Provision of a horizontal policy approach to standby power

Final report

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Abstract

Products in standby modes consume approximately 1% to 2% of all electricity worldwide. Even modest increases to the efficiency of these modes will lead to meaningful energy savings, simply by improving the functioning of a function that is largely invisible to users. By addressing standby power modes horizontally (across all products) and internationally in a harmonised way, policy makers will find it easier and less costly to establish their policies and manufacturers will find it easier and less costly to design and produce efficient, compliant products. This report presents a framework for analysing policies that aim to address standby power in electrical end-use equipment. This framework is used to analyse several options for an internationally harmonised approach to standby power, leading to recommendations for an approach based on a hybrid combining a hard limit and functional allowances. The values for the limit and the allowances are maintained in a central repository that is made available to policy makers as a resource. This approach is argued to be most efficient in the long term, although somewhat burdensome to establish in the short term. As an interim measure, the establishment of the approach's hard limits is proposed. The report also includes a framework for understanding energy management from the perspective of standby power and modes. The report concludes with a list of further steps required to establish the proposed standby policy framework.

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Executive Summary

The standby-power issue

Unnecessary power consumption of electrical appliances and electronic end-use equipment in standby mode[1] is an issue of considerable importance that requires the attention of policy makers. While properly-designed standby modes are value-adding features that lead to overall energy savings, they need to be optimally designed and implemented in order to realise their full energy-saving potential. In developed economies such as Australia, the European Union, and California, standby power consumption is estimated to account for upwards of 10% of residential electricity use. Globally, and considering all end-uses of electricity (including commercial and industrial applications), standby power consumption is thought to represent 1% to 2% of electricity use.[2] At this scale, even modest increases in efficiency will lead to meaningful energy savings.

Well-designed policy interventions are an effective and appropriate means to address unnecessary standby power consumption. While the wasted energy is considerable when seen in the aggregate figures above, the continual power drain (and the associated cost) is largely invisible to end-users. As such, the average consumer does not base their purchasing decisions on the efficiency of the design. Given this behaviour, manufacturers of electrical appliances and electronic end-use equipment — often constrained by highly competitive markets with very narrow profit margins — tend to focus on minimising the purchase price of their products and components, often resulting in designs that could be made more efficient.

Value of an internationally harmonised, horizontal approach

As the issue of unnecessary standby power consumption is not specific to any one jurisdiction and the products available in markets worldwide are increasingly homogeneous, there is considerable value to be gained from a harmonised, international approach to tackle the issue. On the one hand, manufacturers would benefit from policies developed on consistent principles and definitions as this would facilitate the task of developing compliant and efficient products. On the other hand, policy makers would benefit from the development of a pool of common resources on which they could base their policies. Furthermore, the implementation of comparable policies worldwide will provide policy makers with a broader base against which they

[1] Here, "unnecessary power consumption…in standby mode" is understood to mean the difference in power consumption between non-optimised standby designs and current best practices for standby power design.

[2] *Standby Power and Low Energy Networks – issues and directions.* 2010. Report by Energy Efficient Strategies for APP IEA 4E Standby Annex.

could compare their own policies, facilitating their policy evaluations and giving a clearer picture on the efficacy of the approach in a particular jurisdiction.

A 'horizontal' policy approach is one that applies to a mode or function that is shared across many different product types. A horizontal policy that addresses power consumption in standby mode, however faces several challenges. The first is that the approach must be flexible enough to apply to a wide variety of products, ranging from toasters to desktop computers, including those which are not yet available on the market, as well as those which have not yet been invented. The second challenge appears when a horizontal approach is scaled up to the international level and it must remain applicable in a wide range of countries at different stages in their economic development and with different market structures. The approach that his recommended in this report addresses these challenges.

The recommended approach

All horizontal policies that aim to address standby power consumption must specify their scope (i.e. the products that they cover), their limit (i.e. the maximum power that may be consumed in the standby mode) and their evolution (i.e. whether the policy becomes stricter over time and, if so, by how much and at what date). There are several possible approaches that could address the standby power issue in an internationally harmonised way, though the most promising approach is one that sets a limit based on a combination of the 'hard limit'[3] and a 'functional allowance'[4] approaches. The efficiency and effectiveness of this approach is increased when the policy is applied as broadly as possible across all product types and when the key definitions and limit values defined and updated in a central, shared repository, which would be made available to interested policy makers as a common resource.

The combination of a hard limit and a functional allowance approach means that the compliance of most simple products would be judged based on the hard limit, greatly simplifying compliance checks and reducing the overall number of functional allowances that would need to be defined. For more complex products that are not able to meet the hard limit, allowances could be awarded on the basis of functions actually present in the device in order to determine an appropriate limit value.

The development of a repository to host the definitions and limit values would mean that individual jurisdictions would not need to invest resources in undertaking lengthy technical studies in order to assess the current state of the art for various products. In order to ensure that the repository responds to the needs of policy makers worldwide and across different levels of

[3] A hard limit approach is a method to define the limit value of a policy by specifying an explicit limit for standby power for all products within its scope. For example, such an approach would give the same limit to the standby power of a toaster, a television and a personal computer.

[4] A functional allowance approach is a method to define the limit value of a policy by calculating a total limt value based on allowances that are awarded for the presence of specific components and/or functions in a particular product. For example, both a television and a ceiling fan would receive an allowance of the same value for the fact that they can be reactivated via a remote control, and would then receive additional allowances based on the presence of other relevant functions.

economic development, multiple tiers would be defined for the hard limit and functional allowances. Different jurisdictions would then choose different tiers, and could select if and when they may wish to move from a less ambitious tier to a more ambitious tier.

Operation of a standby power repository

Such a repository could be hosted by an international organisation, with a panel of international technical experts undertaking the necessary studies to ensure that the definitions and limit values held in the repository represent the current state of the art. It would be reasonable to expect that the governments that reference the repository would support it either through direct financial contributions, the secondment of experts or the provision of other required resources. Compared to undertaking the required technical studies independently, the support of such a repository would result in considerable savings, with each additional, participating government leading to increased overall savings.

Ensuring effective energy management

In order for any policy that aims to address excessive standby power consumption to be maximally effective, the product must include effective energy management from the design phase forward. Energy management comprises both the optimisation of power levels in different power modes (e.g. off, standby, active,) as well as the intelligent and automated transitions between those modes. While the policy approach recommended in this report covers the regulation of power levels in standby mode, ensuring intelligent transitions between modes cannot be achieved simply through requiring a particular approach as the scenarios in which products are used can vary greatly across different product types. That said, the central repository could also contain best practices for energy management requirements for different types of products, based on the technical analyses of the contributing experts.

Next steps

While the approach recommended in this report would require the buy-in of several participating governments and their initial investment, the overall savings and the opportunity to help countries currently lacking any standby power regulations implement such measures warrant the required efforts. In particular, seven principle steps need to be undertaken in order to implement the approach, namely: defining the managerial details of the repository, defining the technical details of the repository, defining functions, defining allowances, specifying energy management for stand-alone products, specifying energy management for networked products, and preparing guidance for adherents.

While the time-consuming task of defining the functional allowances is underway, the hard limit could be defined and agreed upon. This limit could serve as an interim measure, allowing countries without such a limit to reference the repository before all its details are defined.

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Chapter 1: Introduction

Standby power is the electricity consumed by end-use electrical equipment when it is switched off or not performing its main function. Standby functions (e.g. remote control activation of a television set) are a common feature of electrical and electronic household and office equipment (consumer electronics, information and communication technology equipment, personal care products, etc.). Users are often not aware of the electricity consumption and costs of standby mode, which are usually small for individual products, therefore low power consumption in standby mode is not an important purchasing criterion. Though the actual power draw in standby mode may be small, as little as 0.1 watts or less for some products, it can also exceed 20 watts or more, for others. As products are in standby modes for a much longer amounts of time than active modes, and more and more new appliances have features that consume standby power, the result is a cumulative total which is significant.

Technical solutions that could reduce standby power to very low levels are frequently not applied, mostly due to possible additional costs for the manufacturer and traditional product designs which have not included this functionality. Standby attributes are difficult to convey to the user and the potential cost savings are relatively small, so even if user had information available, this will be given a very low priority in purchase decisions. Therefore, manufacturers, who are operating in highly competitive markets with very narrow margins, have little incentive to reduce standby power consumption because it is generally not a point of product differentiation. Nonetheless, given the low marginal cost for most low-standby solutions, a slightly higher purchasing price pays off for the user because of the overall life-cycle cost, i.e. the purchasing cost plus the costs for operating the product, is generally reduced.

In light of this apparent market failure, there is a legitimate role for governments worldwide to play in encouraging manufacturers to produce increasingly efficient standby power modes. Given the global nature of the market for electrical appliances and electronic end-use equipment, there are efficiency gains to be made in harmonising the policy efforts of governments worldwide. Governments would benefit from pooling their resources behind common efforts which would otherwise be wastefully reproduced, while manufacturers would benefit from greater clarity and regulatory simplicity when brining their products to market in multiple jurisdictions.

This report analyses different options for a globally harmonised standby policy framework, ultimately making a single recommendation and exploring what would be required to bring that framework to reality. Far from the final word, this report aims to open the debate on such a harmonised, international framework and provide the building blocks which can be taken forward to assemble the final structure.

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Chapter 2: Analytical framework of standby policies

In brief: *Standby polices can be analysed in terms of the scope of the products the cover, the way in which they set standby power limits and how they evolve over time. The different approaches are described here and their pros and cons are discussed in Chapter 3.*

There are certain characteristics which are essential to any policy that seeks to limit the energy consumption of products in standby mode. First, such a policy must have a defined **scope** which specifies the set of products to which it applies, however broadly or narrowly defined. Second, the policy must set a **limit** for power levels (or energy consumption) for the standby modes of the products in its scope. Finally, policies can be set to **evolve**, generally becoming stricter (i.e. having more stringent limits) or broader (i.e. covering more products) over time. Changes in requirements over time need to consider both the costs for suppliers and the benefits for consumers.

Defining one of the above characteristics in a certain way will necessarily influence the range of possible and reasonable options for the other characteristics. For example, defining the scope in a particular way will affect how ambitious the limit can be as well as how frequently the measure should evolve. Carefully balancing the three characteristics is essential for developing an effective and efficient policy.

Different approaches for defining each of the above three characteristics are possible and have their distinct advantages and disadvantages. Table 1 provides a non-exhaustive summary of the most notable approaches, some of which are seen in existing policies, while others have only been proposed. The pros and cons of these approaches are discussed in further detail in the sections which follow the summary table.

Table 1 : Summary table of standby policy characteristics

Scope	**Product-by-product** The policy applies to one or more narrowly-defined product groups *Examples: Televisions, personal computers, etc.*
	Truly horizontal The policy applies to all products[5]
	Sectorally horizontal The policy applies to broad groups of similar products *Examples: Consumer electronics, IT products, etc.*
Limit	**Hard limit** The policy specifies an explicit limit for standby power for all products within its scope
	Functional allowance The policy specifies allowances for the presence of specific components and/or functions *Examples: High-definition video decoding, multi-room diffusion, etc.*
	Services The policy defines different limits for products within its scope based on the service which it provides to the user *Examples: High-network availability, low-network availability, etc.*
Evolution	**Tiered** The policy specifies certain changes (e.g. stricter limits, broader scope) which will come into effect at a given time in the future
	Externalised The policy references an external source which will evolve over time, allowing the policy itself to remain static
	Fixed The policy has no inherent provision for evolving over time, but could be reviewed at a future time if deemed necessary

[5] Under this definition, a "truly horizontal" policy can allow certain exceptions to its scope.

2.1 Scope

Defining the scope of products that a policy measure covers is a fundamental choice which deeply influences the measure's limits and future evolution. Broadly speaking, measures with a broad scope covering many types of products may find it difficult to set limits which are reasonable for the diverse range of products covered. A limit which is appropriately set for a mid-range product could be too lenient for a simple product — resulting in energy waste which could be otherwise avoided — while simultaneously being too stringent for a more complex product — resulting in non-compliance or unreasonable design costs.

Therefore, a measure's scope is its defining characteristic which determines what is possible and reasonable for its limit and evolution. The three approaches to setting the scope of a standby measure, which are described in the following sections, range from the narrowly-defined product-by-product approach, to the "one-size-fits-all" truly horizontal approach.

2.1.1 Product by product

A product-by-product approach to setting the scope of standby policies is, by definition, not a horizontal approach. Rather than defining standby power levels or energy consumption for a wide range of products, as a horizontal policy would, it addresses narrowly-defined product categories individually. In practice, such an approach could set different levels for televisions, home audio systems and personal computers. This could be considered as a horizontal concept that is implemented differently for individual product groups.

Such an approach has the advantage of allowing for the measure to be carefully tailored to the particular needs and context of the product. This can allow for greater energy savings from the product groups which are covered as each limit can be set to be maximally ambitious for the given product group, potentially resulting in great variation between the product groups.

The trade-off for such precision is the heavy burden borne by policy makers to establish multiple measures for functions that may be common across all product groups. There is potentially of the order of 100 product groups that could be covered by such an approach, so setting up and maintaining such a diverse array of requirements is very unwieldy and resource intensive. Given this additional burden, there is a risk that the limited resources available to policy makers will result in certain product groups simply not being addressed, leading to missed opportunities for energy savings.

2.1.2 Truly horizontal

In a strict sense, a truly horizontal measure would apply to all products, though potentially including some allowance for exceptions in particular cases. As such, a truly horizontal measure would require the same approach for setting the limit for standby power levels — or energy consumption — for products as diverse as microwave ovens and game consoles.

Such an approach is attractive due to its conceptual simplicity. In the complex setting of policy-making at the national and international levels, where the diverse interests of different stakeholders are at play, having an approach which is simple and easy to communicate is an advantage. Additionally, while dealing with the greater number and diversity of stakeholders involved in defining the exact nature of a truly horizontal measure may be more complex than the same exercise for a product-specific measure, in principle a truly horizontal measure would only need to be created once (although the underlying details may need to be maintained). Finally, a truly horizontal approach has the advantage of giving clarity to manufacturers as to whether their products are included in the scope or not. Simply put, under a truly horizontal standby measure, if a given product has a standby mode or function, then it is included within the scope.

The simplicity of such an approach may be offset by the challenges of defining the limit and evolution for a measure with such a broadly defined scope. Considering the products used as examples in this section's first paragraph — microwave oven and game consoles — it is clear that the range of functionality provided different products when in standby mode can vary considerably. While a device such as a microwave oven may provide very limited functionality in standby mode, perhaps consisting of little more than a clock and/or other status display, a game console may be performing non-trivial amounts of work including, for example, storing game data in memory or processing incoming network transmissions (the challenge presented by networked products in particular is discussed briefly in Box 1 on page 19).

2.1.3 Sectorally horizontal

Between a broadly-defined, truly horizontal approach and a very specific product-by-product approach, a sectorally horizontal[6] approach may be a useful middle ground. By grouping products into similar[7] categories, policy makers may be able to avoid the excessive burden of a product-by-product approach while also establishing measures which are more appropriate for the products within each product sector.

The central challenge of a sectorally horizontal approach is defining the sectors. In the case of the European Union, a distinction is made between stand-alone and networked products. While the EU's regulation EC 1275/2008 covers all stand-alone products, the ongoing preparatory study, "Lot 26: Network Standby Losses" seeks to address products which can be connected to a network and which can be reactivated via a signal sent over that network. The reasons behind this distinction are further discussed in Box 1.

[6] The concept and terminology of a sectorally horizontal approach is attributed to Bruce Nordman, appearing in comments provided to the European Commission's study, "Lot 26 Preparatory Study on Network Standby Losses draft Task 8 report", prepared on behalf of CLASP.

[7] Similar here means "similar for the purposes of a standby measure". This could mean, for example, similar levels of functionality in standby mode, similar power levels in standby mode, and/or similar designs at the component level.

Box 1: The challenge of networked products

Products which can be connected to networks and reactivated via signals sent over that network pose a particular challenge for measures aiming to limit standby power levels and energy consumption.

On the one hand, stand-alone products generally provide almost no functionality using simple components when in a standby mode — for example, limited to an infrared sensor to allow reactivation via a remote control — meaning that a measure's power or energy limit can be set at low levels without particularly in depth study.

On the other hand, networked products often perform non-trivial amounts of work while in standby mode, using a variety of different and complex technologies, resulting in a wide range of standby power levels across different product groups and even between different models within a given product group. All together, these factors make the definition of a specific level particularly challenging.

These methodological challenges are set against a backdrop of an increasing number of networked products in the market, an increasing number of stand-alone products gaining networking functionality, and the introduction of entirely new networked products. These trends, combined with the products' greater standby energy consumption, lead to an urgent need to address these products through efficient and effective measures.

While the distinction between networked and stand-alone products may be useful given the issues discussed in Box 1, how networked products are defined and addressed is another issue. For example, networked products could conceivably be grouped together and treated as homogenous bloc, distinguished based on the reactivation time needed to provide the necessary service to the user, distinguished based on their market segment[8], or distinguished by some other means. Furthermore, it is possible to imagine a measure which does not address networked products as individual products at all, but which addresses the network as a whole[9], or which addresses networked products which are provided by a service provider not as a product, but as a service[10].

Given the challenges of clearly segmenting networked products explicitly in the measure, which may require considerable review and consultation, approaches which make the distinction implicitly, by referring to, for example, functions or an external source, could be more efficient.

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[8] Bruce Nordman, in comments provided in the context of the European Commission's "Lot 26 Preparatory Study: Network Standby Losses" suggests four segments: appliances, audio/video devices, IT products, and network equipment.

[9] While considering a network as a whole, and not simply a constellation of interconnected products may allow for more creative solutions, it faces many challenges, including defining network boundaries and compliance issues, especially in domestic environments.

[10] For example, an internet service provider could be required to pay for the electricity consumed by the home gateway which they provide to the consumer. By shifting the burden to the ISP, they would have the incentive to develop more efficient devices and to update them as needed. This stands in contrast to the current situation where consumers have no choice in the hardware provided by their ISP and design decisions are generally driven by very tight cost concerns.

2.2 Limits

Based on the scope of products covered by the measure, a limit must be defined, either in terms of standby mode power levels, or in overall energy consumption for a typical use cycle over some period of time. These limits could have different applications in different policy measures. For example, a limit could define the cap in a mandatory regulation or could serve as a threshold for obtaining a voluntary certification. Such choices remain in the purview of policy makers. As mentioned in Section 2.1, a central challenge defining a limit, regardless of its application, is setting a value which is balanced with regard to the standby-power heterogeneity present among the products covered by the measure's scope.

The concept of a limit is to set a power consumption requirement that is achievable at reasonable cost. As technology changes and improves over time, this balance will be always changing, so in theory the basis of setting limits is a dynamic one over time. There is also a limitation in terms of knowing what is technically achievable at a given cost in the present (let alone in the future), given the complexity of product design and functions. One of the "market failures" in the area of standby power is the lack of incentive for suppliers to focus on reducing standby power in the absence of effective policies to do so. Setting requirements for standby power will stimulate innovation on how to achieve reductions in standby power at the least possible cost, which should deliver more savings more cheaply and faster than could ever be anticipated in the absence of a policy framework.

2.2.1 Hard limit

In theory, the simplest approach is the hard limit that sets a strict limit on power levels or energy consumption for the products within the scope. As with a truly horizontal approach to setting the scope (see Section 2.1.2), this approach for setting the limit must balance the advantages brought by this simplicity against the disadvantages of being relatively inflexible. As such, a hard limit would tend to function best within a measure that covers a relatively homogenous group of products.

2.2.2 Functional allowance

An alternative to setting a hard limit for all products within a measure's scope is to specify allowances based on the configuration or functionality of the covered device. As such, the limit that concerns a given product is a function of its particular design which should, in principle, result in limits which are more appropriate for each product.

A principle challenge of such an approach is that the allowances must be defined for a wide range of components and functions. Given the diversity of products on the market, this is a potentially burdensome task. Additionally, such approaches run the risk exploitation should an unscrupulous manufacturer seek to add components or functions solely for the purpose of increasing the product's limit, rather than for a legitimate need.

Finally, different implementations of the functional adder approach have been based on allowances linked to the presence or absence of either components (e.g. 802.11 WLAN interface in a home gateway) or functions (e.g. high-definition video decoding in a complex set-top box). Basing a functional allowance calculation on either a product's components — the hardware present in the device — or its functions — produced by the interaction of its hardware and software — may have significant implications for the effectiveness and efficiency of the measure. This is an area that could merit further research (see Chapter 8:), particularly with regard to the components and functions required in standby mode.

2.2.3 Services

While a functional allowance approach looks at the components or functions inherent to a product, a services approach considers the product from the perspective of the user, basing its limits on the services required to meet the expectations of the user. This approach is seen in the European Commission's "Lot 26 Preparatory Study: Network Standby Losses" which considers reactivation time from standby to be the essential service provided by different products when in standby mode. While users of some products can accept longer reactivation times (e.g. printers), fast reaction times are needed for certain products to provide their main function (e.g. network equipment).

2.2.4 Hybrid approach – Hard limit and functional adder

In addition to the approaches described above, it is also possible to develop hybrid approaches which combine elements from several others. Of the different permutations possible, one hybrid approach in particular is worth noting: a hard limit for simple products combined with a functional adder for products not able to meet that limit. Such a hybrid approach would have the advantage of simplifying the setting of the limit for a great number of devices (those which can meet the hard limit) while reducing the number of functional adders which need be defined, thereby reducing the burden of that approach.

2.3 Evolution

Product designs, configurations, and uses are changing at a pace that can be difficult for the policy process to keep up with. As such, policies can be designed to anticipate future changes by including a mechanism or provision for future updates. The evolution of a measure can cover its scope (generally including more products over time), its limit (generally becoming stricter over time), or both.

Policies which change frequently can be more difficult for manufacturers to comply with as the redesign of certain products can require significant financial and human resources which may be difficult to mobilise on short notice. Therefore, communicating future changes as far in advance in possible will help to facilitate manufacturers' development of compliant and competitive products.

2.3.1 Tiered

The most basic approach for a measure's evolution is the tiered approach, where the measure specifies a certain changes to its scope and/or limit at a given point in the future. For example, the European Union's EC 1275/2008 regulation specifies two tiers: the first which entered into force at the same time as the regulation itself, the second which entered into force three years later. Similarly, Version 4 of the European Union's Code of Conduct on Energy Consumption of Broadband Equipment[11], which uses a functional allowance approach for setting limits, specifies two tiers for each allowance, the first covering 2011-2012, the second covering 2013-2014. This approach works effectively as a stepping stone from a less stringent requirement to a more stringent one – it allows policy makers to set (what are currently considered) stringent limits in the medium term and gives suppliers time to meet these future requirements in an orderly fashion through changes in product design. However, there are limitations on how far a tiered approach can reasonably look into the future, because future technology changes cannot be accurately foreseen. So setting future tiers is a dynamic process. Energy Star is an excellent example of this process where future levels for many products are under continual review and future tiers are developed to take account of technological responses over time.

2.3.2 Externalised aspects

While the two examples given for a tiered approach both specify the changes explicitly in the measures themselves, an alternative would be to reference an external source for certain aspects of the policy measure, thereby allowing the developers of the measure to avoid having to continually update certain details of the measure as the technology progresses. Examples of the aspects that could be externalised include technical definitions, test procedures and limit values associated with different products or functions. Such a system could include multiple tiers of limit values, each more or less stringent, allowing policy makers to maintain control of the requirements within their jurisdiction.

2.3.3 Fixed

A final option is to forego policy evolution all together, establishing a purely static policy instead. Such an approach would not have the benefit of measures which are designed to evolve, namely clearly setting a path towards greater efficiency for all stakeholders, and manufacturers in particular.

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11 re.jrc.ec.europa.eu/energyefficiency/pdf/CoC%20Brodband%20Equipment/Code%20of%20Conduct%20Broadband%20Equipment%20V4%20final%2010.2.2011.pdf

2.4 Example of existing policies

The characteristics of the horizontal policy framework developed above can be applied to the current policies on standby power implemented in different parts of the world.

2.4.1 IEA 1 Watt Plan

The IEA's 1 Watt Plan provides guidance for governments seeking to implement measures to address standby power losses from products within their jurisdiction. The Plan is characterised by its simplicity — a single aspirational limit which is to be applied to all products. Though the limit remains unachievable for certain more complex products, the Plan has been successful in drawing attention to the issue of standby power consumption. The Plan is summarised according to the above framework in Table 2.

Table 2 : Characterisation of the IEA 1 Watt Plan

Scope	**Truly horizontal** The plan makes no distinction between different product groups and, in principle, applies to all products.
Limit	**Hard limit** The plan suggests a hard limit for all products of 1 Watt or less.
Evolution	**Fixed** The plan has no explicit mechanism for future evolution. Given that a 1 Watt limit is still unreachable for certain more complex products, it can be considered aspirational.

2.4.2 European Union Directive 1275/2008

The European Union's standby power regulation introduced in 2008 excluded networked products from its scope due to the complexity of products which can be reactivated by a signal over that network connection. The power requirement of products within the scope is essentially a hard limit, though as it distinguishes between devices with and without a display, it can also be considered the simplest form of a functional adder. The policy is intended to focus on standby functions are have some sort of user orientation. The initial tier was in 2009 and the second tier applies in 2012.

The Regulation is summarised according to the above framework in Table 3.

Table 3 : Characterisation of the European Union Directive 1275/2008

Scope	**Sectorally horizontal** This regulation applies to all products, excluding networked products.
Limit	**Functional adder** The policy represents the simplest form of a functional adder approach, specifying one value for devices with a display and another for devices without a display.
Evolution	**Tiered** The policy consists of two tiers spaced 3 years apart.

Chapter 3: Horizontal policy options

In brief: *Different combinations of the characteristics of standby policies described in Chapter 2 are analysed. The recommended approach is based on a truly horizontal scope, a hybrid hard-limit/functional-allowance limit with a tiered evolution based on an external repository of definitions and limit values.*

In the following sections, several options for horizontal standby policies are presented and analysed according to their strengths and weaknesses. Ultimately, Option 1 is recommended and analysed further in subsequent chapters. That said, it is useful to consider the differences between these different possible approaches.

The description of each option is preceded by a summary table to allow for an easy comparison of the approaches.

3.1 Horizontal policy option 1

Scope	Truly horizontal
Limit	Hard limit / Functional allowance hybrid
Evolution	Externalised / Tiered

This policy option is based on the concept of a hard limit and functional allowances that are stored and updated in a central repository. The values stored in the database include multiple tiers (more or less ambitious levels), with ongoing maintenance and updating as required.

3.1.1 Coverage across product types and country groups

This policy option sets a hard limit for all products and provides functional allowances for the products which are not able to meet the hard limit. Several different tiers would be proposed for the hard limit and the functional allowances to give policy makers referencing the repository the choice of several different levels of ambition. This unique feature allows the approach to provide flexibility to different countries both by addressing only the functionalities which are actually present in a specific product, and providing an option for less ambitious limits across all functions, which can be adopted in accordance with local timetables. For example, a TV sold in a developing country may only provide basic standby functionality of activation and deactivation via an infrared remote control, whereas a more complex TV sold in developed countries may offer additional standby functionalities such as memory or network functionality and energy management. Thanks to the functional adder approach, the standby limits would already be different for these two products while the multiple tiers allows simple products which can meet the hard limit (e.g. TVs with only IR remote reactivation) to be granted a less stringent levels for countries in the early stages of policy development that may need more relaxed requirements.

3.1.2 Costs to consumers, producers and governments

This implementation of this policy option will result in an appropriate marginal increase in manufacturing cost for the producers, which if translated to the consumers, will result in consumers paying an appropriate marginal extra price for their products.

Individual governments will be responsible for controlling and monitoring the implementation of this policy, however, as they will not be required to independently define the hard limit or the functional allowances stored in the central repository, the implementation of this policy should cost the individual governments less relative to other options.

The value of this approach is that all the research and investigations into what is technically feasible for different functions can be centralised and can take into account the latest developments in technology worldwide. It avoids the difficult of each country having to undertake their own primary research from scratch, which is necessarily limited to a review of the designs and technologies that are locally available or which researchers can find out about. A truly international system would take a global view and would have links with appliance and equipment designers and key component suppliers that are aiming to achieve exceptional designs for low standby power.

3.1.3 Effectiveness of the measure in reducing energy consumption

This policy will result in the high energy savings relative to other horizontal policies analysed in this section due to:

- the truly horizontal scope of this policy that covers all currently available products as well as those not yet introduced in the market;
- the standby allowance set by this policy for a specific function being based on the currently best available technology (or at an appropriate local level up to that stringency).

Additional analysis in this regard is provided in Section 4.5.

3.1.4 Ease and speed of implementation

The implementation of this policy requires the creation of the central standby power allowance database and the mapping of these functions with corresponding product types, which requires further work and delay.

3.2 Horizontal policy option 2

Scope	Sectorally horizontal
Limit	Hard limit
Evolution	Tiered

The key characteristic of this policy option is its simplicity. This policy intends to propose two hard limit values on power allowance, first concerning the stand-alone products and the second concerning the networked products.

However, it seems unlikely that a completely horizontal approach to network standby, as for stand-alone products, is feasible. Due to substantial differences between network products, a reasonable hard limit for all products may be much too lenient for some.

3.2.1 Coverage across product types and country groups

Like Option 1, this policy also allows covering standby power issue in all different kinds of products (both stand-alone and non-network) types across various countries.

3.2.2 Cost to consumers, producers and governments

This implementation of this policy option may result in marginal increase in manufacturing cost for certain products and substantial increase for some other products. This increase in manufacturing cost, if passed on to consumers, will result in consumers paying marginally to substantially higher prices for their products.

The resulting increase in costs from this policy for both consumers and producers will therefore be higher than that from Option 1. The cost of implementation of this policy to individual governments should be similar to that of Option 1.

3.2.3 Effectiveness of the measure in reducing energy consumption

The choice of the limit value on standby power proposed by this policy may run the risk of being either over- or under-ambitious, in particular for complex products, such as those connected to networks. This is because standby power levels of networked products vary considerably depending on the service which the product must provide. Such an approach, although desired to cover all products, may lead to many non-compliant product types which are not able to meet the limit. Alternatively, a less stringent limit runs the risk of leaving potential savings unrealised, leading to energy waste.

Due to these reasons, the overall energy savings from standby power resulting from this policy option may be lower than that from Option 1.

3.2.4 Ease and speed of implementation

Once the power allowance for hard limits is defined, this approach can be implemented very quickly. It may therefore be simpler to implement this approach Option 1.

3.3 Horizontal policy option 3

Scope	Sectorally horizontal
Limit	Hard limit / Service
Evolution	Tiered

This policy option is similar to that of the EU's approach[12] on horizontal policy for standby power. This policy intends to propose a hard limit on power allowance for standby functionality in stand-alone products while applying the services approach to networked products.

The hard limit for stand-alone products can be defined in a manner similar to Option 2, as described above. However, concerning networked products, this policy will require that they be classified further based on characteristics such as network availability and resume time to application.

3.3.1 Coverage across product type and country groups

This option will have the same coverage as Option 2 (see Section 3.2.1).

3.3.2 Cost to consumers, producers and government

For stand-alone products, an impact similar to that seen for Option 2 can be expected for consumers, producers and the government. In case of network products, it could have higher implementation costs because it would require more in-depth analysis to set the multiple values for the networked products. The costs are therefore closer to those in Option 1.

3.3.3 Effectiveness of the measure in reducing in energy consumption

For stand-alone products, an impact similar to that seen for Option 2 can be expected. In case of networked products, it should be more efficient than a strict hard limit by recognising the different power levels and services provided by different types of networked products.

[12] Regulation EC 1275/2008: Ecodesign requirements for standby and off mode electric power consumption of electrical and electronic household and office equipment

3.3.4 Ease and speed of implementation

Implementing such a policy is estimated to be slightly more burdensome than Option 2 due to the need to distinguish between different types of networked equipment, though less burdensome than Option 1.

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Chapter 4: Recommended approach

In brief: *The recommended approach is based on a central repository that specifies several tiers of hard limits and values, allowing countries referencing it to choose an level which is appropriate for their situation. The approach is meant to cover all products, most of which will be compliant with the hard limit. Those products that cannot meet the hard limit will use a set of functional allowances to determine an appropriate limit value for their standby power consumption.*

In order to be effective and efficient, an internationally harmonised approach to standby power measures should have the following qualities:

- strong reliance on shared resources,
- clear visibility on its evolution over time,
- sufficiently flexible to cover a wide range of existing products, as well as future products which have yet to be introduced,
- sufficiently flexible to be applied in countries and regions with diverse socio-economic situations.

Shared resources will help to reduce the administrative burden of the implementing governments, an especially important aspect for emerging economies. One of the major barriers to the development of new policies in this area is the need for each new government to "reinvent the wheel" and undertake their own technical analyses and develop their own approach — this is avoided to a large degree by an international approach, and particularly one which shares common resources. A harmonised international approach with clear future visibility will be welcomed by industry as it will facilitate their development process for products that are marketed internationally. As with any horizontal policy, it must be sufficiently flexible to cover the wide range of existing products with standby modes, as well as products which have not yet been introduced or even invented. Finally, flexibility with regard to the socio-economic situation of a country will allow the approach to be adopted by a wide range of countries. The challenge then is to create a framework which will be ambitious for simple devices in highly developed counties (which should have more stringent standby power levels), while still being accessible for large and/or complex devices in emerging economies (which would likely have less stringent standby levels).

These different qualities can be best met through the **development of policies which reference a central repository** of power allowances, definitions and other details. Such an effort would also require the development of **guidance documents** to explain the principles of the approach and to assist subscribing governments in implementing national measures based on the approach. Though such an approach would be burdensome to develop (see Section 4.2) and would require some resources to maintain, it would allow for the most efficient and effective long-term implementation of harmonised standby measures worldwide.

4.1 Principles of operation

The success of the proposed approach hinges on the quality of the repository design itself. In order to meet the above requirements, the repository should include:

- a hard limit for the many simple devices which are able to meet such a limit [13];
- additional allowances for various functions[14], to be added to the base allowances for relevant products;
- for each functional allowance, multiple values corresponding to more and less ambitious "tiers" which implementing authorities can elect to subscribe to, depending on the level of ambition that they seek for their policy;

These aspects as well as the governance, maintenance, and implementation of the system are discussed in the following sections.

4.1.1 Hard limit

This hybrid approach would specify a hard limit which could be applied to all products.[15] In principle, many common household appliances should be able to meet such a limit easily. In the event that a more complex product is not able to meet the hard limit, then the relevant functional allowances could be applied to determine an appropriate limit.

As will be discussed in Section 4.1.3, multiple values for the hard limit, corresponding to different tiers, could be designed to give policy makers a range of options when setting more or less stringent policies, as dictated by the specific needs of their jurisdiction.

4.1.2 Functional allowances

In addition to the hard limit, this approach will include functional allowances for determining the standby power limits for the products falling within its scope. The general principles of such an approach were discussed in Section 2.2.2.

In this case, the system would first accord a base allowance to any covered device for the basic, "passive" standby function. This allowance would serve as a foundation upon which allowances would be added according to the functions and/or components present in the device.

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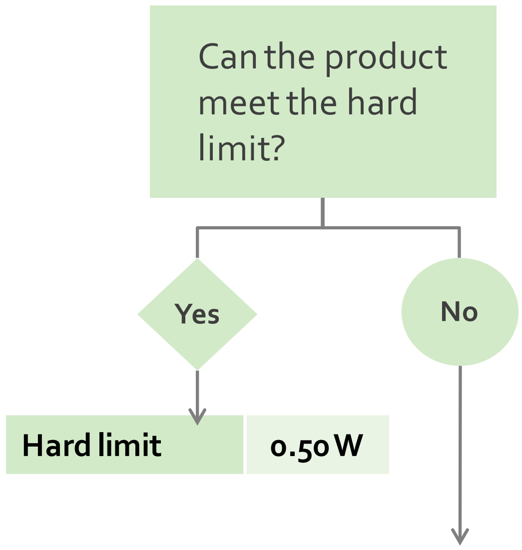
[13] This could be based on the definition used in EU Regulation EC 1275/2008

[14] The EU Code of Conduct for Broadband Equipment provides a useful typology of key networking functions.

[15] Such a limit could be based on EU Regulation EC 1275/2008 which sets a maximum power level 0.5 Watts for products without status or information displays in 2013.

Figure 1 illustrates how the decision process would function under this approach. The central question for manufacturers developing compliant products and policy makers ensuring compliance is whether the product can meet the hard limit, or not. If so, then the testing process is simple: if the product consumes less than the value of the hard limit (given as 0.5 W in Figure 1), then it is compliant, regardless of its functions or components. If, however, the product cannot meet the hard limit, then an appropriate limit must be calculated based on the functions actually present in the product (several examples are given in Figure 1), leading to a total value that the product must meet when in standby mode.

Figure 1: Decision process for determining the limit value for a hypothetical product



Functional allowances	Value
Time display	*0.10 W*
Reactivation via Ethernet	*0.25 W*
Reactivation via USB	*0.25 W*
Reactivation via WiFi	*0.25 W*
Total	**0.85 W**

This approach implicitly addresses the distinctions between different groups of products. As such, it is not necessary to explicitly distinguish between product groups, such as networked and stand-alone products. Instead, the hard limit or the allowances are accorded based on the functions actually present in the device. A networked device, if it is not able to meet the hard limit, would therefore receive the additional allowances appropriate for such a device, providing it with a higher standby power limit in reflection of its greater needs.

4.1.3 Tiers

If the repository contained only a single value for the hard limit and for each functional allowance, then it would not be particularly flexible with regard to the different socio-economic situations of the countries which adhere to the approach. The concept of “tiers” addresses this concern.

Tiers are a series of more or less stringent values for the hard limit and functional allowances. Policy makers referencing the repository would be able to choose a tier which is appropriate for the specific context of their jurisdiction. Furthermore, they could also specify transitions to more stringent tiers at given dates, giving manufacturers the forward visibility necessary to ensure that compliant and competitive products are available.

While tiers introduce needed flexibility into the approach, they also introduce additional complexity. For example, if the repository includes three tiers for a given function, the amount of data required to support repository triples.

The setting of the values for the tiers would be based on expert technical assessment of best available technologies and expected technological evolution in the short to medium term (perhaps on the order of two to five years). Given the rapid rate of technological innovation, it is likely impractical to attempt to forecast such values further in the future.

The selection of a given tier would be the responsibility of policy makers and would be determined by factors relevant to their jurisdiction.

4.1.4 Organisation

The primary role of the repository will be to undertake technical analyses in a centralised manner so as to alleviate policy makers of this burden. As such, the persons responsible for the management and maintenance of the repository will be primarily technical in background, though it is advisable that they also have a strong understanding of the policy process so as to be able to better understand the needs of the repository’s final users.

As the subscribing governments would realise significant savings to the costs of their policy making, it would be appropriate to expect that the subscribing governments would support the repository either by direct financial contributions, the secondment of national experts, and/or the provision of other required materials and facilities. Particularly at the launch of such an approach, the strong support of a core group of member states would be needed to ensure its establishment and initial operation.

It could be expedient to host the repository within an existing international initiative such as the IEA’s 4E Standby Power Annex. Other potential host organisations include technical standardisation organisations such as IEC, CENELEC, IEEE, etc., although these bodies tend to be less cognisant of government needs and objectives, so would be less suitable.

4.1.5 Review and maintenance

The repository would require regular review and maintenance to ensure that it was responding to the needs of the governments adhering to its approach. This would mean reviewing that the structure and approach to identifying and structuring functions remains applicable to current market and technological trends, that the values of the hard limit and allowances and the method use to set them are still relevant in light of ongoing technical progress, and that they are adjusted as necessary.

Such efforts could be coordinated by a technical committee composed of technical experts seconded from adhering governments. The work, in turn, could be undertaken directly by the members of the committee or sub-contracted to external experts as needed.

4.1.6 Implementation of policy measures

How this approach is transposed into any particular policy measure is the prerogative of the relevant policy makers and is not inherent to the repository. The repository provides the foundation for a common framework, allowing policy makers to combine forces and share resources, and avoid duplicating efforts.

Naturally, policy makers would retain all rights to develop their policies as they see fit, selectively referencing certain tiers, or allowances, and performing their independent research as they see fit. The goal, however, of the repository is to provide sufficient relevance and flexibility to member states so as to avoid such efforts for the member states themselves.

In short, the repository and accompanying support is provided as a resource, developed collectively by the adherent governments, but which does not oblige any particular transposition into a policy or measure.

4.2 Development

The establishment of such a repository would require the investment and engagement of an initial cohort of participating governments in order to get it off the ground. This initial group would be responsible for defining the internal operating principles of the repository, as well as establishing a structure for the data and filling the repository with enough data for it to be function. These aspects are discussed in the following sections.

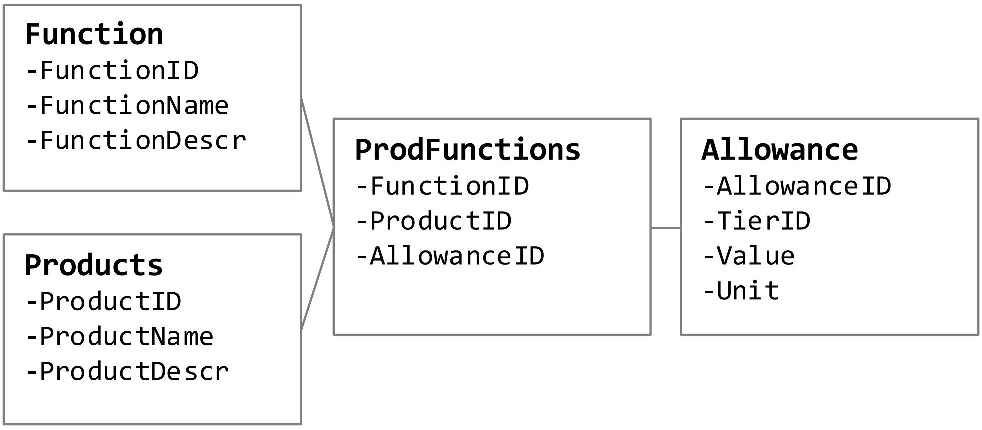
4.2.1 Engaging participating governments

As with any new initiative, there is an inherent "first-mover" risk of adhering to an approach which will ultimately not be productive. As such, it will be important to establish clear interim measures (Section 4.2.3) which will require less commitment and investment of the participating governments, while also providing tangible results. By successfully completing the interim measures, the initial group of participating governments will have the opportunity to gain experience in the operation of the repository and will also see the benefits of such cooperation.

4.2.2 Defining the structure of the repository

Deciding what information to include in the repository and how to structure it will be a critically important determination which will set the stage for the functioning of the repository in the long term (see Chapter 8:). The data at the heart of the repository would need to be stored in a structured format so as to ensure easy maintenance and retrieval. A relational database would offer a flexible framework for developing s functional data store. Given the principles of operation described in the preceding sections, Figure 2 presents an example schema (data structure) for such a database. The rectangles represent tables within the database; the bold titles represent the titles of the tables, while the list of text within each table represents the fields contained within each table. Note that this is only an example schema and the final structure of the database would need to be subject to further research (see Chapter 8:)

Figure 2: Example schema for the repository database



The fields named in the above schema are as follows:

- **FunctionID**: Unique identifier for each function
- **FunctionName**: Short, human-readable name of the function
- **FunctinDescr**: Detailed description of the function
- **ProductID**: Unique identifier for each product
- **ProductName**: Short, human-readable name of the product
- **ProductDescr**: Detailed description of the product
- **AllowanceID**: Unique identifier for the allowance
- **Value**: Value of the allowance
- **Unit**: Unit of the allowance (usually Watts)
- **TierID**: Unique identifier for the tier

4.2.3 Filling the repository

the number of functions multiplied by the number of tiers leads to a great many values to be defined to fill the repository. It is not reasonable to think that such an effort could be accomplished quickly or cheaply. That said, there are ways in which the development of the repository can be accomplished as efficiently as possible.

Functional allowances could be gathered from existing sources and submitted to a formal approval process by all subscribing governments. The subscribing governments could nominate experts to serve as a review committee or expert panel to ensure the regular updating of the allowances to take into account technological developments. Close cooperation with manufacturers will be key as they will be an important source of data on the power needs for specific functions, both at present and in the future. Section o discussed the way in which the values for the many tiers and tracks could be produced through computation and not field research.

While such development will certainly be costly, by combining efforts and sharing in the burden, governments will be able realise savings in the long run by avoiding duplicated efforts.

4.3 Interim measure

Given the long lead time needed to establish the repository, it is important to establish a meaningful interim measure which will also support the overall development of the repository. The development of such measures would also give the participating governments the opportunity to review the managerial process which would govern their cooperation.

These criteria could be fulfilled by using the **establishment and agreement of the hard limit** as an interim measure and a test case for the future functioning of the repository. This approach would have the advantage of being markedly more simple than establishing the many allowances needed to adequately cover all advanced functions, while also allowing governments which presently lack any standby regulation to quickly develop a policy for simple products by simply reference this common hard limit.

4.4 Exclusion and vertical policy requirements

As with any horizontal policy, there are likely to be certain cases which are best excluded from the approach presented above. As the goal of the proposed framework is not to specify any particular measure which could be implemented by a participating government, however, it is suggested that repository not explicitly exclude any particular product groups, but rather give guidance on the types of products which may be best addressed through vertical policy measures, as well as implementation advice which would include suggestions for product categories to be excluded.

Generally speaking, products in critical military, health, security and safety applications may require exclusions from any policy as a horizontal measure may not appropriately address their specific needs. As an example, fire alarm systems are complex, network-connected devices which include multiple sensors, central processing equipment, and which communicate with remote servers. Given the risk to life and property should a system malfunction, they are typically designed with multiple layers of redundancy. This redundancy and the need to ensure an immediate response to a detected fire mean that a limit on standby power which is appropriate for less critical applications would result in an unacceptable degradation of the quality of service of the system. The same argument could be made for other products such as remote health monitors.

In addition, there may be special cases where a product requires significant standby power consumption in order to provide its basic service to users. An example is air conditioners that require crankcase heaters to be active in standby mode. These heaters can consume upwards of 20 W and would be difficult to assess in a horizontal policy. As such, the total energy consumption of products like air conditioners is best addressed in a vertical measure that considers all power modes.

4.5 Energy coverage and gaps

Ultimately, the degree to which the proposed approach covers the energy use of products worldwide depends on three factors:

1. the number of participating governments and the size of the respective markets in which they implement any measures;
2. the final definition and structuring of the functions covered by the repository;
3. 3. the values for hard limit and the allowances across the multiple tracks and tiers.

While it is impossible to know any of these factors with certainty at this stage, it is possible to analyse the proposed approach in terms of its theoretical potential.

In contrast to product-by-product or sectorally horizontal approaches, the proposed approach is truly horizontal in the sense that, by default, any product with a standby mode is covered. The hybrid approach also means that the limit value will, in principle, be well-adapted to the product which is covered, being set neither too high, nor too low. As a result, the proposed approach is positioned to have extremely broad coverage, with the majority of simple products being covered by the hard limit, and more complex products being covered by functional allowances, as necessary.

That said, to realise such broad coverage, the governments of the major world markets would need to participate and the repository would need to include data for enough functions to cover the necessary product types and, in particular, those which currently have low levels of optimisation in their design of standby power modes.

Given these considerations, there are no significant gaps which can be identified at this stage, though the final energy coverage and gaps will depend on the three factors listed above.

Chapter 5: Practical examples

In brief: *Several hypothetical examples are given, based on a domestic electric oven, a complex set-top box and a home gateway. The examples demonstrate how certain products may or may not be compliant based on either the hard limit or the functional allowances, as well as in jurisdictions which reference different tiers.*

In order to analyse example applications of the approach outlined in this report, example devices need to be posited and the allowances the standby-relevant[16] functions included in those products need to be specified.

So as to provide an overview of the breadth of coverage by such a horizontal approach, a diverse range of products have been chosen, namely generic examples of:

- domestic electric oven,
- complex set-top box (CSTB), and
- home gateway.

Collectively, these products include the standby-relevant functions which are detailed in Table 4. This table also includes example values for what could be determined to be Best-Available Technology (BAT). These BAT values could serve as a basis for the development of additional tiers.

Note that this list is not meant to be exhaustive and the values are provided for illustrative purposes only.

[16] "Standby-relevant" means functions which need to be active when the device is in standby mode. Naturally, the products contain many more functions than those listed here, but they are only relevant to active mode.

Table 4: Standby-relevant functions present in example products

Function	BAT Value	Relevant products
Time display	0.2 W[17]	Oven, Home gateway
Heat status display	0.2 W[17]	Oven
Reactivation via IR remote control	0.1 W[18]	CSTB
Reactivation via Ethernet	0.3 W[19]	CSTB, Home gateway
Reactivation via USB	0.25 W[19]	CSTB, Home gateway
Reactivation via WiFi	0.25 W[19]	Home gateway

These BAT values could serve as a basis for the development of additional tiers, for example one which is more stringent which policy makers could use as an indication of future policy evolution, and one which is less stringent, making it more accessible to member states that have only recently begun their development of standby policies. Examples of such values are given in Table XX, as well as the alternative hard limit values associated with each tier.

Table 5: Example values for three tiers of the hard limit and functional allowances

Function	Tier 1	Tier 2 (BAT Value)	Tier 3
Hard limit	1.0 W	0.5 W	0.2 W
	OR		
Time display	0.4 W	0.2 W	0.1 W
Heat status display	0.4 W	0.2 W	0.1 W
Reactivation via IR remote control	0.2 W	0.1 W	0.1 W
Reactivation via Ethernet	0.6 W	0.3 W	0.2 W
Reactivation via USB	0.5 W	0.25 W	0.1 W
Reactivation via WiFi	0.5 W	0.25 W	0.1 W

As the foundation for a horizontal policy approach, the values are set without regard to any particular product. Thus, if any product is not able to meet the hard limit, it must develop a limit value based on an appropriate combination of allowances corresponding to the functions present in the product.

The following sections demonstrate how the hybrid approach would function for a domestic electric oven, a CSTB and a home gateway.

5.1 Domestic electric oven

Take, as an example, a hypothetical domestic oven with two standby-relevant functions: a time display and a heat-status display. Assume, for the purposes of this demonstration, that the oven

[17] Based on DG ENER Lot 6 preparatory study, "Standby and off-mode losses"

[18] Based on EU Code of Conduct on Energy Consumption of Broadband Equipment.

[19] Based on EU Code of Conduct on Energy Consumption of Broadband Equipment.

is measured to consume **0.3 W in standby mode**. This model would be compliant in jurisdictions basing their policy on Tiers 1 and 2, but not Tier 3, the strictest jurisdiction. In order to be compliant in a Tier 3 jurisdiction, the product designers would have to find a way to improve upon their design or perhaps offer a simpler model with fewer features.

Table 6: Example hard limit and functional allowances: Domestic electric oven[20]

Function	Tier 1	Tier 2	Tier 3
Hard limit	**1.0 W**	**0.5 W**	**0.2 W**
	OR		
Time display	0.4 W	0.2 W	0.1 W
Heat status display	0.4 W	0.2 W	0.1 W
Total	**0.8 W**	**0.4 W**	**0.2 W**

5.2 Complex set-top box

Take, as an example, a hypothetical CSTB with three standby-relevant functions: reactivation via IR remote control, reactivation via Ethernet and reactivation via USB. Assume, for the purposes of this demonstration, that the CSTB is measured to consume **1.1 W in standby mode**. This model would not be able to comply with the hard limit in any jurisdictions basing their policy on the repository as that value exceeds even the most lenient hard limit (Tier 1). Considering the relevant functional adders, the model under consideration would be deemed to be compliant in a Tier 1 jurisdiction, but not in a Tier 2 or a Tier 3 jurisdiction as the measured value exceeds the sum of the relevant functional allowances.

Table 7: Example hard limit and functional allowances: Complex set-top box

Function	Tier 1	Tier 2	Tier 3
Hard limit	**1.0 W**	**0.5 W**	**0.2 W**
	OR		
Reactivation via IR remote control	0.2 W	0.1 W	0.1 W
Reactivation via Ethernet	0.6 W	0.3 W	0.2 W
Reactivation via USB	0.5 W	0.25 W	0.1 W
Total	**1.3 W**	**0.65 W**	**0.4 W**

5.3 Home gateway

Take, as an example, a hypothetical home gateway with four standby-relevant functions: reactivation via IR remote control, reactivation via Ethernet, reactivation via USB and

[20] In the case of a simple product with few standby-relevant functions, such as a domestic electric oven, it is normal that the total of the functional allowances be lower than the hard limit. Indeed, it is because the product is so simple that it can qualify as compliant simply by meeting the hard limit and would not need to consider the functional allowances.

reactivation via WiFi. Assume, for the purposes of this demonstration, that the CSTB is measured to consume **0.8 W in standby mode**. The model would be able to achieve compliance by meeting the hard limit in Tier 1 jurisdictions and by meeting the total of functional allowances in Tier 2 jurisdictions. The model, however, would be non-compliant in Tier 3 jurisdictions.

Table 8: Example hard limit and functional allowances: Home gateway

Function	Tier 1	Tier 2	Tier 3
Hard limit	**1.0 W**	**0.5 W**	**0.2 W**
	OR		
Reactivation via IR remote control	0.2 W	0.1 W	0.1 W
Reactivation via Ethernet	0.6 W	0.3 W	0.2 W
Reactivation via USB	0.5 W	0.25 W	0.1 W
Reactivation via WiFi	0.5 W	0.25 W	0.1 W
Total	**1.8 W**	**0.9 W**	**0.5 W**

Once again, it must be reiterated that these examples do not necessarily provide exhaustive coverage of the relevant functions in the products and therefore underestimate the totals.

5.4 Power caps and potential abuse

One risk associated with a functional allowance approach is that unscrupulous manufacturers could add unnecessary functions if the allowance for the function is set too high. For example, imagine that a function has an allowance of 2 W but, in reality, it can often be implemented for less than 1 W. The manufacturer could use the savings to offset inefficient design elsewhere in the product.

To guard against this risk of abuse, it is possible to set absolute caps on the total power levels allowed in standby mode, regardless of the total number of functions present. Such caps would not need to be defined for all products, only those where a risk of such abuse is identified. Multiple values for the caps could be established for each tier, to ensure consistency with the rest of the approach.

Finally, it should be made clear in policies referencing the repository that only functions which are justifiably active in standby mode are eligible for allowances

Chapter 6: Functions

In brief: *In order to define the functional allowances of the repository recommended in previous chapters, appropriate functions must be identified and clearly defined. Relevant functions should be user-oriented and should not be based on a particular component.*

In the case of a policy framework which is based on a functional adder approach, it is of critical importance to define functions in such a way so as to carefully group those which are similar while separating those which are different, according to the needs of the policy. In particular, it is important to arrive at a level of specificity which is detailed enough to ensure that functional allowances are precise, while abstract enough so as to not create an undue burden in terms of the number of allowances which must be defined.

Additionally, there is a broader debate as to whether components, functions, or services are the appropriate focus for policy. These issues are explored in the following sections.

6.1 Classifying standby relevant functions

In a standby policy which fixes limits according to functional allowances, the functions themselves must be defined so as to strike a balance between precision and abstraction in order to maximise the administrative efficiency of the policy.

The first step in determining that appropriate level of precision is to obtain a clear overview of all functions, across all products, which are relevant to the services provided by a device in standby mode. The focus on "relevant" functions is important. For example, one can imagine a manufacturer arguing for a functional allowance for their device given that it includes a hard disk drive (for example). Certainly, a hard disk spinning at 7,200 RPM does indeed consume energy, but the important question is, "Why would the hard disk need to be active in standby mode?" In the absence of a satisfactory answer, it must be concluded that the hard disk need not be active in standby mode and that no allowance should be accorded.

Standby functions must be user-oriented functions, that is functions which provide some direct benefit to the user. On the one hand, examples such as a status display or remote reactivation fall within this category as they are useful features which bring additional value to the user. On the other hand, basic features such as filters to ensure electromagnetic compatibility (EMC filters) or power factor correction (PFC) should not be considered as "user-oriented" as they are required for the basic functionality of the product. Networking functions occupy a middle ground and will require closer attention, though broadly speaking, energy management is the most crucial issue for products with networking functions.

A global overview of standby-relevant functions has been started by the United States' Lawrence Berkeley National Laboratory in California. The authors refer to it as a "periodic table of functions" (Figure 3) and it provides a clear overview of the different categories and types of functions which are relevant to standby mode, giving a qualitative assessment of the power levels associated with each level category of function.

While a strong first step towards a clear categorisation of functions, it is likely still too aggregated to be the basis of a functional adder approach. For example, under the heading "Communication – devices", sub-categories are defined to the level "Data" and "Network". It would be necessary to go beyond this, specifying at least the physical layer (e.g. wired or wireless) given the significant differences in power required to operate these technologies. To the authors original categorisation, the functions "equipment and property protection" and "human safety" have been added to the "Power" category.

Figure 3: The Periodic Table of Functions[21]

Communication - Devices	Communication - People and environment	Timer	Power	Memory	Other
Remote power	Temperature sensor	Timer	EMC filter	Volatile memory	Quick wake
Remote other	Light sensor	Clock	Surge protection	Non-volatile memory	
Data	Audio sensor	Schedule	Equipment and property protection		
Network	Motion sensor		Human safety		
	Pressure sensor		Not charging		
	Fluid/gas sensor		Charging		
	Audio display		Powering		
	Tactile display				
	Visual display				
	Power indicator				
	User input device				

Key

Key
Low power
Medium power
?
High power

6.2 From component to function to service

The question about the level of aggregation posed above leads naturally to a question of abstraction. Should a functional allowance be based on the physical components which make up a product (e.g. a network interface card operating under the IEEE 802.3 Ethernet protocol), the functions which those components provide (e.g. high-speed network access), or the standby services which the user can derive from such functions (e.g. remote reactivation).

[21] Original source: Lawrence Berkeley National Laboratory. Taken from *Standby Power and Low Energy Networks – issues and directions.* 2010. Report by Energy Efficient Strategies for APP IEA 4E Standby Annex.

On the one hand, specifying allowances at the component level will allow for a precise judgment of the appropriate value for the allowance based on the best available example of that technology. On the other hand, not only would it require the determination of a large number of allowances, but it would also not provide manufacturers with any incentive to move away from out-dated solutions to providing a function or service sought by the user. Imagine that there is a new technology which provides the high-speed network access equally as well as Ethernet, but at half the power level. If a manufacturer simply receives an allowance for Ethernet, there is no incentive to make the necessary investment to transition towards the higher efficiency technology.

Specifying allowances at the level of the function provided by the components would seem to overcome this principle shortcoming of component-level allowances, though at the expense of precision in the allowances. For example, given the same hypothetical situation posed above, if the allowance is aligned with the services (i.e. the provision of high-speed network access) but agnostic with regard to the specific technology used to provide that function, then the allowance can re-align with the more efficient technology, giving manufacturers the incentive to invest in the redesign of their products to comply with the new, more stringent requirements.

In order to ensure that the allowances are set at an appropriate level, the functions need to be defined at a sufficient level of specificity so as to distinguish between different implementations of similar functions. For example, "network connection" would not be sufficiently specific as it would include both high- and low-bandwidth connections which have very different standby power requirements. Instead, it could be appropriate to specify certain physical layer attributes along with the function such as "1 Gigabit network connection" or "1 Megabit network connection", with appropriately defined allowances.

The "services" approach for segmenting products was developed in the EU's Lot 26 Preparatory Study: Networked Standby Losses[22] as a way to simplify the challenge of setting standby power levels for all networked devices with their diverse designs and functions. The authors of that study concluded that "network availability", essentially the time that a device can resume its application after receiving a signal over a network, is the essential service provided by networked products when in standby. Creating three classes of the service; high-, medium-, and low-network availability, the study succeeded in segmenting a complex group of products in a way which is meaningful for the user.

In the case of the approach proposed in Section Chapter 4:, which aims to cover all products in all markets, it is not yet clear what classification of functions will be most appropriate. This is an area which warrants further study prior to the implementation of such an approach (see Chapter 8:).

[22] www.ecostandby.org

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Chapter 7: Energy management

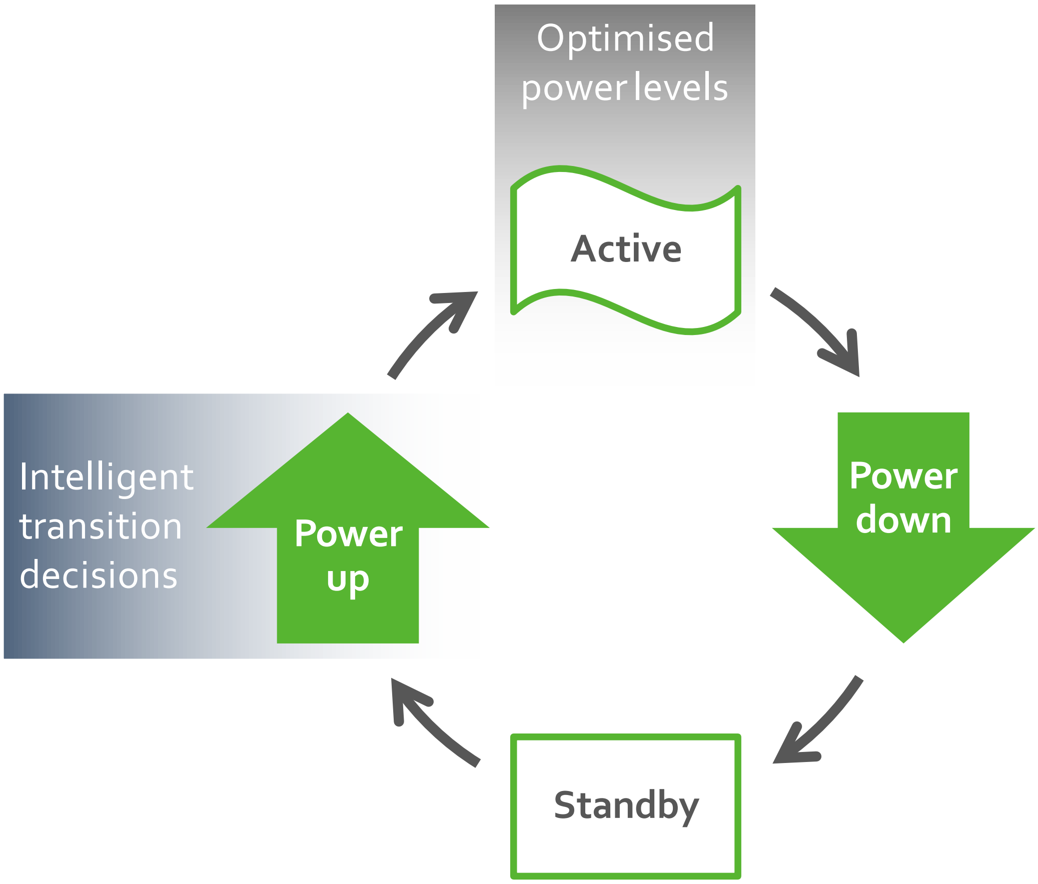
In brief: *Energy management is crucial to achieving low energy consumption across all power modes. Effective energy management leads to lower power levels in different modes, and automated and intelligent transitions between modes. How to ensure intelligent transitions between modes varies in relation to whether the product is simple or complex, and whether the transition is going into a low-power mode or coming out of a low-power mode.*

Ambitious standby power levels are only beneficial if the product actually enters a standby mode during a typical use cycle. The greatest energy savings can be realised from products that combine ambitious power levels with features to ensure that they enter standby mode as quickly as possible and remain there as long as possible. These two elements**,** **low power levels across all modes** and the **automated transitions between modes**, comprise the essential elements of energy management. The critical issue that this energy management has to be autonomous (automatic) while not detracting from user experience of the product. It is effectively an approach that can limit or even eliminate the impact of poor user behaviour.

In its simplest form, energy management can be conceived of as a cycle (Figure 4) beginning with an active mode which transitions to a standby mode (when the main function is not required), which in turn transitions back to active mode (when the main function is again required). While the concept of energy management in this form is simple, creating an optimised energy management system is a complex endeavour which requires two elements:

1. **reducing the power levels** in the active and standby modes to the bare minimum required to provide the service required by the user;
2. **automated and intelligent transitions** between power modes to ensure that the product is always in the lowest power mode given the current and anticipated needs of the user.

Figure 4: The energy management cycle



As represented in the cyclical diagram above, these two elements create vertical and horizontal axes that provide a useful framework to understand energy management. As each axis requires different technical approaches, involving different operators in the value chain, it is relevant for policy makers to consider them individually within the broader framework of energy management.

7.1 Optimising levels

Optimising the power levels within a product's given low power modes is, generally speaking, the responsibility of a single manufacturer and can be achieved simply through using best available technologies in the hardware and software design.

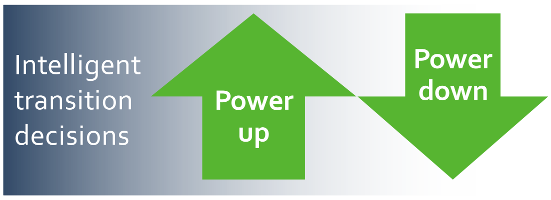
When setting power limits for specific low power modes, policy makers should keep in mind the service which the user expects from the device. While power levels that are set too high result in wasted energy, power levels that are set too low can result in unacceptable performance for the user or non-compliance for the manufacturer. For example, the fast reactivation of a product from a standby mode generally requires more power than a slower reactivation. If a manufacturer complies with a standby power level which is set too low given the current state of the art, the result may be a device which functions unsatisfactorily for the user who may, in turn, deactivate energy management features. The result would be a product which remains in active mode throughout most of its use cycle, leading to much higher overall energy consumption.

For policy makers, the key to addressing power levels effectively is to set limits which are ambitious, while remaining in-line with the current state of the art and the intended use of the device. This can be challenging in the context of a horizontal policy which addresses many products, but can be alleviated by certain approaches, such as the functional allowance approach discussed in Section 2.2.2. But setting power management requirements and limits will itself stimulate innovation to meet these limits at low cost, because there is currently little incentive to do so. The first step in this process is perhaps the hardest.

7.2 Intelligent transitions between modes

To be maximally effective, an energy management system must ensure that the transitions to and from standby modes:

1. match the user's expectations and intended use of the device;
2. maximise time spent in the lowest power mode appropriate for the intended use of the device.



Doing so requires a **determination of the user's expectations** for the device based on observation of the user's interaction with the device and rules to govern how to interpret that behaviour. This process can be quite simple in certain cases, and extremely complex in others. Additionally, there are certain aspects which vary between a "power-up" transition (from standby to active) and a "power-down" transition (from active to standby).

While defining optimal power levels is a challenging political effort that is technically straightforward, ensuring intelligent transitions between modes is a much greater technical problem that can be relatively easily addressed in policy. Indeed, a policy which simply states, "when equipment is not performing its main function, it should automatically enter the lowest power mode which is appropriate for its intended use"[23] could be argued to have adequately addressed power management. That said, the technical hurdles for designing such a systems are quite high, especially in the case of networked equipment which may be reliant on the power states of other devices on the network and which are also subject to frequent requests from the network.

For illustrative purposes, the following sections discuss transitions simple devices, complex devices, and ICT products. The differences between power-up and power-down transitions are also discussed.

[23] This text is loosely based on the power management requirement of the European Union's EC 1275/2008 Regulation.

7.2.1 Transitions in simple devices

Transitions in simple devices are **characterised by straight-forward rules governing the transition** that can be **embedded in the basic functioning of the device**, based on **clear and explicit user interactions with the device**. Simple devices are typically stand alone (not linked to or dependent on other devices) and tend to have a single or limited number of main functions. Taking a domestic coffee machine as an example, the rules that govern the transitions between power modes may be as simple as "enter standby mode three minutes after the end of the last cycle; enter active mode when power button is pushed by the user." In that case, determining the appropriate delay time is the key judgement. This should be based on observing typical use patterns and determining the moment after which users are unlikely to use the device again, following an initial use.

We can imagine that after users make one cup of coffee, they often make any additional cups within a minute or two, presumably for a group of people. After three minutes, we can imagine that the likelihood that a user will attempt to make an additional cup is sufficiently low that the device can enter standby mode without bothering the user.

These rules and the supporting data is relatively easy to obtain. For the product designer, a study of typical user behaviour will suffice. For the device itself, given its limited functionality, it is clear when the user is present and expecting it to be fully functional. At all other times it should be at the lowest possible power level.

7.2.2 Transitions in complex devices

As devices become more complex, offering users a wider range of services, so too does determining at which point a transition between power modes should occur. For example, audio/video products pose a challenge for developing intelligent power-mode transitions as users may have multiple user patterns. For example, users browsing television channels give a clear indication that they are present and engaged with the device and that the device should therefore remain in active mode. On the other hand, what should a television understand of a three-hour period without any input from the user. Has the user walked away, fallen asleep, or are they approaching the climax of an epic film? The correct answer to the question results in very different determinations of the appropriate power mode. If the user is asleep or away, then it is safe to transition to standby mode. If the user is simply watching a long programme, however, powering down to standby would be quite frustrating for the user and may result in deactivation of the energy management features.

Technological developments could provide a solution to these challenges. For example, Sony introduced a line of televisions in 2010[24] which included facial recognition capabilities to determine if a user was present and, if so, he or she was watching the television. If the user was present but not watching the television, then the brightness of the screen could be dimmed. If the user left the room for a certain period of time, then the television could transition to standby

[24] www.guardian.co.uk/environment/2010/may/14/sony-energy-saving-tvs-watch-sleep

(or the picture transmission could be stopped while retaining the audio output) knowing that it would not interrupt the user.

Even more advanced technologies can be imagined. By observing the typical use pattern of the individual user, a product could make better inferences with regard to the appropriate power state. A long, uninterrupted, late-night viewing session may be more likely to be a film if it occurs on a weekend, whereas the same conditions may be more likely an indication that the user has fallen asleep if it occurs on a weekday. The intelligence required to make such judgments need not be embedded in the product itself. For example, in 2011 Google released a Prediction API which gives access to the company's hardware and software infrastructure to add predictive capabilities to other products.

7.2.3 Transitions in networked devices

Networked devices introduce an additional challenge into the determination of an appropriate power mode as, in addition to the user, the device must also interact with other devices. As a result, a device may need to coordinate its power mode with other devices on the network and/or carefully filter network communications to determine if a change in power mode is needed to respond to the needs of the network. In fact the prospect for good energy management outcomes are enhanced if networked devices can automatically coordinate their power management based on individual user requirements and opportunities to minimise power of interdependent devices on the network.

A fundamental distinction is whether such a transition should be made in cooperation with the network (which would require some standard method to communicate power state information across the network) or if individual devices should be designed so as to control their power state individually. The changing power mode in cooperation with the network, the device may be able to avoid being reactivated by routine, non-critical network communications. Such coordination, however, requires the development and wide adoption of standards which do not yet exist. That said, efforts such as the IETF's Energy Management Working Group[25] are working to develop just these standards.

7.3 Powering down versus powering up

In certain respects, the act of powering up (transitioning from a standby mode to an active mode) is fundamentally different from powering down (transitioning from an active mode to a standby mode). These differences can have important implications for the technology that controls the transition. The essential elements of each type of transition are summarised in Table 9 according the following three key characteristics:

- **Trigger**: This is the action or condition which incites the transition

[25] datatracker.ietf.org/wg/eman/charter/

- **Consequences of poor implementation**: These are the consequences which could result from a poorly designed transition
- **Considerations for networked devices**: These are the particular concerns related to networked devices

Table 9: Key characteristics of the two directions of power mode transition

	Power up	Power down
Trigger	Valid signal from the user or another device on the network	Detected period of non-use, with or without a certain delay
Consequences of poor implementation	Unnecessary reactivation leading to energy waste	User annoyance, possible deactivation of energy management features leading to energy waste
Considerations for networked devices	Reactivation via a network signal requires increased standby power to allow for adequate processing of network traffic	Devices could coordinate their transition to standby with other devices on the network so as to avoid being unnecessarily reactivated and to ensure that secondary devices that are not required are powered down

7.3.1 Powering down

To maximise energy savings, devices must be designed to power down to a standby mode as quickly as possible, without interfering with the intended use of the device. As the examples in sections 7.2.1 and 7.2.2 illustrate, however, identifying the user's "intended use" can be a complex determination based on variables such as the user's recent use, normal use, and other environmental factors such as the time of day or the day of the week.

In order to determine whether or not it is appropriate to transition to a standby mode, the device must be monitoring the most appropriate indicator of the user's intentions. In simple cases, such as the coffee machine, this can be as trivial as time since the last use cycle. A similar approach could be used for wet appliances and a number of small kitchen appliances. In more complex cases, such as the television, this could be the presence — or even the attention — of the user. Other alternatives include the power state of related devices. For example, a media player or set top box connected to a television could power down when the user switches the television to standby. This, however, would require standards to allow for that type of communication between the devices.

Designing the power-down trigger should focus on identifying an indicator of the user's expected needs that is both accurate and low cost[26]. The ideal indicator will likely vary between different

[26] Here, "low cost" is used in terms of financial cost of any required components, energy costs for operating the components, and processing/storage costs for any collected data.

types of products and use cases. Given the complexity of determining the appropriate indicator, it is likely best to avoid specifying a particular indicator (e.g. time since last user interaction) in a horizontal policy which is to apply to a wide range of products.

7.3.2 Powering up

In the case of transitioning from a standby mode to an active mode (i.e. powering up), a fundamental distinction must be drawn between networked and stand-alone devices. In the case of stand-alone devices, it is only the user who can instruct the device to reactivate, either through directly interacting with the device (e.g. pressing a power button on the device itself) or via a remote control. In either case, the user must be in close physical proximity with the device.

In the case of a networked device, however, it is not only the user who can reactivate the device locally, but the user and other devices which can reactivate the device remotely as well. For example, a user may need to remotely access a file stored on a network-attached storage device, or a central server may need to update the electronic programme guide of a set-top box in a customer's home.

This legitimate need for remote reactivation is currently complicated by the number of signals broadcast over a network which may reach any given device. The device cannot respond to this cacophony simply by deactivating its network interfaces lest it miss a legitimate request, nor can it reactivate fully to process each and every signal. As such, a networked device in standby mode must be constantly filtering the signals which it is receiving, discarding the unimportant ones and reactivating upon receipt of an important signal.

A final consideration for the transition from standby to active mode is the duration of that transition — referred to as "**latency**" or "**reactivation time**". In short, fast reactivation typically means higher standby mode power levels (under current product configurations and designs) while slower reactivation can generally be achieved with lower standby power levels. In certain cases, a fast reactivation time may be simply a desired attribute for the convenience of the user and always results in improved user experience. The challenge is to achieve fast user initiated reactivation times while achieving very low standby levels. In other cases, it may be required for technical reasons and the overall functioning of the network. For example, computer-to-computer requests made over the Internet generally require a response within one second or less before they signal an error. This is easily satisfied when all devices are in active mode, however when a device must reactivate from a standby mode this can become more problematic. Solutions which would bring a layer of "power-mode intelligence" to such networks are being explored, for example by the IETF's Energy Management Working Group[25]. These technical requirements can be met within the operational parameters of current or future network architecture and in many respects are easier to resolve as the solutions can be at a product level in order to meet current network requirements or network architecture can be adjust to meet future energy management objective. These solutions either work or they don't, so the assessment criteria can be simpler.

7.4 Addressing energy management in horizontal standby policy

The two axes of energy management illustrated in Figure 4 — optimised power levels in any given mode and intelligent transitions between modes — are both of critical importance to ensuring that a horizontal policy is effective in reducing overall energy consumption. That said, they are fundamentally different issues which should be understood and addressed separately.

In the first case, encouraging product designers to use power levels which are appropriate for the expected use of the device across the different modes can be achieved by setting limits via any of the approaches discussed in Section 2.2. It is the responsibility of policy makers to ensure that the limits that they set are both achievable and ambitious. By basing such determinations on real-world data and, in particular, best available technologies, policy makers can generally find a level which achieves the needed balance between realism and ambition. It also needs to be understood that technology will evolve rapidly in time once incentives for innovation in these areas are introduced, so any approach needs to consider dealing with a dynamic market place over time.

The second case, ensuring that devices transition intelligently from one mode to another in such a way as to maximise energy savings and minimise user frustration, is more challenging for the policy maker in the context of a horizontal policy which must apply to a wide range of products. Given the major functional differences between these products, different approaches will likely be required for different types of products. For example, for some products, the time since the user's last interaction is likely a strong indicator of the appropriate mode to enter. For other products, a more complex indicator, such as the user's presence or interaction with a connected device may be more appropriate. As such, a common repository containing optimal power levels and product definitions could also conceivably include appropriate indicators for different product types based on the careful analysis of experts. As such aspects are more closely linked to the product type and not the use setting, there are opportunities to reduce the collective administrative burden of establishing horizontal standby policies worldwide by sharing such a resource.

Chapter 8: Next steps

In brief: *Before the recommended approach is operational, its technical and managerial details must be defined. This should be done in cooperation with ongoing and future projects recommended in the* Standby Power and Low Energy Networks – issues and directions *report.*

In order to move from the recommendation made in this report to a workable, internationally-harmonised policy framework for standby power, several intermediary steps need to first be accomplished. These steps can be divided in to seven main categories:

1. Defining the managerial details of the repository
2. Defining the technical details of the repository
3. Defining functions
4. Defining allowances
5. Specifying energy management for stand-alone products
6. Specifying energy management for networked products
7. Preparing guidance for adherents

While some of these steps could be carried out in parallel, others would require the outcome of previous studies in order to begin. The order in which the categories are presented above corresponds roughly to the order in which the studies would need to be carried out. Details of the studies are provided in the sections below.

8.1 Managerial details of the repository

Questions surrounding many of the functional details of the repository still need to be resolved. These include:

- What organisation could host the repository?
- Which countries would be well positioned and/or interested in taking part in the interim period?
- How would additional countries join the programme?
- How would the repository be governed? Under what conditions could a vote pass? Would any/all of the member states have veto power?

Answering these questions clearly will allow an interim managerial structure to be established which would allow progress to be made on the questions which follow.

8.2 Technical details of the repository

While this report provides a broad outline of the functioning of the repository, there are still many questions which would need to be answered before the repository could become operational. These include:

- Precisely what information should the repository include? Should it be limited to the allowances and supporting data as illustrated in Figure 2, or should it also include definitions of functions and modes, bibliographic references, etc.?
- For the allowance data, how should it be structured, using which technology, and providing what functionality to the user?
- What would be the impact (in terms of accuracy and workload) of calculating additional tier and track values for the allowances via a formula instead of basing each value on observed data?

8.3 Defining functions

As discussed in Chapter 6:, an open question remains as to the correct definition and segmentation of functions for this type of repository. Once the intended functioning and use of the repository are defined through studies addressing the above questions, a clearer picture of the needs and expected uses of the repository can be obtained which will influence the structuring of the functions. This could be achieved in coordination with and by supporting Project E "Mapping functions into modes for common products", as detailed in the *Standby Power and Low Energy Networks – issues and directions* report.

8.4 Defining allowance

Once the functions have been identified, the work of defining the allowances can begin. While much of this could be based on existing research, it would be necessary to compile, check, and enter this data into the repository's database. This work could be accomplished in coordination with and by supporting Project H "Power required for functions" as detailed in the *Standby Power and Low Energy Networks – issues and directions* report.

Additionally, a scheme for monitoring and updating the allowances would need to be devised and accepted to ensure that the allowances remain up to date.

8.5 Guidance for adherents

Finally, once the repository and broader policy framework are operational, it will be necessary to provide guidance to the participating governments on how to use the repository and how it can be best reflected in national law. This study would focus on providing best practices and recommendations, leaving the final decision to the participating government.

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