Standby and off-mode Power Demand of new Appliances in the Market

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Abstract

For more than a decade, it has been recognized that the energy consumption in low power modes for electrical and electronic products is an important issue because it represent permanent loads (sometimes up to 24 hours per day) of a huge number of products. With the 1 W standby initiative of the International Energy Agency (IEA), several low power mode measurement campaigns have been led on a regular basis in a number of countries outside and inside Europe Union (EU). Based on these results and on the Energy-using Products Study Lot 6, the EU has prepared new regulation to limit the standby and off-mode power consumption of non-networked household electronic and electrical equipment, which is being applied since January 2010.

The IEE project SELINA carried out a large scale monitoring campaign in shops in order to characterize the low power modes of new appliances being sold in the EU market.

In order to ensure consistency of the collected data, a common measurement methodology was developed and the same high resolution measurement equipment was used by all partners. This publication analyzes the results of more than 6000 different equipments measured in the 12 EU countries involved in the project. Standby and off-mode values by product categories are analyzed and compared with data from other regions of the World. The measurements are also benchmarked against the new 2010/2013 EU standby and off mode regulation thresholds and the impact of the EU regulation is discussed.

In parallel with the measurement campaign, an awareness study of the retailers was carried out. This survey helps to understand the customers buying motivations and the influence of retailers advice in their choices.

An overview of the collected policies and initiatives to improve the low power mode energy consumption are reviewed.

Introduction

The introduction of energy labels, together with MEPS Minimum Energy Performance Standards, implemented with EU Directives during the last fifteen years, has produced a positive trend in the sales of more energy efficient appliances. However there has been a fast increase of electrical and electronic loads (entertainment, office equipment, communication/internet, white appliances with embedded electronics), coupled with the proliferation of gadgets which have electronic controls, and which are typically connected to the AC supply all the time.

The relevance of the standby and off-mode energy consumption is illustrated by the fact that the IEA estimates that, even with a continuation of all existing appliance policy measures, the electricity consumption for ICT and consumer electronics will grow by almost 800% from 1990 to 2030. Next figure shows an overview of IEA projections for ICT and CE electricity consumption up to 2030.

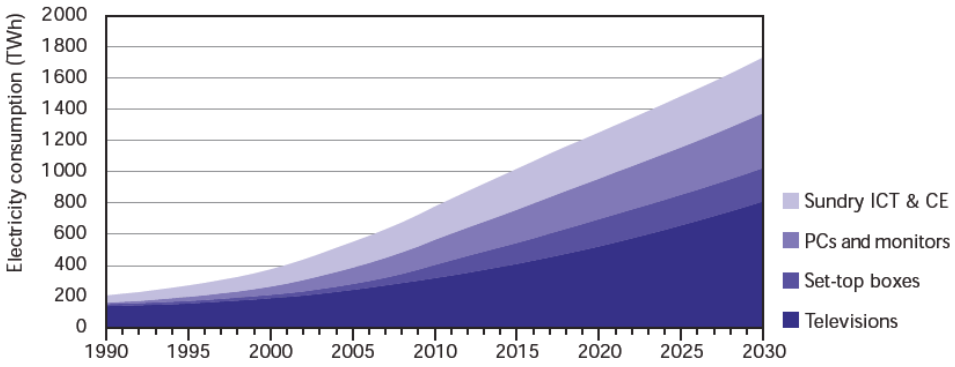

Figure 1. Projected IEA electricity consumption for ICT and CE equipment, 1990-2030 (1).

According to the IEA, by 2030, 15% of the total appliances electricity consumption in Europe could be due to standby functions. This represents the largest area of potential energy savings because efforts to introduce measures to reduce the standby and off-mode energy consumption have only started in the last 10 years. In the future, power demand will be influenced by technical improvements in the equipment introduced by manufacturers, as well as by Minimum Energy Performance Standards, such as the one recently set by the European Commission (e.g. Commission Regulation (EC) No 1275/2008 of 17 December 2008, implementing Directive 2005/32/EC of the European Parliament and of the Council with regard to ecodesign requirements for standby and off-mode electric power consumption of electrical and electronic household equipment).

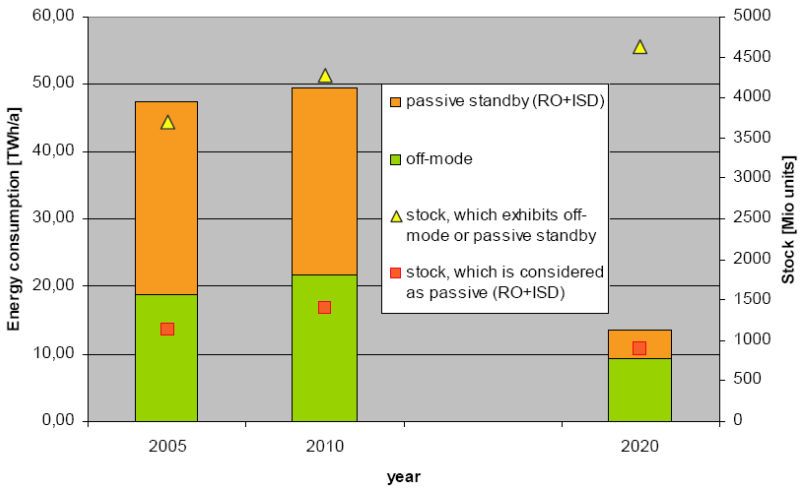

Figure 2. Development of stock and electricity consumption of standby/off mode, excluding networked equipment and assuming a 0.5W/1.0W power consumption level in 2020 (RO: reactivation only; ISD: information or status display) (2).

According to the DG TREN Impact Assessment report, the electricity consumption of electrical and electronic equipment in standby and off-mode is expected to be 13.6 TWh by 2020, due to the new requirements of the regulation. Excluding networked equipment, the expected reduction is of about 35 TWh compared to the Business as Usual (BAU) scenario that can be seen in the figure above. This represents about 4.5 billion Euros in electricity savings supposing the prices of the year 2005[1] (2).

Although significant improvements in energy efficiency have been achieved in appliances technologies, during the period of 2004 to 2007 the end-use electricity consumption increased by 2.11% in the residential sector and by 10.45% in the tertiary sector. In the tertiary sector it is a significant increase when compared with the growth rate for the period of 2001 to 2004, when an increase of 6.96% was registered (3).

Some of the reasons for such increase in the residential and tertiary sector electricity consumption are associated with a higher degree of basic comfort and level of service and amenities (particularly in the new EU member countries), as well as with the widespread utilization of relatively new types of loads whose penetration and use has experienced a very significant growth in recent years.

Office equipment (PCs, monitors, fax machines, photocopiers, printers, internet equipment, etc.) are the fastest growing electricity end uses in the tertiary sector. It is expected that this electricity consumption doubles by 2020 (4). The EL-TERTIARY European Project estimated that the office equipment electricity consumption represents around 5.3% of the tertiary sector in France, 6% in Italy, 14% in Germany and 7.5% in The Netherlands (4). Based on a recent published estimation, in 2007, more than 48 million desktop computers and 59 million laptops were acquired for non-residential applications (3).

Based on statistics data, the total standby electricity consumption of home appliances in EU-27 in 2007 amounted to around 43 TWh, which is 5.4% of the total residential electricity consumption (3).

In a recently completed Intelligence Energy Europe (IEE) Project, REMODECE (Residential Monitoring to Decrease Energy Use and Carbon Emissions in Europe - http://remodece.isr.uc.pt), the electricity use of appliances in houses has been monitored in detail (with separate metering of lighting and individual appliances) in some 1300 homes across the EU. The average measured standby power was about 40 W and electricity consumption is 305 kWh per household per year, which is about 11% of the total annual electricity consumption per household. The standby electricity consumption, for all participating countries of REMODECE project, amounts in total to about 40 TWh (5). For the tertiary sector the annual electricity consumption for the standby of office appliances in EU-27 countries is estimated to be 9.43 TWh (3).

In Germany, the share of standby is estimated to be about 6.8% or 9.4 TWh (6). Substantial technical and behavioural saving options exist to reduce standby consumption. For Germany, electricity savings of 4.6 TWh are estimated until 2020, if all saving options with regard to standby were applied. This means a halving of current standby consumption in the residential sector. On the part of manufacturers, the technical solutions for reducing standby consumption, which are mostly cost-effective, are often not applied due to possible additional costs for the manufacturer, and also because it is not a market access requirement [(3), (7)].

In 2005, the G8 leaders agreed to promote the application of the International Energy Agency s (IEA) 1-Watt initiative which aims to reduce standby requirements for all new appliances below 1 Watt by 2010, which was a positive step in the right direction.

It is generally accepted that the demand for information and communication services and technologies will sharply increase. The future power demand will be more influenced by the technical improvements introduced in the equipments by manufacturers, as well as by voluntary agreements and programmes (such as the Code of conduct for Digital TV Services, Code of Conduct on Energy Consumption of Broadband Communication Equipment, Code of Conduct on Efficiency of External Power Supplies and IEA Standby Power Initiative). Electrical and electronic equipment with standby

[1] Average electricity price in 2005 in EU-25: 13.6 Cent/kWh

and off-mode losses is a fast growing load (e.g. entertainment, information and communication technologies -ICT, set top boxes-STB). In the near future, all domestic equipment (including white goods) is likely to be controlled by electronic equipment, and will have the capability to communicate with other equipment. This situation will potentially lead to an increase in the standby and off-mode electricity consumption, if appropriate policies are not implemented.

SELINA - The European Project

The name SELINA stands for Standby and Off-Mode Energy Losses In New Appliances Measured in Shops. The SELINA project is directed to characterize the EU market in terms of standby and off-mode consumption in new electrical and electronic household and office equipment, being sold in shops, with a developed appliance specific measuring methodology. A large scale monitoring of new equipment characterized low power modes (opomos), of the equipment being sold in a large sample of EU Countries. More than 6000 pieces of equipment were measured, in the period 2009-2010, before and after the entering in force of the European Regulation EC 1275/2008 regarding standby and off-mode power consumption. This will allowed the creating of an equipment online database with all the measurements made during the campaigns that can be accessed through the project website: www.selina-project.eu. The groups of products that were covered include:

- Entertainment equipment (Set Top Box, TVs screens of all sizes and technologies, DVD players and recorders, Video Projectors, Hi-Fi, Home Cinema systems, game consoles, all external Power supplies and Chargers associated with portable entertainment equipment);
- Information and Communication Technologies - ICT (Desktop and Notebook Computers, Monitors, Printers, Fax machines, wired and wireless Routers, cordless Telephones, Answering Machines, all External Power Supplies and Chargers associated with portable ICT equipment.);
- Large appliances (Washing Machines, Dishwashers, Tumble Dryers, Chillers, Air Conditioning devices, etc.);
- Miscellaneous (Electronic Controllers for central heating/cooling and solar systems, home Alarm Systems Garage Door Openers, Occupancy Sensors / Automatic Light Switches etc).

Another aim of the SELINA project was to propose a representative basket of products for which standby and off-mode power levels could be measured and tracked in any country around the world. This basket was measured by interested parties to compare trends in standby and off-mode power within that country and across countries.

International cooperation with institutions outside the EU, involved in similar efforts [IEA Implementing Agreement 4E (Efficient Electrical End-use Equipment) with an Annex on Standby, Energy Star/EPA in USA, Australia Standby Initiative, Swiss Federal Office of Energy] were used to promote synergies in the definition of common approaches to characterize the market and to define realistic and cost-effective performance targets which can be achieved in a short time frame.

Methodology used during the measurement campaigns

A key early objective of the SELINA project was to identify a test methodology providing a safe and accurate measurement of off and low power modes for a basket of products to be found in store. Simulated testing of a wide range of products in replicated store conditions was put in place in the UK Intertek laboratory to develop a methodology that would provide accurate off and low power mode data measured as closely as possible to the metering criteria stipulated in the international standby test methodology standard IEC 62301.

It was accepted at an early stage of the simulated testing exercise that those measuring conditions stipulated in IEC 62301 associated with mains supply voltage regulation and harmonic content would be outside the control of an in- store test rig. Even a basic regulated supply capable of powering the wide range of products likely to be tested would fall outside the financial resources of the project and would prove impractical in the physical conditions of the shop floor. In this context it should be noted

that such a regulated supply would be required to withstand the power load of products in "on-mode", not just the low-power mode.

The accuracy of power meters available to the project testing teams in large quantities (a potential requirement for 120 meters was identified) at an affordable hire cost quickly became a critical issue. Although it was accepted that the selected power meters could be pre-calibrated prior to distribution to the National testing teams, no meters were found, within the budget constraints of the project, that would allow accurate low power measurement to 0.25W or less.

Fortunately, at the Consumer Electronics Show in early 2009, AD power, a Korean manufacturer of sampling power meters, introduced a low cost meter based on very new electronic design that allowed consistant and accurate firmware calibration in production. The sample sourced for testing was well within the limits specified in IEC 62301 for low power measurements (less than 1W) and for all power measurements up to 2.5kW. Arrangements were made to source all the meters required for the testing teams. These were tested for calibration before distribution against a high grade laboratory power meter at the Intertek laboratories and found to easily meet the IEC 62301 metering tolerance.

The common methodology and the equipment from ADpower – WATTMAN HPM-100A - was used by all partners in their national measurement campaigns. For the shop measurements, it was developed an excel sheet that automatically communicates with the measurement equipment, and inserted the average values for Voltage, Power factor and Power (W). This way it was possible to collect comparable values between countries and reduce human errors.

Measurement campaigns results

During the measurement campaign of the SELINA project 6318 appliances were measured, over the 6000 appliances targeted. The results for the off-mode and standby power input are presented in the next figures.

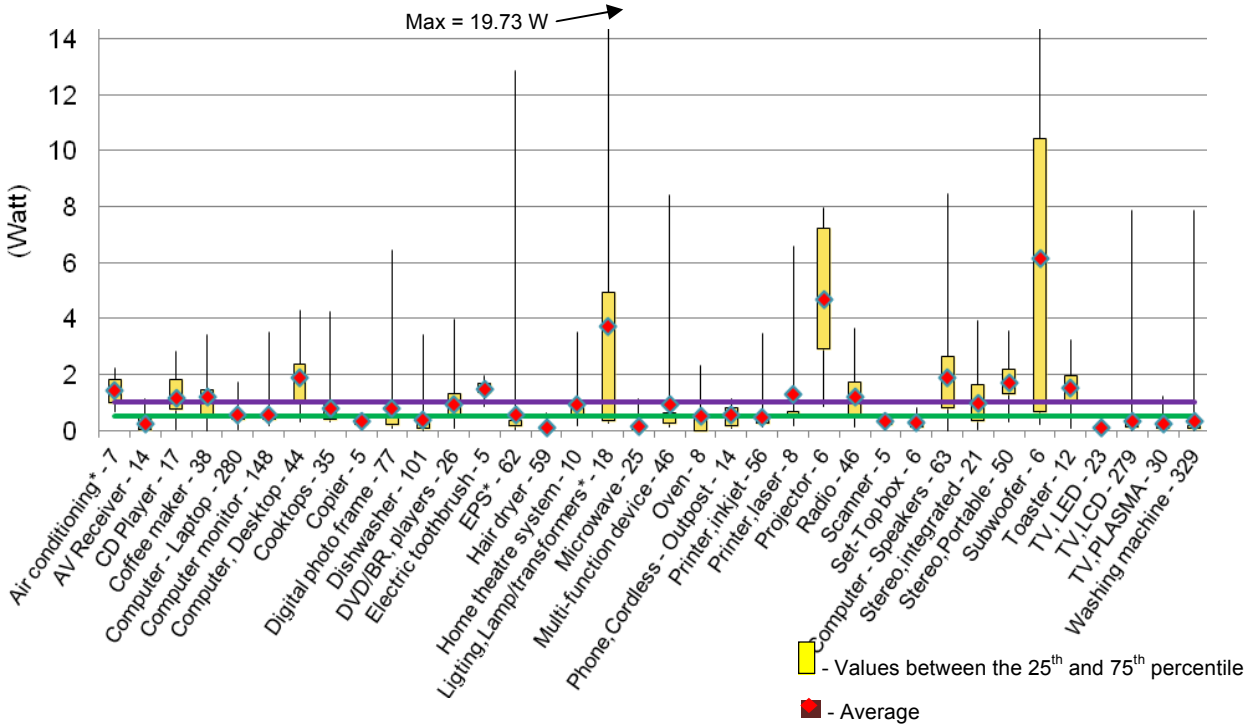

Figure 3. Off-mode input power for the basket of products[2].

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- Some products listed on the figure are not in the EC 1725/2008 scope.

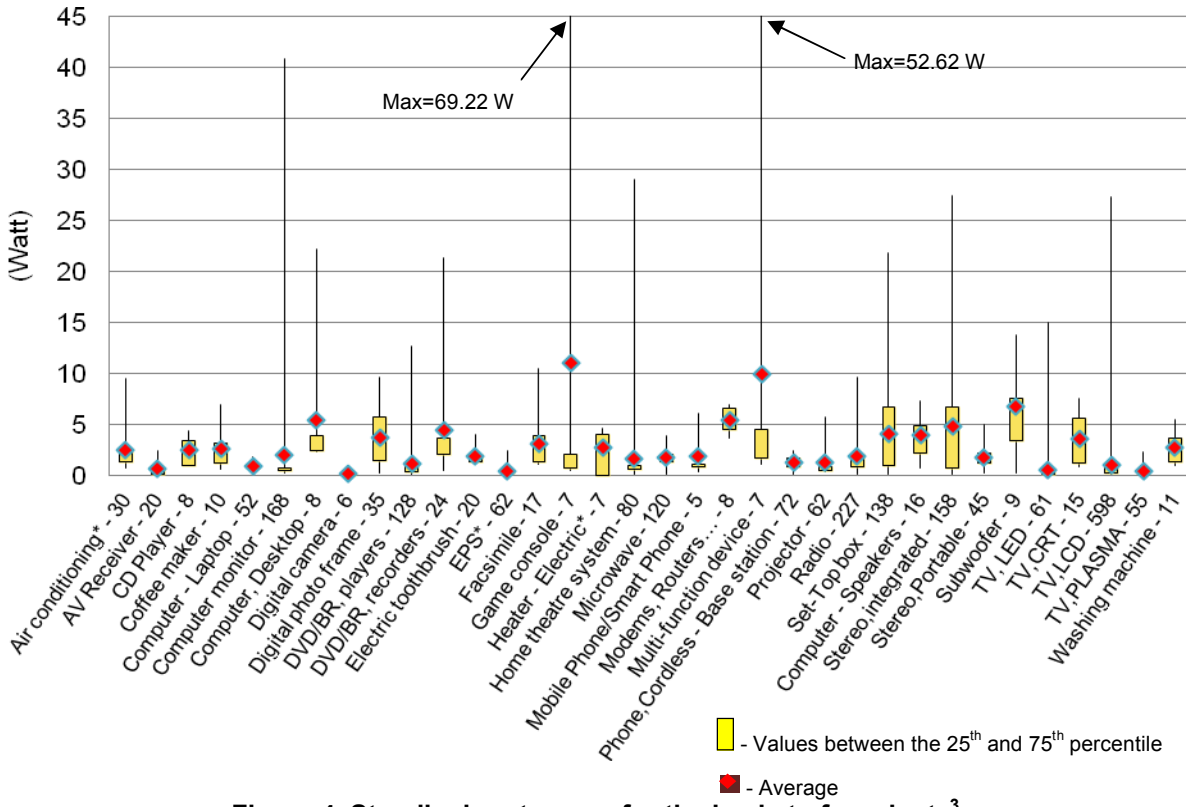

Figure 4. Standby input power for the basket of products[3].

The reason why there is a small number of measurements for example for copiers, home security systems, modems, and others is because some products were very difficult to find in shops or to get the necessary conditions to measure them. The reasons behind this are: either that there are only a few number of models being sold or exposed (sometimes only the product box is exposed or for modems, there is no off mode and it is difficult to simulate passive mode) or that they are hard-wired.

In off-mode, Lighting-Lamp/transformer registered the highest input power with 19.7 W. Regarding the standby mode for the basket of products the highest input power registered was for game console with 69.22 W.

Copiers, game consoles, multi function devices and computer monitors are the products with the highest standby measured input power. However these high values represent a low percentage of the total measurements. It should be noted that these high values can be due to equipment damage, production defect or products with special features.

The values for off-mode input power are in general low and almost always near the EU regulation limits. In the case of the standby mode, the input power values are higher, as expected, but only slightly above the EU regulation (1 W and 2 W for 2010 limits depending if the equipment has only a reactivation function or a display/information).

- The numbers after each product type represents the number of measurements in off-mode.
- The yellow bar represents the distribution, where 50% of the measured consumption can be found. The values placed above and below the yellow bar, represented by a solid line, correspond to the other two distributions where the other 50% of measurements can be recorded.

3
- Some products listed on the figure are not in the EC 1725/2008 scope.
- The numbers after each product type represents the number of measurements in off-mode.
- The yellow bar represents the distribution, where 50% of the measured consumption can be found. The values placed above and below the yellow bar, represented by a solid line, correspond to the other two distributions where the other 50% of measurements can be recorded.
- No EU regulation thresholds is presented in this figure because they depend on each products characteristics (presence of display/clock or not)

In the next figure, the values for input power in off-mode and standby of all the measured equipments (even the ones not in scope of the EU regulation), is compared with the regulation limits, showing the percentage of products over the EU regulation threshold.

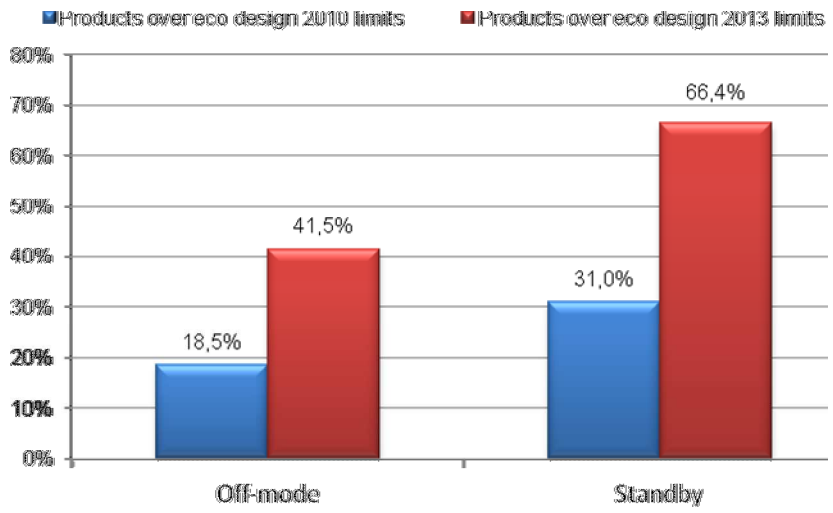

Figure 5. Compatibility of the appliances input power with the EC 1275/2008 regulation threshold.

The previous figure shows that 18.5% of the measured products presented power values higher than the 2010 EC 1275/2008 regulation threshold in off-mode. For standby this value reaches 31%. When a comparison is made with the 2013 EC 1275/2008 regulation threshold these values are doubled.

If the appliances not in the EC 1275/2008 scope were removed from the above analysis, a decrease of 4 % for the non-compliant products over standby eco-design 2013 limits was visible. The other values would be affected with differences of less than 0.5 %.

Because the measurement campaign started in 2009 and ended in June 2010, with the EC regulation entering into force in January 2010, it was expected to identify a significant difference between the values measured before and the ones measured after the entry into force of the regulation. However, the 2010 measurement results tend to show that the number of products over the EU regulation threshold did not vary significantly (see next table).

Table 1. Difference between 2010 and 2009 measurements related to measurements out of EU regulation limits.

	Off-Mode	**Standby**
Difference between 2010 and 2009 Products over eco design 2010 limits	2.6%	-1.7%
Difference between 2010 and 2009 Products over eco design 2013 limits	-1.7%	2.1%

The values of the above table suggest that manufacturers of most products already adopted their production to the DGENER Lot 6 EuP study on standby, which started in 2006. The low difference between 2009 and 2010 measures could also be due to remaining product stocks.

Anyway it appears that future market surveillance will be helpful to verify and to clean the market as intended by the European Regulation.

Retailer's awareness survey

During the implementation of the SELINA project, a large period of time was spent in shops carrying out measurements on equipments. This was an opportunity also to gather other types of information. Two other sources of information were exploited: the customers and retailers role in the decision to purchase more energy efficient appliances. These sources represent vital information, to be able to understand the customers' motivations to choose more energy efficient appliances and the influence of retailers' advice concerning the energy features of the equipment.

A total of 390 questionnaires were collected and analyzed. These questionnaires were divided into four parts in order to evaluate: the retailer's advice regarding energy efficiency, customer decision, information about energy information and labels in stores and retailers knowledge of standby & off-mode modes.

The results showed that, despite of retailer's consciousness of products energy consumption and their energy labels, other types of arguments like, appliance price or functionalities are more frequently used by them to sell a product. Furthermore, the results showed that retailers try to adapt their advice to the customers' needs (price and product functionalities).

Retailers assume that publishing more information regarding the energy consumption of products and some kind of cost saving calculator/reference would influence the clients to buy more efficient equipments.

Retailers in general show that they have a good knowledge about the presence of low power modes. During the surveys some retailers admitted that sometimes they are "forced" to advise products, not always efficient, because some products are not being sold and to avoid stock problems, leading the clients to buy inefficient products. Another problem revealed by retailers was that sometimes a bonus is given to salesman if they sell specific products chosen by the shops, so the salesmen are led to sell whatever the shop wants them to sell. More exhaustive surveys deserve to be carried out in order to evaluate not only the retailer's awareness, but also the shops policy towards energy efficiency.

Policies and market transformation

The MURE measure database, which was developed and is continuously updated within the EU-IEE project "ODYSSEE-MURE" (www.mure2.com), shows more than 160 policy measures at the level of the EU and its Member States addressing the electricity consumption of household appliances in the residential sector and of office equipment in the tertiary sector. Almost half of these measures are legislative measures (many of them are the national implementation of the EU measures/regulation), in addition there are some financial and information measures mainly at the national level (see next figure). A similar result can be drawn from the IEA database on energy efficiency measures[4].

[4] http://www.iea.org/textbase/pm/index_effi.asp

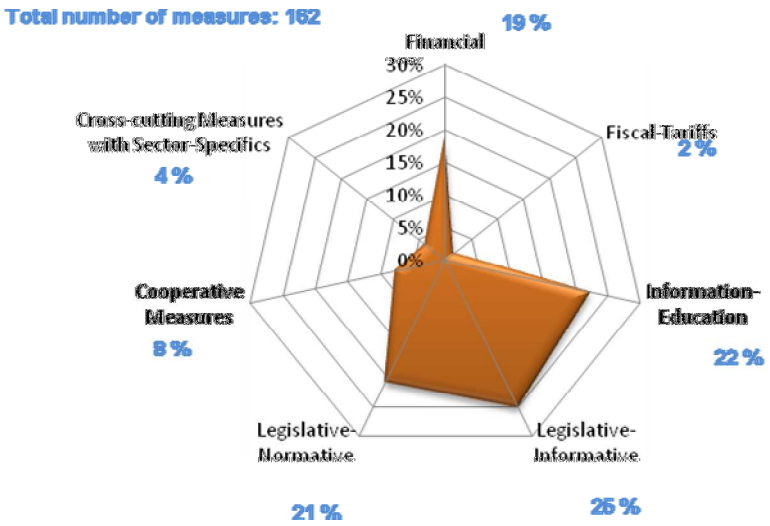

Figure 6. Policy measures addressing energy consumption of residential appliances and office equipment in the tertiary sector (EU, EU Member States, Norway and Croatia).
Source: MURE measure database as of November 2010 (www.mure2.com)

One target of the SELINA project was the collection of specific actions directly addressing consumers and retailers both taking into account actions aiming at the reduction of total energy consumption of the appliances in all operation modes and at standby and off-mode consumption in particular. This includes information and education programmes by energy agencies or other institutions, voluntary activities by retail trade or manufactures, financial support for efficient appliances, additional voluntary labels or the development of information tools for retailers.

The measure collection was based on a common template both including a formal measure description by type of equipment addressed, actor, target group and status, and some detailed on the contents of the measure, the costs and results with regard to energy and standby savings. In the end, more than 100 measures have been collected within the SELINA project by the partners.

The most important measures types are informative and educative measures (61) and financial measures (16). The detailed description of all measures collected for European countries can be found at the project website (www.selina-project.eu) on the specific document with the collection and analysis of the policies and initiatives.

The overview shows that in most countries, information programmes (esp. brochures, leaflets, websites, national labels) are the dominating measure type (also see the next figure). In some countries, however, financial subsidies for very energy-efficient appliances, often paid by an energy utility and not by the government, play an important role, too (e.g. in the Czech Republic or Switzerland). Energy savings are indicated for all measures for which this information is available. In general, the impact of a financial programme is easier to quantify than the single impact of an information campaign, which often serves as an accompanying measure for regulations (labels, minimum efficiency standards) or fiscal and financial measures.

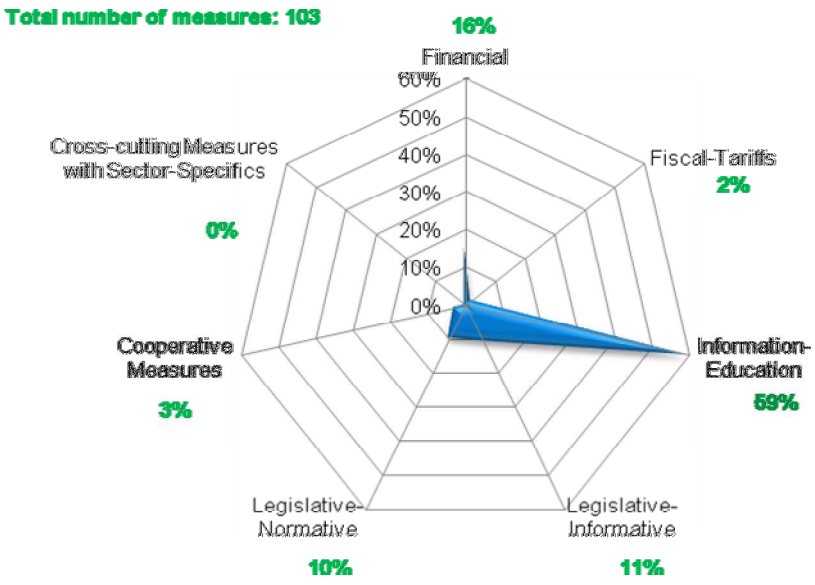

Figure 7. Characterization of the measure types collected in the SELINA project.

Conclusions

The SELINA project developed a common measurement methodology and created extensive data collection of off-mode and standby input power values for more than 6000 different products, allowing for the first time, the collection of a large representative sample of low power mode measurements for the EU market of electrical and electronic appliances in 12 geographically diverse countries. All the data can be accessed through the project website: www.selina-project.eu.

An analysis of the measurement accuracy was performed, showing an average error of about 12%. The standard deviation was also calculated, which has a value of about 20%. This indicates that the measurement method in the shops probably be improved.

It was found that 18.5% of all the measured appliances (including some not in the scope of EC 1275/2008), whose off-mode power was measured, do not respect the EU regulation threshold of 1 W. When the measurements are compared to the 2013 threshold of 0.5 W, the number raises to 41.5%. Regarding standby mode consumption, 31 % of the measured products did not comply with EU regulation limit for the 2010 threshold. When the measured values are compared to the 2013 limit, the numbers of products over the EU regulation target increases to 66 %.

If the appliances not in the EC 1275/2008 scope were removed from the above analysis, a decrease of 4 % for the non-compliant products over standby eco-design 2013 limits was visible. The other values would be affected with differences of less than 0.5 %.

When comparing the 2009 and 2010 measurements, only a slight decrease of the share of appliances exceeding the EU regulation limits was observed.

The results of the retailer s survey showed that, despite of retailer s consciousness of the products energy consumption and energy labels, other types of arguments like the appliance price or functionalities are more frequently used to sell a product. This could be due to a lack of information in shops about the equipment energy consumption. Furthermore, the results show that retailers try to adapt their advice to the customers needs (price and product functionalities). Retailers in general show that they have a good knowledge about the presence of low power modes. Retailers assume that publishing more information regarding the energy consumption of products and some kind of cost saving calculator/reference would influence the clients to buy more efficient equipments.

The survey on measures enhancing the market transformation towards more energy-efficient electrical appliances showed a wide range of actions and policy tools in the SELINA partner countries.

In most countries, information programmes (particularly brochures, leaflets, websites and national labels) are the dominating measure type. In some countries, however, financial subsidies for very energy-efficient appliances, often paid by an energy utility and not by the government, play an important role, too (e.g. in the Czech Republic or Switzerland). In general, the impact of a financial programme is easier to quantify than the single impact of an information campaign, which often serves as an accompanying measure for regulations (labels, minimum efficiency standards) or fiscal and financial measures. It appears that it is important to keep in mind product changes, like increased network connectivity, which could largely change the low power mode consumption.

The concept of a warning label on products with standby consumption is supported. This appears to be a feasible approach for some products and modes. However, that warning label should not be necessary where there are mandatory requirements such as Minimum Energy Performance Standards (MEPS) that cover relevant products and modes.

It is recognized that equipment connected to networks is of growing importance. It is recommended that increased efforts to compile data and measurements of networked products from a variety of sources in order to obtain better information on networked product characteristics needs to be made.

The new technologies offer many opportunities for energy savings potential but also there are some threats which need to be recognized and understood. There is a strong need to ensure that energy saving paradigms and strategies become a core consideration in all future product designs.

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