Staying Connected:
Unravelling energy waste issues in network standby

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Contents

1. Overview

Electronic products are an integral part of modern life. There has been great advancement in the capability and functionality of such products with network connectivity between electronic products rapidly becoming readily available. Moreover, consumers now expect to be able to select from a wide range of products with this type of functionality across all equipment types. With the growth in the demand and availability of appliances with network capabilities comes increased energy waste. Yet significant potential energy savings could be realised in networked products.

Governments cannot stop the tide of technology innovation, nor would they want to. However, it would be remiss of Governments not to address energy waste. Hence, it is important that Governments develop policy that enhances consumer choice and services while delivering the most energy efficient technology.

Network standby is the energy used by a product when it remains connected to the network even though no primary function is being performed. It is applicable to both network equipment (e.g. modems, routers and switches) and "networked products" ranging from home entertainment and ICT products like computers, televisions and game consoles to white goods. To date most policy initiatives do not cover network standby and designers are only giving it limited consideration.

This report presents policy makers with an overview of the fast moving developments in network standby and provides a window into what policy options might be available to reduce network standby energy waste.

Based on literature reviews of the research and studies conducted to date, as well as data on the topic of network standby, this report aims to:

- ⋏ Describe network standby and the issues surrounding the associated energy waste
- ⋏ Provide a review of the contribution to policy development made by the findings of recent research conducted into network standby.
- ⋏ Obtain insights into policy options from international experts in the area of network standby.
- ⋏ Provide a discussion on policy options and how these can be progressed to address network standby.

Based on the research conducted to date including our own interviews with international experts, a range of policy options that could provide solutions to network standby are described. They are discussed in detail in Section 7 and include:

- ⋏ Amendments to current policies
- ⋏ Comparative Labels
- ⋏ Endorsement labels
- ⋏ Horizontal regulation – functional adder approach
- ⋏ Clustered Horizontal Approach
- ⋏ Certification Scheme
- ⋏ Intelligent Energy Management

While there are several options, work currently being undertaken developing appropriate definitions, test methods and procedures and investigating in detail how networked products behave, will assist in providing more clarity and will be crucial in maximising the energy savings any policy implementation can make. As discussed in Section 8, in order to allow the proposed policy options to progress to practical and implementable programmes, further work will need to be undertaken to:

- Enhance international cooperation
- Establish commitment to the guiding principles
- Develop test procedures and methodologies
- Engage with network technology developers
- Further develop the understanding of power requirements for networked products.

2. Background

Standby power was first recognised as an area of significant energy waste in 1986. Standby power consumption is the power used by appliances when they are switched off or not performing their primary function. For example, a device will continue to draw power after the user switches it off with the remote control. Experts estimate that standby energy accounts for in excess of 1% of global electricity consumption, with approximately 10% of residential electricity use comprising standby power (EES 2011). It is present across all product categories including white goods, ICT, home entertainment and small appliances.

Year	Event
1992	ENERGY STAR Program commenced
1999	IEA 1 Watt plan
2001	EU Voluntary code – consumer electronics
2002	Australian standby plan released
2003	European manufacturers Voluntary Code TVs
2005	G8 leaders endorse 1 watt plan Korea publishes 1 watt plan IEC 62301 Measurement Standard
2006	Californian 3W TV requirement
2007	Asia Pacific Partnership Standby project
2008	Korea standby warning label introduced
2009	4E Standby Power Annex established Australia, New Zealand, China, EU, Korea, & USA Standby MEPS and labels. Brazil and Japan – Standby Labels
2010	EU Horizontal MEPS at 1W APEC Standby Power project
2011	SEAD Network Standby Collaboration Group
2012	Canada MEPS for Audio, Video and TVs
2013	EU Horizontal MEPS at 0.5W Australian Horizontal MEPS

ENERGY STAR® was the first program to address standby power efficiency with its launch in 1992. These efforts turned global in 1999 when the International Energy Agency urged governments to act on the standby power problem, releasing a 1 watt plan and setting a goal to reduce standby consumption to below 1 watt. This plan was endorsed by the G8 leaders meeting at Glen Eagles in 2005. Since this time, Governments have been working cooperatively to tackle the issue through programs such as 4E, APEC and the Asia Pacific Partnership program. Additionally governments in Europe, Asia, North America and Australia have moved to reduce standby power waste through regulation and voluntary codes to address energy waste in low power modes. For example, the Republic of Korea has had great success, first introducing voluntary measures in 2005, with mandatory warning labels in 2008 along with efficiency regulations for an expanding range of electronic appliances setting challenging but achievable low power mode requirements.

A decade on from the International Energy Agency announcement, standby power consumption in appliances is showing signs of decreasing. (4E IA 2012). In 2013, the European Union will become the first region to move beyond 1 watt, introducing regulation for off and passive standby power mode at 0.5 watts or below. While standby power waste has not been completely erased, great results have been achieved with a large reduction in energy consumption. A variety of policy tools have proven successful in reducing energy consumption and are available for governments wishing to act in this area.

Although the standby power issue would appear to be well on the way to being solved there is a group of products that are both creating a new type of energy waste and reducing the success of current measures. Networked products, that is appliances that have the capacity to communicate with other appliances via the internet or other networks, are not currently covered in most standby measures for the networked function. The number of products with network connectivity is rapidly increasing, a pattern which will continue as smart metering and smart houses become the norm and consumer expectation and desire to be "connected" grows. Taking action to curb energy waste in

networked products will enable governments to capitalise on the success of standby power initiatives and prevent increased energy waste from these new technologies.

3. What is network standby?

A "network" enables the communication among products via physical components or equipment links, using wired or wireless connections. Network products or equipment are devices that drive the network (e.g. modems, routers and switches). Networked products or edge devices are any appliances that have the ability to use the network, including but not limited to home entertainment, ICT, lighting or white goods.

The term "networked standby" was first used in the 2007 TREN Lot 6 study (Fraunhofer IZM 2011). This study recognized that network services were becoming increasingly common in appliances and these services required a product to remain responsive, that is on (at the ready), and that off and sleep modes (non-network low power modes) might never be utilized. This situation would result in increased energy consumption.

> *Network Standby is the energy used by a product when it remains connected to the network even though no primary function is being performed.*

Simply put, network standby is the energy used by a product when it remains connected to the network while no primary function is being performed. Network standby is applicable to both network equipment (e.g. modems, routers and switches) and "networked products" or "edge devices" ranging from home entertainment and ICT products to white goods.

Over the previous decade, work in the standby field has led to the acceptance of standardised definitions for power modes such as on, off and sleep (standby). When working in a global environment, it is important to establish definitions that are internationally accepted and in turn can be incorporated into policy development. These modes have provided technical instruments for identifying different power states and allowed for the implementation of energy efficiency initiatives to reduce consumption. Unlike on, off or standby mode the definition of network standby has been difficult to pin down as it is not a distinct mode defined by what a device is doing, but rather a state or condition defined by what the device is not doing and by the processes that are still maintained. Addressing network standby will be much easier if it is viewed not as a singular operational mode but rather any low power mode in which the device has persistent network connectivity. Network standby modes may distinguish different levels of network availability and by that different resume-times-to-application, physical layers in use and degree of connectivity to the network (in terms of what protocols implemented). These elements will vary greatly and effect power consumption.

Network standby therefore, is not a mode but a state that could occur in any low power mode. It occurs when equipment provides reduced functionality, but retains the capability to resume applications through a remotely initiated trigger via a network connection. Network standby states typically exist as a non-lineal continuum from no link to establishing and maintaining a link and checking for reactivation requirements and re-establishing the link, to actually connecting and

receiving or providing information. It is a state the products are in which could require a continuum of power consumption, not a specific discrete mode. See Figure *1* below.

Figure 1: Discrete Modes vs Complex State
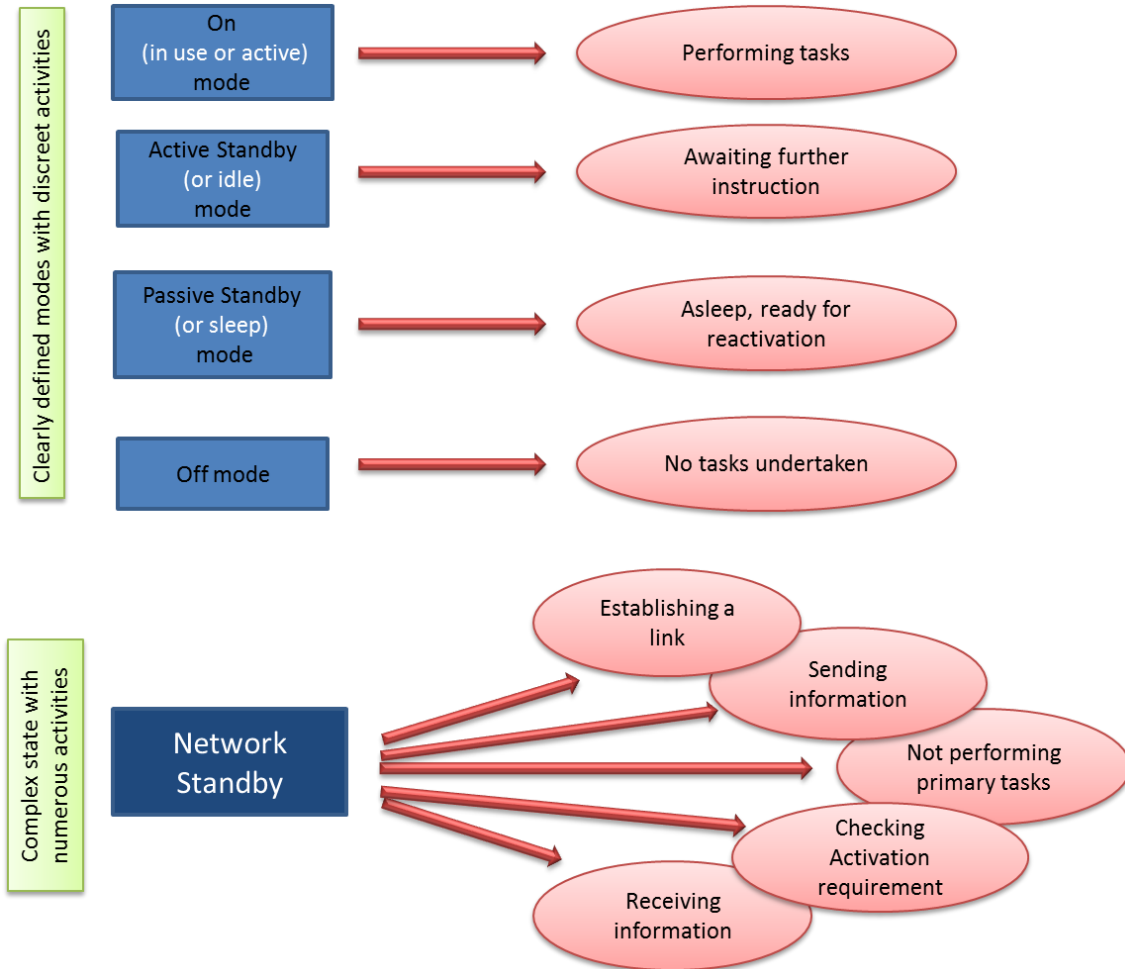
4.   Why network standby is an issue

Network standby is an issue requiring attention from governments and industry due to the rapidly rising level of energy consumption and the associated waste when products are in the network standby state. This increase in consumption can be apportioned to a number of factors.

Network standby requires attention because:

❖ *Availability and demand for networked products is increasing rapidly*

❖ *Significant energy waste could be transformed into energy savings*

❖ *Networked products potentially reduce standby power energy savings*

❖ *Networked products are not covered by current policy initiatives*

❖ *Energy Efficiency is not a priority for network designers*

Growth in the demand and availability of appliances. Network connectivity is rapidly becoming available in more and more products (e.g. televisions, white goods, lighting). Experts predict that nearly all major consumer products will have this feature in the not too distant future. The introduction of "smart" grids and "smart" houses will see both consumers and electricity suppliers keen to network appliances and remotely control the timing and length of usage. The 2010 survey of household products in Australia reported "Appliances connected to network are becoming increasingly prevalent within households", finding 6% of non CRT televisions are already network capable (EES 2011).

Significant energy waste
Conservative estimates indicate that the excess power consumption that is wasted energy due to network connectivity could exceed 550 TWh globally by 2020 (BIO Intelligence Service 2011). With global energy consumption of networked products likely to reach at least 850 TWh per year, efficiency measures have the potential to save more than half of this.

As shown in Table *1* there are three scenarios for energy waste and the potential energy savings in networked products. The lower-end estimate of wasted energy is 20% due to excess connectivity and/or the use of suboptimal technologies. This level of saving could be achieved through the implementation of power management and power-level reduction policies. The maximum estimate of around 65% of energy assumes a low-power state of 1W for all network-connected equipment. This 65% energy savings would require both technical improvements of the products and their components and the implementation of effective power management policies.

Table 1: Potential global energy savings estimates from networked products by year

Global Estimate Year	20% savings potential TWh	33% savings potential TWh	65% savings potential TWh
2008	85.11	140.29	275.36
2015	129.78	213.92	419.90
2020	170.40	280.87	551.31

Source: BIO Intelligence Service 2011

Networked products potentially reduce standby power energy savings

Governments and industry have worked together over the past decade to reduce the energy wasted by products in standby low power modes. Through a combination of voluntary and mandatory initiatives, including power consumption limits and power management requirements, major globally traded products are trending towards the 1 watt standby goal launched by the IEA. The addition of network capability built in to products could undermine this success, for the simple fact that products may not be allowed to enter the standby and/or off mode. Products being woken unnecessarily or constantly being alert to the activities of the network may prevent the use of the lowest power modes and thereby decrease or remove the energy saving benefits that have been achieved in this area.

Current policy doesn't accommodate networked products

The coverage of networked products in most existing policies that deal with low power modes has been limited. Network equipment is generally not covered at all by current policies, because this type of equipment is required to remain in active mode virtually all the time in order to perform its primary function. There are also issues of how to create policies for networked equipment when standardised definitions and test methods are still being developed and have not yet been internationally agreed to.

Energy Efficiency is not a priority for network designers

The key focus areas of network designers have generally been to increase the speed, quality and quantity of information which can be transferred over the network. Energy efficiency as a rule has not been incorporated into the design processes as it has not been seen as part of the goal. In the mobile world, telephones, laptops etc., energy efficiency is of great importance and thus is seen as a core criteria in design of networked products in these fields. One of the challenges will be to increase the profile of energy efficiency to designers and transfer some of the technologies and lessons developed for mobile technologies into appliances and electronics that are tethered (require a socket plug).

5.   Network standby - International studies

The IEA produced the work *Guiding Principles for Energy Efficiency in Networked Products* in 2007 raising awareness of the need to consider energy efficiency implications when networking products and appliances. These principles were endorsed as being fundamental to any policy development in the area of networked products by the Asia Pacific Partnership (APP) standby project, the 4E Standby Annex and the APEC standby projects in 2010.

Guiding Principles

Network Connected Devices – Initial Hardware Objectives:

> All digital network technologies should actively support power management and should follow standard (international) energy management principles and designs.

> Connection to a network should not impede a device from implementing its own power management activities.

> Devices should not impede power management activities in other devices connected to the network.

> Networks should be designed such that legacy or incompatible devices do not prevent other equipment on the network from effective power management activities.

> Network connections should have the ability to modulate their own energy use in response to the amount of the service (level of function) required by the system.

Network Connected Devices – Initial EE Policy Objectives:

> Governments should ensure that electronic devices enter low-power modes automatically after a reasonable period when not being used (power management).

> Governments should consider limits on energy consumption in low-power modes for networked products and develop technically feasible options where these are warranted.

> Governments should ensure that network-connected electronic devices minimise total energy consumption, with a priority placed on the establishment of industry-wide protocols for power management.

> Governments should ensure that electronic devices be shipped with power-saving features enabled by default

> Energy efficiency specifications should not require a particular hardware or software technology.

> Requirements for networked products need to be generic and performance based.

Source: 2010 Guiding Principles adapted at Network Standby Workshop Paris 2010 from the IEA 2007 Guiding Principles document.

In 2009 the European Commission (EC) commissioned the EuP preparatory study *Lot 26: Networked Standby Losses* (available at http://www.ecostandby.org/). This in-depth study undertaken by Fraunhofer IZM and Bio Intelligence Service involved wide consultation with industry organisations and other interested stakeholders covering issues as broad as market analysis, consumer behaviour, best available technologies, and improvement potential. The study concluded in 2011 making a recommendation to implement a horizontal policy approach to tackle network standby, including both power management and minimum energy efficiency requirements. The report acknowledged that while the 'one size fits all' approach is problematic, it is necessary to ensure the network waste minimising measures are implemented as broadly as possible. This approach was refined by the Dutch Government's NL Agency who proposed that the findings from the study become an amendment to current EC standby regulations (EC/1275/2008). The EC is currently preparing an impact assessment on the proposal and document for voting by the EC Regulatory Committee with the aim of implementing a two tier regulation.

Simultaneous to the *Lot 26* study the Asia Pacific Partnership (APP) and the 4E Standby Annex combined resources to commission Energy Efficient Strategies (EES) *Standby Power and Low Energy Networks: Issues and Directions* (available at 4E Standby Power Annex). As part of the report's development, an international workshop was held in Paris. The report was endorsed by not only APP and 4E but at the APEC international Workshop in Tokyo. The EES research reviewed existing work into standby and network energy waste and extensively consulted with key experts on issues relevant to network standby. Importantly the authors proposed a pathway to deliver an implementable policy solution for network standby waste, in the future see Figure 2. The report acknowledged that in order to achieve a comprehensive policy framework, a series of research projects on a number of areas where the existing knowledge is insufficient needed to be carried out.

Figure 2: Pathway to network standby policy framework
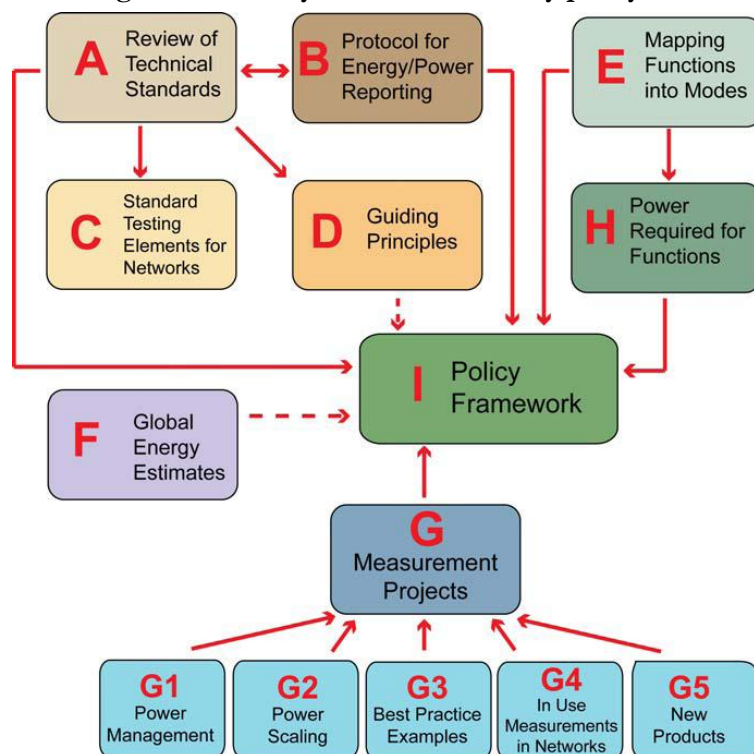
Source: EES 2010

Subsequently several projects were commissioned by APP and IEA's 4E Standby Annex with the following reports published throughout 2011:

> *Estimate of the Energy Wasted By Network Connected Equipment (BIO Intelligence Service)*
> *List of Technical Standards for Equipment Connected to Energy Using Networks (BIO Intelligence Service)*
> *Testing Products with Network Connectivity (Nordman, B.)*
> *Energy Reporting on Networks (Nordman, B)*
> *Cutting Edge Technology Feasibility Study (ECOS)*
> *Power Scaling in Proportion to Data Processing (ECOS)*
> *Investigation and Exploration of Network Power Consumption in Complex set Top Boxes (STBs), Voice over Internet Protocol (VOIP) Telephones and Game Consoles (ADT)*
> *Examples of Low Energy Product Designs (ECOS)*

These projects significantly improved the understanding of the network standby issue. Importantly one project quantified the scale of the network standby problem estimating the worldwide energy wasted by network-connected equipment is between 85 TWh and 275 TWh in 2008, and is likely to increase to between 130TWh and 420 TWh in 2015 and between 170 TWh and 551 TWh in 2020. Others explored the power management and best practice examples of existing and cutting edge technologies (such as power scaling, network proxying and Energy Efficient Ethernet) that could be utilised by policy makers in the development and implementation of energy efficiency measures for networked products to reduce network standby waste. The reports can be accessed at: 4E Standby Power Annex.

These completed projects have furthered the collective knowledge of network standby creating a firm basis for developing and implementing effective measures. However, there are still many unknowns including developing methodologies for data collection, standardised test procedures, and establishing globally accepted definitions. To this end three international organisations are working cooperatively, funding research and driving discussion to ensure lasting implementable policy options can be developed.

International Energy Agency (IEA) network standby project - The IEA is developing an overarching report which will promote the implementation of policies that address the network standby issue. The report is to be finalised in September 2013, and will assist policy makers, discussing steps and processes which need to be addressed as well as recommended pathways to policy adoption. As part of the project, the IEA is investigating the potential of creating software that will allow the network standby power consumption of products to be tested in situ by simulating a network connection. This study will assist the development of methodological measurement approaches for network standby that will be crucial to development of baseline data, compliance and evaluation of polices.

Super-Efficient Equipment and Appliances Deployment (SEAD) Network Standby Collaboration - The Network Standby Collaboration group has invested in a project that will provide the foundation for the future development of test methods and procedures as well as policy development. The Standardized Definitions for Network Standby & Application to Televisions is due to be completed in 2013 and will

set out standard terminology and use the example of televisions to demonstrate the application of this. Establishing an agreed set of standardised definitions early in the development of the solution process means that some of the difficulties in aligning practices globally can be overcome. Also due for completion in 2013 is the *Real World Usage Of Networked Products* projects that will investigate how consumers and their products interact with the network in real life situations. This will ensure future policies are based on real life rather than theoretical assumptions ensuring that the maximum energy savings can be gained without interfering with functionality desired by users. The final project is working through the steps and developing materials that would see the creation and acceptance of an IEC test standard for network standby.
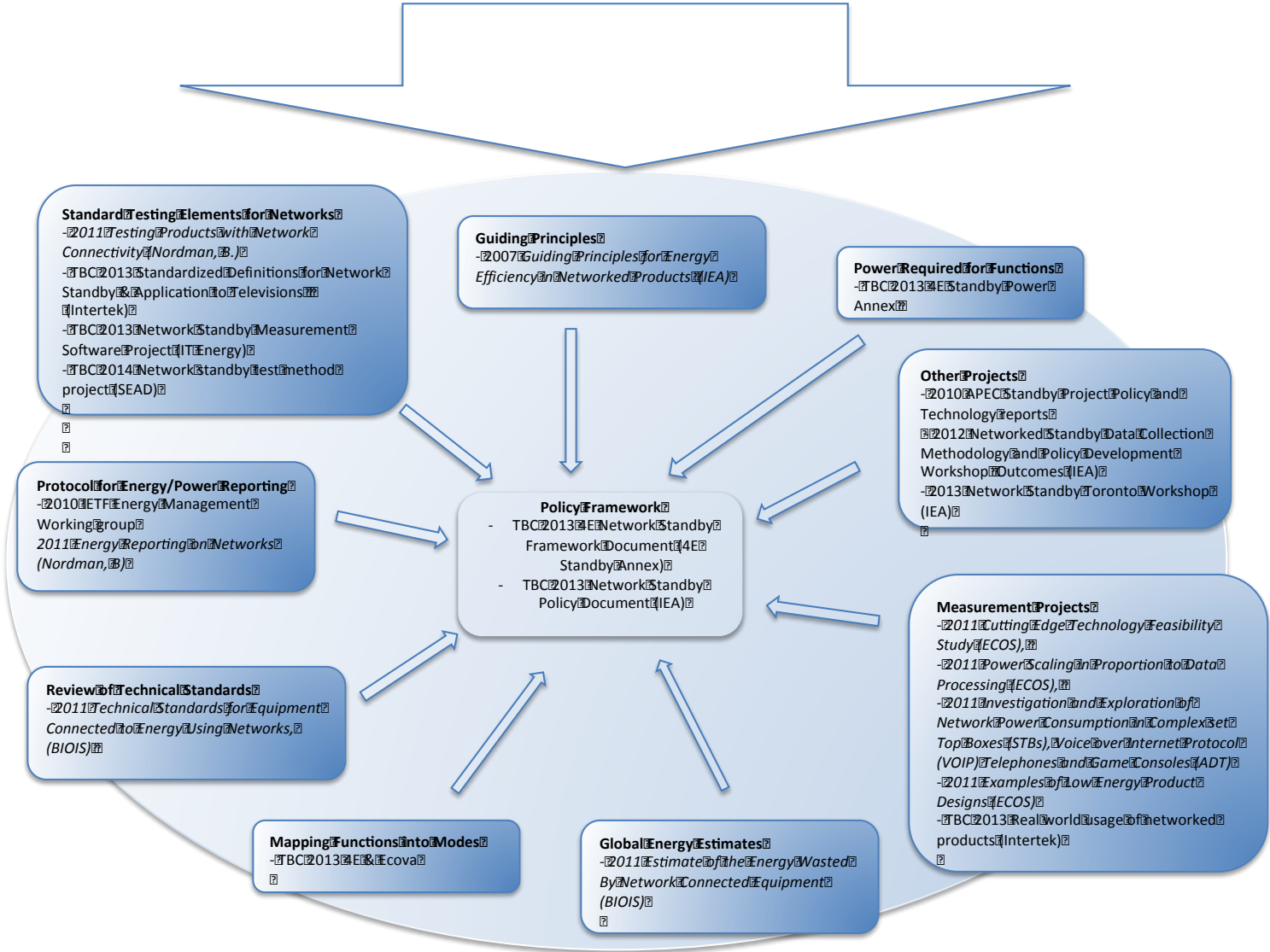
4E Standby Power Annex – The Annex has committed to completing 2 projects in 2013 that will investigate the most common functions that are present in the various operational modes for major product groups and then evaluate the power requirements for each of these. These projects will improve understanding of the levels of power consumption required by products in low power modes and improve understanding on the possibilities of using functional adder approach in policy (see section 6.c for more detail). In addition the Annex is collaborating with the IEA project on developing the components of a policy framework to address network standby issues and assist policy makers take action to curb network standby waste.

Alongside these international efforts it should be acknowledged that in 2010, the Internet Engineering Task Force (IETF) established an Energy Management Working Group (EMAN), to explore avenues for "operating communication networks and other equipment with a minimal amount of energy while still providing sufficient performance to meet service level objectives". The group is in the process of producing a number of papers which can be viewed at http://datatracker.ietf.org/wg/eman/. Another noteworthy development is the establishment in 2011 of the Korean Smart Convergence Household Appliances Forum. The forum has members from the major electronics companies, education institutions and R&D labs. They are working together to establish standard platforms and protocols to allow different brands of networked products to communicate and operate within a smart house or home network. The forum is hoping to achieve easier user interfaces and be able to promise an interoperability guarantee.

Figure *3* demonstrates how all the projects mentioned above are assisting in establishing a policy framework which will enable governments and industry to address energy waste in networks.

Figure 3: Network Standby Policy Pathway by Projects

Standard Testing Elements for Networks
- *2011 Testing Products with Network Connectivity (Nordman, B.)*
- TBC 2013 Standardized Definitions for Network Standby & Application to Televisions (Intertek)
- TBC 2013 Network Standby Measurement Software Project (IT Energy)
- TBC 2014 Network standby test method project (SEAD)

Guiding Principles
- 2007 *Guiding Principles for Energy Efficiency in Networked Products (IEA)*

Power Required for Functions
- TBC 2013 4E Standby Power Annex

Other Projects
- 2010 APEC Standby Project Policy and Technology reports
- 2012 Networked Standby Data Collection Methodology and Policy Development Workshop Outcomes (IEA)
- 2013 Network Standby Toronto Workshop (IEA)

Protocol for Energy/Power Reporting
- 2010 IETF Energy Management Working group
2011 Energy Reporting on Networks (Nordman, B)

Policy Framework
- TBC 2013 4E Network Standby Framework Document (4E Standby Annex)
- TBC 2013 Network Standby Policy Document (IEA)

Measurement Projects
- *2011 Cutting Edge Technology Feasibility Study (ECOS),*
- *2011 Power Scaling in Proportion to Data Processing (ECOS),*
- *2011 Investigation and Exploration of Network Power Consumption in Complex set Top Boxes (STBs), Voice over Internet Protocol (VOIP) Telephones and Game Consoles (ADT)*
- *2011 Examples of Low Energy Product Designs (ECOS)*
- TBC 2013 Real world usage of networked products (Intertek)

Review of Technical Standards
- *2011 Technical Standards for Equipment Connected to Energy Using Networks, (BIOIS)*

Mapping Functions into Modes
- TBC 2013 4E & Ecova

Global Energy Estimates
- *2011 Estimate of the Energy Wasted By Network Connected Equipment (BIOIS)*

6. Policy developments in network standby

a. Europe

The primary policy development in network standby in the European region is based on the Lot 26 proposal and is currently being considered by the EC Regulatory Committee, with a vote expected in the first quarter of 2013. The aim is to begin implementation in 2015 with a lowering of power limits in 2017. This proposal recommends a horizontal implementing measure be introduced as an amendment to the existing Commission Regulation (EC) No 1275/2008, covering the power management and minimum requirements for efficient networked standby for the products listed under the existing regulation. The final report of the Lot 26 project and relevant documents can be found at Ecodesign.

The proposal is based on the high network availability (HiNA) or a resume time of less than 1 second and low network availability (LoNA) resume time of more than ten seconds. The HiNA category will be a limited list of products and all other products will be categorised as LoNA. Each connection on a product will be required to meet the power consumption requirements appropriate to that connections' condition as set out in Table 2 below.

Table 2: Proposed Tier 1 and Tier 2 Network Standby Power Limit levels

Networked standby condition	Tier 1 (Jan 2015)	Tier2 (Jan 2017)
HiNA	12W	8W
LoNA	6W	3W

A distinct advantage of this horizontal policy approach is that it can be introduced rapidly as an amendment to the current standby and off mode regulation EC/1275/2008 by including provisions to limit consumption in networked products. It is also adaptable to the rapidly changing market and can be conveniently applied across many product types and will be able to capture new "converged" products and cover products that may fall into the gaps between several existing and future vertical measures. It is however recognised that a "vertical" product specific approach could specify tougher requirements for the networked modes of particular products where necessary. This proposed EU approach, while not perfect can be implemented quickly as it is covered under Eco design regulation as an amendment and does not need to be looked at in a separate process.

Note: A horizontal policy approach is one that applies the same criteria or policy measures across broad groups of products, whereas a vertical approach applies product measures specifically designed for one type of product category. Simply put it horizontal policy is a "catch all" approach.

b. Korea

The Korean Government has identified energy saving measures for home networked products as one of three major efficiency targets to be addressed by 2015 (MKE & Kemco 2011). A plan has been developed that includes support for R&D into near zero standby power technology particularly for smart household and networked appliances. Korea has also begun incorporating network

standby power limits into the current efficiency rating label and e-standby programs, with plans to expand the range of products, covered by network standby power limits over the next few years.

Incorporation of network standby mode power limits into energy label programs has been implemented for 11 products. Korea has used the EuP Lot 26 study's definition of network standby mode "Networked standby modes are conditions, in which the equipment provides reduced functionality, but retains the capability to resume applications through a remotely initiated trigger via network connection. Networked standby modes may distinguish different levels of network availability and by that different resume-times-to-application as well as power consumption."

Network standby has been incorporated into Korea's mandatory energy efficiency rating labelling program as one of the criteria a product needs to meet if it is to receive the highest efficiency rating of 1. That is network standby is considered a part of the product's overall energy efficiency that includes in-use, and standby limits as well. Seven products already included in the labelling scheme now have network standby power limits as well. The products and required limits are listed in Table 3

Table 3: Network Standby Mode Power Limits for Korean Energy Efficiency Rating Label.

Target Product: Energy Efficiency Label Scheme	Low Power Mode Limits For Networked products
Air Conditioners	≤ 1W (Passive Standby) ≤ 3W (Active Standby)
Gas Boilers	≤ 3W (Sleep Mode)
Water Heaters	≤ 3W (Sleep Mode)
Washing Machines	≤ 2W (Active Standby)
Drum Washing Machines	≤ 2W (Active Standby)
Dish Washers	≤ 3W (Active Standby)
TVs (Effective July 1 in 2012)	≤ 1W (Passive Standby) ≤ 2W (Active Standby)

Source: Sangguk Jung 2012.

Korea's e-standby program, allows manufacturers to voluntarily label products that meet efficiency standards in standby power modes. This program is designed to promote the most efficient products in the market to consumers. Network standby mode limits have been included for 12 products in the e-standby scheme as shown in Table 4.

Table 4: Network Standby Mode Power Limits for Korean E-standby Endorsement Label.

Target Products: - E-standby program	Low Power Mode Limits For Networked products
Computers:	TEC including sleep mode
Printers, Facsimiles, Copiers, Scanners, Multifunction Devices	Various on Off Mode and Sleep Mode
Door Phones, Cord/Cordless Phones	≤ Various (Standby Mode)
Set-Top Boxes	≤ 1W (Optional, Passive Standby) ≤ 10~20W (Active Standby)
Digital Convertor (Set top Box)	≤ 1W (Sleep Mode) Must enter sleep mode ≤ 4 Hours
Modem	≤ 0.75W (Off Mode) ≤ Various (Standby Mode)
Home Gateways	≤ 10~20W (Sleep Mode)

Source: Sangguk Jung 2012.

c. ENERGY STAR®

The US Environmental Protection Agency and Department of Energy operate this voluntary endorsement labelling program. Their focus is primarily domestic, however many specifications for consumer electronics and IT equipment are used internationally. ENERGY STAR® has considered network connectivity in its specifications since 1992, covering PCs and monitors with a further eight specifications now addressing some aspect of network standby.

Current ENERGY STAR® specifications that address network connectivity in some manner include those for: audio/visual equipment, game consoles, televisions, set top boxes, servers, computers, imaging equipment, digital TV adaptors (analogue converter boxes) and displays.

Table 5: ENERGY STAR® Current Specifications that Consider Network Connectivity

Product	Network Connectivity Specifications
Audio Visual Equipment	Network connectivity in test procedures Extra power allowance for network connectivity in sleep mode Extra allowance for network connectivity when device on mode Auto-power down requirement To qualify for ENERGY STAR, AV products that offer one or more Networking / Control Protocol options must meet all applicable ENERGY STAR criteria in all networking and control configurations.
Computers	Network connectivity in test procedures -Test procedure requires Ethernet connection Extra power allowance for network connectivity in sleep and on modes Auto-power down requirement Reduce link rate in sleep mode Short latency on waking Must ship with Wake –On-LAN (WOL) enabled if for business market Reward for systems that support network connectivity proxying
Displays (monitors)	Auto-power down requirement
Digital TV adaptor	Auto-power down requirement
Game Consoles	Network connectivity in test procedures Extra power allowance for network connectivity in sleep mode Auto-power down requirement
Imaging equipment	Network connectivity in test procedures

	Extra power allowance for network connectivity in sleep mode
	Auto-power down requirement
Set Top Boxes	Extra power allowance for network connectivity in sleep mode
	Extra allowance for network connectivity when device is fully on
	Auto-power down requirement
Servers	Network connectivity in test procedures
	Extra power allowance for network connectivity in on mode
Televisions	Maximum allowable energy consumption for downloadable acquisition mode (0.04 KWH/day)

Version 3 of the Audio/Video specification is also now complete and scheduled to be introduced in 2013, with significant changes including a new allowance for multiple networking and control protocols. Other recent developments from ENERGY STAR® include a revision of the specifications for residential refrigerators and freezers which will consider inclusion of networking provisions and how this might be applied across other appliance categories. The ENERGY STAR® is currently developing a new product specification for Small Network Equipment defined as: a device whose primary function is to pass Internet Protocol traffic among various network interfaces/ports. The Draft 2 Version 1.0 Small Network Equipment Specification was released on 15 November 2012. A specification for Large Network Equipment, defined as: network equipment that is rack-mounted, intended for use in standard equipment racks, or contains more than eleven (11) ports for wired network, is currently underway.

7. Network standby policy options

Possible Policy Options:

❖ ***Amendments to existing standby power policy approaches***

❖ ***Labelling***

❖ ***Horizontal functional adder approach***

❖ ***Clustered horizontal approach***

❖ ***Certification Scheme***

❖ ***Intelligent Energy Management***

While governments can apply the successful collaborative approach used to tackle standby power to the network standby problem, existing policy and testing procedures for dealing with standby power are not directly transferable to network standby. As previously discussed, networked products are likely to have multiple modes of operation beyond a simple on/off and therefore current policy approaches of setting simple power limits by mode need to be adapted to cater for more complex energy requirements. In discussion with a range of international network standby experts, several potential policy options were raised, ranging from those that can be implemented quickly within existing policy frameworks to those that require long term changes within industry and international bodies. In order to maximise energy savings in the network standby area an adaptable ongoing strategy would work best. Any policy approach needs to be able to deal with the rapid changes in technology and products, but cannot afford to wait to begin addressing the issues as the environment in which these policies will operate, is and most likely always will be fluid. The following policy options were raised as possible partial solutions that could be used in combination or in a staged approach to achieve the best outcomes.

Amendments to Existing policies

Amending existing policy is the way network standby is currently being addressed. In Europe amendments to the Standby Commission Regulation (EC) No 1275/2008 have been proposed and in the US and Korea amendments have been made to existing labelling schemes to include networked products. (See section 6 for more details.)

There is some criticism that this approach will not be able to maximise potential energy savings, however it is generally agreed that the ease and speed with which these measures can be introduced means that prevention of waste, no matter how small can begin in the short term, without having to wait for longer term solutions to be developed. Also this policy option would increase the priority of energy efficiency with network designers. It is widely acknowledged that these measures should be considered as a first step that will contribute to reduce some of the issues associated with network standby but there are other areas that will need to be tackled over time.

Network Standby Labels

Energy labels specifically for network standby are not considered to be particularly suitable since the benefits for the individual user are small and there is a risk that the labels give the wrong message about total energy use. However several experts thought that the success and familiarity of labeling systems could allow for easy acceptance and quick action to be taken. It was highlighted that the warning label for high-standby was effective in Korea and perhaps a similar label for network standby could be worthwhile. With regards to rating or comparative labels, a system such as in Korea where products are required to meet stringent network requirements if they are to secure the top rating, encourages manufactures to improve their products. Alternatively, comparative labels could integrate network requirements into the overall energy consumption, ranking appliances on whole energy use rather than just network standby.

Endorsement labels such as ENERGY STAR™ and Energy boy were viewed as positive methods to address network standby by a few of the experts interviewed. Incorporating network into existing specifications means that the network level can be tailored to that particular product's need. ENERGY STAR™ has already incorporated in network standby in many specifications, calling it sleep mode. This is seen as a positive, particularly for networks where the requirements can be quite varied by product types. The down side of both labeling approaches is that as a vertical measure, many products will not be covered and new products yet to be designed will fall through the cracks.

Horizontal regulation – functional adder approach.

There has been some debate over whether a horizontal regulative approach can be applied to network standby, with suggestions that while it has worked for simple standby it is not applicable to network standby. Both Lot 26 and EES reports recommend a horizontal approach as it would cover those products, which may fall into the "gaps" between several existing and future vertical measures. Nevertheless, "vertical" product-specific implementing measures could specify, where appropriate, a stricter requirement for the networked modes of a particular product. Criticism of the regulation the EC is proposing suggests that in trying to cover such an all-encompassing range of products, the levels set for network standby are too easily met by some product categories (such as computers) and not met by others.

Incorporating the idea of functional adders into a horizontal regulation simply means that a base level of power consumption is determined and then as products offer more complex features additional power allowances are given. For example, 2013 EC standby regulations allow 0.5 watts for a meaningful display. While this approach will encompass diversity in design and functions and optimises allowable consumption accordingly, it will require the establishment and constant review of levels. This approach will require time and global cooperation to enable practical implementation.

Clustered Horizontal Approach

In addressing some of the criticism of horizontal and vertical approaches one expert has proposed a compromise position which we have called a clustered horizontal approach. Based on the assertion that in the case of network standby, a horizontal approach is too broad and a vertical approach too narrow, this approach suggests clustered products with unique targets could be an option to explore. A cluster or a sectorial horizontal approach where products with common characteristic are grouped together for example:

➢ Appliances (and devices with minimal network functionality)
➢ Audio/visual equipment
➢ IT products
➢ Network equipment

This approach asserts that the main variation in energy requirements for network use is contained within product categories. For example, appliances such as refrigerator or a washing machine use the network for similar purposes with similar energy demands so could have the same target, while a computer's interaction with the network is completely different requiring a different target.

Figure 4: Clustered Horizontal approach
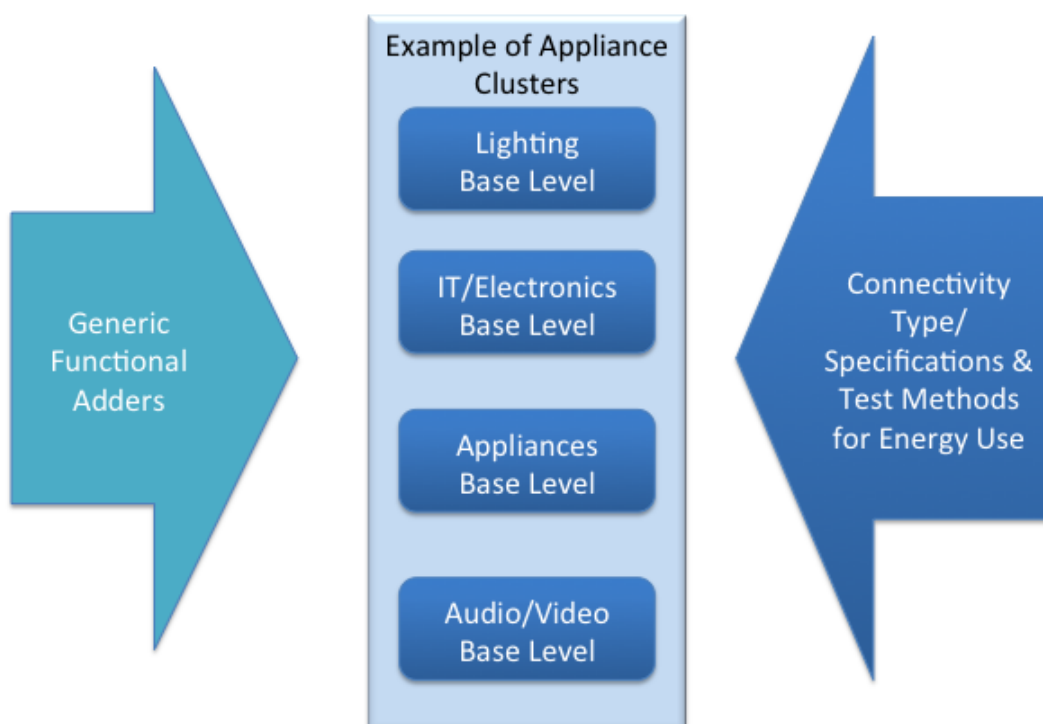
Certification Scheme

An international certification or marking regime as has been developed for external power supplies may also provide some opportunity to make energy savings. Efficiency criteria can be set for a range of performance criteria at each level and new levels can be added or existing levels upgraded as technologies advance. Policy implementation can be varied using different levels as appropriate for different product types, different markets etc. This type of scheme would require a great deal of international cooperation with governments and industries working together and would have a lengthy set up time. However, the success of the EPS (external power supply) protocol would provide a model that could be followed.

Intelligent Energy Management

Energy reporting on networks is a developing area where network connectivity can be perceived in a positive way for efficient energy policy management. Network connectivity could be taken advantage of and used as a tool for gaining knowledge on energy saving opportunities where devices report information on their own status, power levels and energy consumption. This data could be used for power management purposes – exactly what and how they are used will be determined by policy makers.

To facilitate a maximised benefit of these intelligent energy management possibilities, protocols need to be developed that apply to every network connected device. The Internet Engineering Taskforce's (IETF), Energy Management Working Group (EMAN) is developing a protocol for this energy reporting purpose (Nordman 2011a).

Table 6 below summarises the advantages and disadvantages of the network standby policy options discussed here.

Table 6 Network Standby Policy Options – Advantages/Disadvantages

	Policy Option	*Advantages*	*Disadvantages*
Simpler/ relatively quick to implement	*Amendments to Existing policies*	Short lead time to implementation Immediate reduction of network standby waste Increasing the profile/visibility of the network standby Increase profile of energy efficiency in design criteria	Not specific to network standby Too broad - does not maximise savings potential
	Network Standby Labels	Consumer already understand labelling schemes Vertical approach can address products individually and be more targeted	Risk of wrong message to consumers of products energy use Requires regulation for each individual product New products on market may fall through the gaps
Complex/slower to implement	*Horizontal /Functional Adder Approach*	Covers broad range of products Able to include stricter requirements where applicable	Complex to develop Requires global cooperation Need commitment to develop and update appropriate allowances for functional adders
	Clustered Horizontal Approach	Broad coverage of appliances Flexibility for clusters to be individualised by similar types of network standby use Provides allowances that are more targeted – therefore make greater savings	Requires time to develop Multiple regulations for different product clusters
	Certification Scheme	Flexible Adaptable - New levels added as technology improves Adaptable to region	Complex to design Requires global cooperation Savings not maximised or consistent
	Intelligent Energy Management	Enables maximum energy savings Network connectivity used as a tool for gaining knowledge on energy saving potential	Protocols designed by internet experts not necessarily energy efficiency focussed experts Complex to design Requires global cooperation Venturing into new ground for energy efficiency policy

8. Where to from here?

The area of network standby is a complex, technical and fast moving; and is a feature that is likely to be present in almost all products in the near future. The policy options suggested by the network standby experts are not a menu from which policy makers can choose the best solution but rather a suite of possible measures that ideally form a staggered solution to be introduced over time. While the options available in the short term may not completely address the network standby issue, the advantage is that some savings can be made immediately: a first step to curb energy waste now. The more targeted policy options which the experts predict will bring larger savings require further development to fully maximise energy saving potential and will require cooperation and further research to reach a stage where implementation is practical.

As has been demonstrated with standalone standby policy, international cooperation is key to not only driving change but efficiently using resources and developing international standards. The 2005 G8 meeting of leaders at Glen Eagles has driven international agreement to work co-operatively on standby policy. In keeping with this international energy policy makers must now work together in a co-ordinated manner (through groups such as 4E and SEAD) to reduce network standby waste. Success to dealing with globally traded products is best done cooperatively rather than individually within borders. Following the example of the G8 leaders in 2005, it would be fitting for the Clean Energy Ministerial (www.cleanenergyministerial.org/) to highlight network standby as a topic requiring urgent international collaboration and encouraging governments to commit to the guiding principles. This acknowledgment would ensure governments and industries alike start working together to address the issue.

Policy Solutions: Next Steps

- ❖ **Enhance international cooperation**

- ❖ **Establish commitment to the guiding principles**

- ❖ **Develop test procedures and methodologies**

- ❖ **Engage with network technology developers**

- ❖ **Further develop the understanding of power requirements for networked products**

On a practical level the policy options proposed by the experts are reliant on the outcomes of work currently being conducted. This includes developing appropriate definitions, test methods and procedures and investigating in detail how networked products behave. The next steps will need to include continued cooperation and commitment at a global level to invest in the development of test procedures and methodologies and working with network technology developers to enable the uptake of the guiding principles

In summary, Governments need to act quickly to address network standby in order to avoid unnecessary energy waste. This is best tackled through international cooperation and pooling of resources as both the products and the development of the technology that drives the network belong to the global market place. Investment into developing test procedures and methodologies as well as understanding the precise operations and energy requirements of networked products are required to allow the implementation of effective policy. Proposed policy solutions range from pragmatic, rapidly implementable solutions to complex solutions to maximise savings. Some (such as making amendments to current policy, and labelling schemes) will reduce network standby waste immediately whereas others (such as intelligent energy management and certification scheme) require more research and commitment.

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Appendix A: Overviews of Network Standby Studies

The following discussion provides an overview of Network Standby studies conducted to date. The overviews provide a brief description of the study and the project outcomes. It is advised that the following represents a summary only and that the full documents are available on-line and should be referred to for more detailed information.

Lot 26: Networked Standby Losses

Undertaken for the European Commission the EuP preparatory study '*Lot 26: Networked Standby Losses*' (available at Ecostandby) commenced in 2009, with the final report delivered in June 2011. The study comprised a whole life cycle analysis of networked products including: market analysis, consumer behaviour, best available technologies, and improvement potential in terms of increasing energy efficiency and reducing environmental impacts. The study involved wide consultation and cooperation with industry organisations and representatives, and other interested stakeholders.

The key policy recommendation of the Lot 26 study was that a horizontal approach should be used to tackle network standby, covering both power management and minimum energy efficiency requirements. The report acknowledged that while the 'one size fits all' approach is problematic, it is necessary to ensure the network waste minimising measures are implemented as broadly as possible. The Lot 26 team proposed a two tier implementation with differing power management and efficiency requirements for each of the three categories of network availability identified. The three categories are expressed as resume time (the length of time a product takes to begin activity once a signal has been received):

➢ High Network Availability (HiNA): < 1 second
➢ Medium Network Availability (MeNA): resume time <10 seconds
➢ Low Network Availability (LoNA): resume time of >10 seconds

The Lot 26 proposal was refined by the Dutch Government's NL Agency who proposed that the findings from the study become an amendment to current EC standby regulations (EC/1275/2008). The proposal was based on the HiNA, MeNA and LoNA categories that classify each of the network connections present in a product by their level of network availability. Each connection on a product will then be required to meet the power consumption requirements appropriate to that connections' resume time. Following further consultation in September 2011 a reduction from three to two categories - HiNA and LoNA and the possibility of a consumer warning label where products are deemed unable to meet levels due to circumstances beyond their control - was recommended. The European Commission is currently preparing an impact assessment on the proposal and draft final document for in service consultation and voting by the EC Regulatory Committee with the aim of implementation in 2014.

The proposed power consumption requirements appropriate to each connections' resume time is set out in the table below. These values are averages over a set period of time, not absolute levels.

**Table 7: Proposed Tier 1 and Tier 2 Network Standby Power Limit levels**

Networked standby condition	Tier 1 (7-Jan-2013	Tier2 (1 Jan – 2016)
HiNA	12W	8W
LoNA	4W	2W

Significantly the Lot 26 proposal is the first network standby policy proposal to include regulatory levels and while there has been some criticism that the proposal is not a comprehensive solution to network standby waste, it represents a noteworthy first step.

Standby Power and Low Energy Networks: Issues and Directions

In 2010 the Australian Government's, DCCEE Commissioned the Energy Efficient Strategies (EES) report *Standby Power and Low Energy Networks: Issues and Directions* (available at 4E Standby Power Annex). The research underpinning this report was a comprehensive desktop review of existing work into standby and network energy waste and extensive consultation with key experts. The EES report explores technical issues related to the additional energy used by appliances and equipment when linked into networks; identifies potential approaches and low energy solutions for networks; and proposed a pathway to realise policy solutions including identifying key areas where additional research would be required to enable energy saving within networks.

This report plays a crucial role in identifying what the issues surrounding network standby and why existing methods for dealing with standby power and low power mode wastage are not directly transferrable to the problem. Significantly the report proposed key protocols that will help develop low energy networks into the future through investment in a series of research projects on a number of areas where the existing knowledge is insufficient. The graphic below demonstrates how each of these projects will become a fundamental building block enabling the development of comprehensive and manageable policy that can deliver energy savings and reduce needless energy waste in networked products and network equipment.
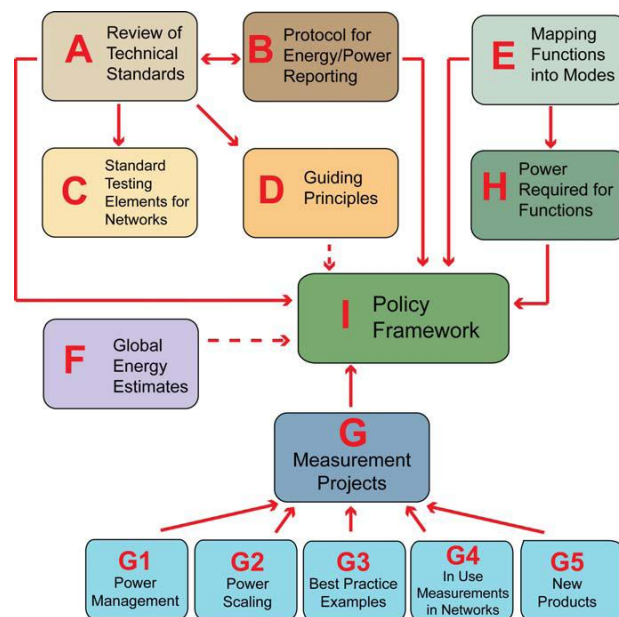
EES noted that while this report was unable to produce an implementable policy solution it proposed a pathway to deliver such an outcome in the future. Key to tackling the challenge will be the establishment of energy management as an important issue for network designers and investing in additional research to gather baseline information, investigate technological possibilities, and develop measurement tools.

IEA/4E Standby Annex Guiding Principles

In 2007 IEA Digital Networks Workshop developed "guiding principles" that underpin the Energy efficiency efforts around building-related networks. At the 4E-APP technical expert network standby workshop in Paris April 2010, these principles were revisited and agreed upon with some minor revisions. The *Guiding Principles for Energy Efficiency in Networked Products* presented here in the text box, provide the basis for future work in this field.   They need to be fashioned in to implementable policies to tackle network standby waste.

4E Standby Power Annex - Network Standby Measurement Projects

The IEA's, 4E Standby Annex is focussing on projects that work toward developing a policy framework capable of addressing energy wastage in network standby and those that enhance horizontal approaches to standby power policy.   Several measurement projects exploring the network standby issues highlighted in the EES report have been completed. Each of these projects provides a building block leading to the development of a practical and workable policy framework. The subsequent reports of this research are briefly outlined here and can be accessed at: 4E Standby Power Annex.

Estimate of the Energy Wasted By Networks

The objective of this Bio Intelligence Service study was to estimate the energy wasted by network-connected equipment due to excess connectivity on a global and regional level. The report includes an estimate for 2008 (the baseline) and projected estimates for 2015 and 2020 and examines the amount of savings possible through better power management policies.

This study estimates the worldwide energy wasted by network-connected equipment is between 85 TWh and 275 TWh in 2008, and is likely to increase to between 130 TWh and 420 TWh in 2015 and between 170 TWh and 551 TWh in 2020.

The report also estimated the potential savings through improved power management policies. The lower-end estimate of wasted energy is 20% due to excess connectivity and/or the use of suboptimal technologies.   This level of saving could be achieved through the implementation of power management and power-level reduction policies. The maximum estimate of around 65% of energy assumes a low-power state of 1W for all network-connected equipment. This 65% energy savings would require both technical improvements of the products and their components and the implementation of effective power management policies.

Significantly this study was the first to quantify the scale of the network standby issue highlighting the need for policy makers to invest effort to tackle the energy wasted by networked products. It demonstrates that with the implementation of effective energy efficiency and power management policy substantial energy wastage could be prevented.

Power Scaling in Proportion to Data Processing

Power scaling means a product can dynamically and proportionally change its energy consumption as its workload varies. The power scaling concept can inform the development and implementation of energy efficiency measures. This Ecova (formerly Ecos consulting) report examined the power scaling abilities for a variety of electronic products, both network equipment (modems, routers and switches) and "edge devices" with multimedia and audio-visual capabilities (game consoles and DVD Players). It discussed the energy consequences of power scaling for these products such as identifying if one device may have reduced energy consumption but increased latency and/or reduced functionality.

The research discovered that power scaling abilities are being underutilised for many of the products tested and that the opportunities for reducing energy consumption with power scaling are evident. This research highlighted the need for policy makers to consider power scaling requirements in the development and implementation of energy efficiency measures for networked products. Power scaling capabilities could be used to specify standby, sleep and idle modes and also for latency and performance considerations such as how rapidly must a product return from sleep to idle mode.

This research highlighted the need for further research on network power scaling to develop standard protocols backed by labelling programs and MEPS to promote product design that meaningfully scale power consumption to network activity.

Examples of Low Energy Product Designs

Ecos produced six brochures outlining examples of low energy product design for electrical appliance components that provide global energy saving opportunities. The brochures provide a brief discussion on the relevance of each area to standby power consumption and present cutting edge low power product designs for different components of electrical appliances that are either currently available or under development. Combined these could have significant impacts in reducing standby energy consumption.

Low energy product design for components of AC-DC power supplies, battery chargers and small networking devices are highlighted. These changes could represent significant savings for example with approximately 7 billion rechargeable battery operated products in use worldwide the potential benefits of using the simple and relatively inexpensive design changes could cut energy consumption by 35% for a wide range of battery charger systems, resulting in savings of 90 TWh/year or the equivalent annual output of 30 coal-fired power stations.

Other energy efficiency measures such as power factor correction and the potential for efficiency measures to reduce indicator and display energy waste are discussed.

This report notes that while great progress in standby power has been made since the 1990s; new features, secondary functions and network capabilities added to products are increasing standby power consumption and thus potentially undoing these gains.

Cutting Edge Technology Feasibility Study

The focus of this research by Ecos was to investigate the feasibility of power saving cutting edge technologies for set-top boxes, game consoles and IP phones (i.e. internet phones). These products were chosen, as the majority of models in these categories consume as much power while in idle

mode as when performing primary functions. Also these three product categories have high energy saving potential by implementing or increasing time spent in low power modes.

The report identified multiple energy efficiency opportunities for each of the product categories summarised in the table below.

Table 8: Summary of cutting edge technology by product

Set Top Boxes	Game Consoles	IP Phones
Multi-room architecture	Power scaling	Proxying
Decrease light sleep and on-mode consumption	User-friendly auto-power down	Energy Efficient Ethernet
Increase time spent in deep sleep		

Ecova note that the challenge is to bring these cutting-edge energy efficient technologies to market saturation as quickly as possible and suggest that policy approaches to reduce energy consumption may be necessary for the three product categories. For STBs, they suggest a voluntary approach based on the success of Europe's voluntary approach. For game consoles direct engagement with manufacturers to discuss ways to incorporate energy efficient technologies is advised. While for IP phones reducing energy consumption is largely dependent on underlying network infrastructure, so as newer SIP-based networks emerge proxy technologies should be broadly applied.

This report aids policy makers in addressing network standby waste by highlighting cutting edge technology solutions for three commonly used devices.

Investigation of Network Power Consumption by Mode in Three Targeted Product Types (STB,VoIP, Game Consoles)

Similar to Ecova's three measurement projects, ADT's research explored the power scaling and control opportunities and the potential for power consumption savings and benchmarking for three product groups: Complex set Top Boxes (STBs), Voice over Internet Protocol (VOIP) phones and game consoles.

ADT concluded that opportunities exist to reduce the network energy waste of complex STB's, VoIP phones and game consoles through the use of design focussing on energy consumption and performance such as power scaling and multi- voltage switching power supplies. Specifically ADT found that:

- Opportunity exists for power scaling in complex STBs.

- Scope exists for reducing power consumption, particularly through the use of multi-voltage switching power supply for VoIP pones.

- Improvements in power consumption could be achieved through better management of auto power down and standby modes for Game Consoles.

Appendix B: Results of Interviews

Interviews were held with five respondents who Maia Consulting contacted because of their expertise in network standby or standby power policy development. Maia Consulting contacted representatives from the 4E and SEAD groups seeking nominations for interviewees. The interviews were conducted over the phone or via Skype. In order to obtain a good representation of network standby policy development at an international level, respondents were chosen in a wide variety of geographic locations including: Australia, United States, the Netherlands, India and Korea.

Respondents were asked whether they believed that there were technical barriers to implementing a policy solution to network standby. All respondents believed that technology exists to allow a device to power down, although one respondent mentioned that it will be difficult to implement policy on a rapidly evolving market with products that do not even exist at this point in time. Another respondent mentioned how there is already excellent technical capacity in the commercial sector that can track energy usage and wastage and he pointed out that this technology could easily be made available in the residential sector. Three respondents mentioned a need for a generic internet protocol to enable a variety of devices to communicate with each other regardless of brand or type.

In terms of policy approaches to reduce network standby wastage, one respondent firmly believed that the European Commission's newly adopted approach was an effective solution. This respondent mentioned that the advantage of the EU Ecodesign directive was that it offered both a horizontal and vertical policy approach and furthermore, it was a mandatory requirement that manufacturers meet the targets and therefore not consumer driven. In this regard, the respondent felt that this policy approach would have a good chance of succeeding in reducing network waste.

Another respondent felt that a 'sectorial horizontal' approach would be an effective policy approach. In this approach, products or devices would be grouped similarly (for example, IT, lighting, fridges, etc.) and a horizontal approach would apply to each cluster or group. This approach was considered advantageous, as it would better address the specific needs of devices. Moreover, this approach would be able to address the type of network connectivity (i.e. wifi, Bluetooth, broadband, etc.) and the way they interact with an appliance rather than the technology type.

Two respondents believed that a labelling program similar to that of Energy Star (or indeed even an extension of Energy Star) would be an effective policy solution to network standby. The advantages mentioned by respondents were that the Energy Star program already exists, people recognize it and it has been a successful program to date.

Advice from one respondent focussed less on the policy *per se* and more on the *process* of introducing the policy. This respondent firmly believed that the successful introduction of any policy involved close dialogue with manufacturers and open communication between government and industry to advise on forthcoming changes and to give specific timing on when the policy and resulting limits will be introduced. Moreover, this respondent emphasised the need for a "strong government". In other words the government needs to be firm and not succumb to pressure/complaints from manufacturers in order for the policy to be implemented and regulation made.

In Korea, the guiding principles set out by the IEA were used in developing their policy response to network standby. In Korea, they are also looking to other countries and looking at their limits to help develop their own limits for network standby.

All respondents mentioned the fast changing technology that is currently occurring and the increasing desire of consumers to have network connectivity in the devices and appliances that they use. The size of the problem (i.e network waste) was considered to be significant and of concern to manufacturers and policy makers alike. Three respondents mentioned the need to enlist support from manufacturers but particularly to encourage them to see that network wastage is important. Two respondents mentioned how important it was to develop a system of sharing information particularly in relation to internet protocols.

Some of the challenges to network standby as mentioned by respondents included:

- Addressing internet protocols and designing products so that they can be woken up only when they are needed.
- Developing network standards that allow for less power consumption during periods of low data activity.
- Getting manufacturers on board to improve their products but also keeping up with the speed at which new products are developing.
- Policy makers will need to have the 'bravery' to introduce limits and manufacturers need to understand that reducing network waste is important.
- For equipment like modems and routers, the challenge will be to reduce the power consumption when connected devices are not using it.