products, including products with off mode (mostly with external power supplies), are also expected to grow in number, although in practice these products might never be in the off mode.

The current generation of policies, which mostly deal with the simple type of standby (i.e. what we have called the on/off products and the standby products) on a voluntary basis, are not adequate to solve the standby problem for many current product types and perhaps the majority of future products. We have suggested that for the simple type of standby a mandatory horizontal approach should be followed, whereas for the complex standby (found in networked products) voluntary policies targeted at power management should be followed (see table below).

Policy options for reducing standby consumption

Policies	voluntary	X	**X** (power management)
	mandatory	**X** (horizontal)	
		simple (including off)	complex
		Type of standby	

X: current prevailing policy
X: suggested policies

A horizontal measure should cover both off mode (product connected to the mains, no function fulfilled) and the simple standby mode (product connected to the mains, not in off mode and no main function fulfilled). The maximum power level for off mode could be set at < 0.3 W and the maximum level for the standby mode at 1 W. The ecodesign directive could be used for such a mandatory horizontal measure. Such a measure would cover also the off mode and the simple standby mode of networked products, if applicable.

Effective power management in complex products or where a product function is shared with other products, will demand the unprecedented involvement of a wide cross section of world-wide manufacturing industry. The object will be to establish basic protocols for all energy using products to automatically communicate their function and required status in a network or chain of products. The translation of this work into standards that are dynamically reviewed with product development is, from experience to date, impracticable in a mandatory regime.

An aspect of power management that may perhaps be mandated in the support of the simple standby state would simply be the requirement that when a product recognizes that its primary function is complete and no other subsidiary functions are essential, it automatically goes to the lowest (simple standby) power state.

From the foregoing conclusions, the following items remain open. Firstly, a horizontal measure that covers off and standby mode does not automatically mean that products covered *should* have an off and/or standby mode. For many product types, several modes may be present (and which ones are covered?) and similar products have different configurations. Care is required to ensure that elimination of a particular mode for a product is not an option to avoid regulatory requirements.

Secondly, extrapolating from the discussion on the voluntary approach regarding the simple standby, it is likely that a voluntary approach regarding the complex standby will not cover all of the market. Thus, the question arises whether in due time power management should and can be made mandatory.

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