Standby and Off Mode Energy Losses in New Appliances

Aníbal de Almeida and Carlos Patrão, ISR-University of Coimbra
Barbara Schlomann, Fraunhofer ISI
Yi-Seul Cho, David Silva, and Philippe Rivière, Mines Paristech
Andrea Roscetti and Lorenzo Pagliano, Dipartimento di Energia, Politecnico di Milano

ABSTRACT

The introduction of energy labels, together with MEPS, implemented with EU Directives over the past years, has produced a very positive trend in the sales of more energy efficient appliances. Consumers have responded positively to this mandatory information scheme at the point of sales enabling the comparison of the energy-efficiency of various models of the same appliance family through their ranking. Despite these improvements electricity demand has increased and it a considerable increase in is expected due to the increasing number of electronic components in appliances that offer more and more functionalities and to the increase of the size of some key appliances as fridges or TVs.

This paper presents the preliminary results of the SELINA (Standby and Off-Mode Energy Losses In New Appliances Measured in Shops) project, focusing on office equipment. The main objective of the SELINA project is to identify effective market transformation policies targeted at all the key stakeholders involved in the manufacture, distribution, sales and operation of appliances with standby and off-mode losses in order to achieve electricity and carbon emissions savings.

The paper presents the analysis of the data acquired up to now during the large scale monitoring campaigns regarding standby and off-mode consumption as well as the methodology developed for measurement of these data. Energy consumption of the measured appliances in low power modes will be compared to the standby and off-mode European legislation and compared to data available, international literature and databases.

Another key issue of the project is to find out the commerce/retailer awareness of energy efficiency in general and of low power mode consumption modes. Are retailers active enough in promoting energy efficient products towards their customers? Are they aware of the impact of low power modes? A short questionnaire was designed in order to evaluate the awareness of retailers, e.g. their knowledge and interest on labeling, standby consumption, energy star, efficiency classes, etc. Information is being gathered on the presence of the labeling on the equipments (inside and outside EU countries) and also of policies and actions to accelerate the market penetration of energy-efficient electrical appliances. Preliminary results of this awareness survey being conducted in stores are presented on this paper.

Possible generic measures to reinforce the EU legislation are discussed on the basis of these preliminary results.

Introduction

Although significant improvements in energy efficiency have been achieved in appliances technologies, during the period of 2004 to 2007 the end-use electricity consumption had an increase of 10.45% in the tertiary sector. This 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 [1]

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) and also with the widespread utilization of relatively new types of loads whose penetration and use has experienced a very significant growth in recent years.

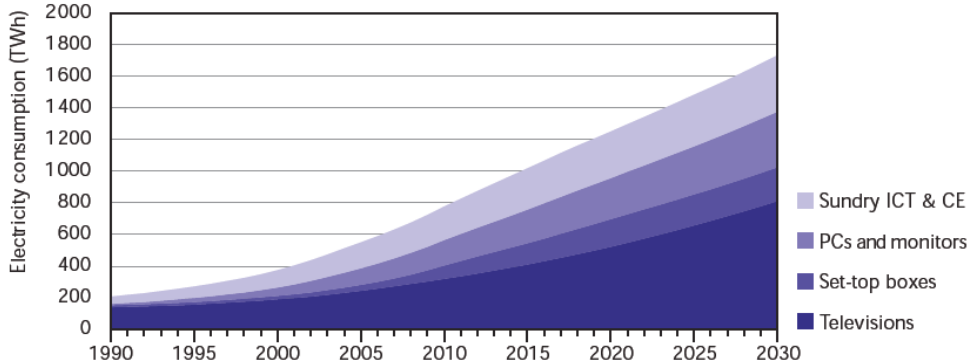
Office equipment (PCs, monitors, fax machines, photocopiers, printers, etc.) are the fastest growing users of energy in the tertiary sector, this is expected to double by 2020 [2]. The EL-TERTIARY European Project estimated that the office equipment electricity consumption represents around 5,3% of the tertiary sector in France, 6% in Italy, 14% in Germany and 7,5% in The Netherlands [2].

Based on a recent published estimation, in 2007 more than 48 million desktop computers and 59 million laptops were installed in non-residential applications [1].

In 2007, total standby consumption of home appliances in EU-27 amounted to around 43TWh, which is 5.4% of total residential electricity consumption [1]. In Germany, the share of standby is even higher (6.8% or 9.4TWh) [3]. On the other hand, substantial technical and behavioral saving options exist to reduce standby consumption. For Germany, electricity savings of 4.6TWh 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 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 [1, 4].

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. In the next figure, an overview of their estimations is shown.

Figure 1: Projected IEA Electricity Consumption for ICT and CE Equipment, 1990-2030 [7]



According to the IEA, by 2030, 15% of the total appliance electricity consumption in Europe could be due to standby functions. This represents the largest area of potential energy saving 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 improvement in 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 244/2009 of 18 March 2009, implementing Directive 2005/32/EC of the European Parliament and of the Council with regard to ecodesign requirements for non-directional household lamps).

In a recently completed Energy Intelligence for Europe (IEE) project, REMODECE (Residential Monitoring to Decrease Energy Use and Carbon Emissions in Europe- http://www.isr.uc.pt/~remodece), the electricity use of appliances in houses has been monitored in detail (with separate metering of lighting and individual appliances) in some 1.300 homes across the EU. In average the measured standby power is about 30Watt and electricity consumption is 169kWh per household per year, which is about 6.3% of the total annual electricity consumption per household. The standby energy of the end-uses metered during the REMODECE project amounts in total to about 21.5TWh for all households in the participating countries, and is responsible for about 9,4 million ton CO2 per year. 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 [1].

The SELINA 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 is characterizing low power modes (“lopomos”), of the equipment being sold in a large sample of EU Countries. About 6000 pieces of equipment will be 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 allow creating an equipment database with the market trends, which is a major tool for policy makers to define future policies and regulations. The groups of products that are being covered include:

- Entertainment (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 is to propose a representative "basket of products" for which standby and off-mode power levels can be measured and tracked in any country around the world. This basket can be 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) are being 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.

The main objective of this project is to identify effective market transformation policies initiatives targeted at all the key stakeholders involved in the manufacture, distribution, sales, purchasing and operation of appliances with standby and off-mode losses. As a result of the future policy actions that may appear after the end of the project it is expected to achieve a huge cost-effective savings of electricity (80TWh projected by 2020) and carbon emissions (30MTons of CO2 by 2020).

Measurement and Awareness Survey in Shops and Stores

The shop measurements allowed following the implementation of the European Regulation EC 1275/2008 regarding Standby and off-mode power consumption. The measurements were made in shops across Europe following the previously described methodology.

Measurements Results

About 6000 equipment are to be measured in the project. Over 3682 measurements have already been conducted, 473 corresponded to office equipment: computers (desktop and laptops), computer monitors, printers, facsimiles, copiers, scanners and multi-function devices.

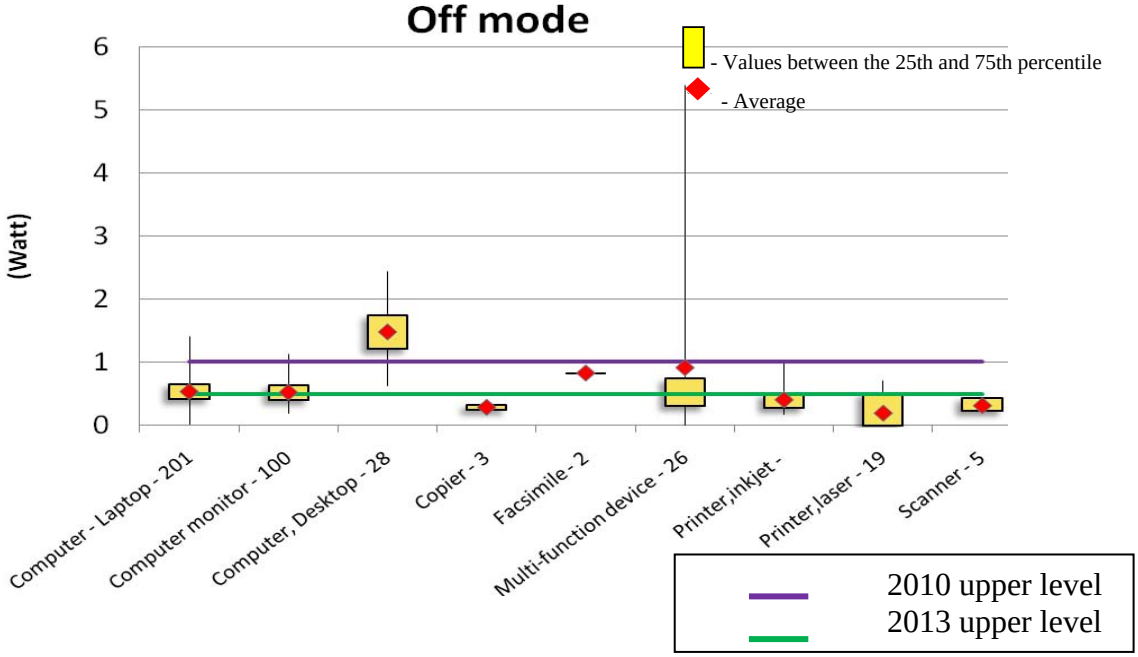
Both measured off-mode and standby correspond to the EU Regulation definitions.

Regarding the first set of measurements of the SELINA project during 2009, Figures 2 shows "off-mode power" and Figure 3 show "standby power"

Regarding off-mode power consumption, the power of almost all measured equipments measured is below the EU Regulation limits [6] for 2010 (limit for 2010 = 1W). Only desktop computers appear not to meet these limits. The maximum recorded value for off-mode was 5.4 W belonging to a multi-function device.

As explained before, the EU Regulation defines two different limits for standby, one for products with reactivation functions only (limit equal to 1 W in 2010) and another limit for products with display/clock (limits equal to 2 W in 2010). It was not possible to record standby values for some of the measured equipments, like printers and multi-function devices, because this mode was not available. This was due to the fact that no cart-ink was installed in the equipment resulting in an anomalous operating mode "error-mode". However for scanners any equipment presented standby mode.

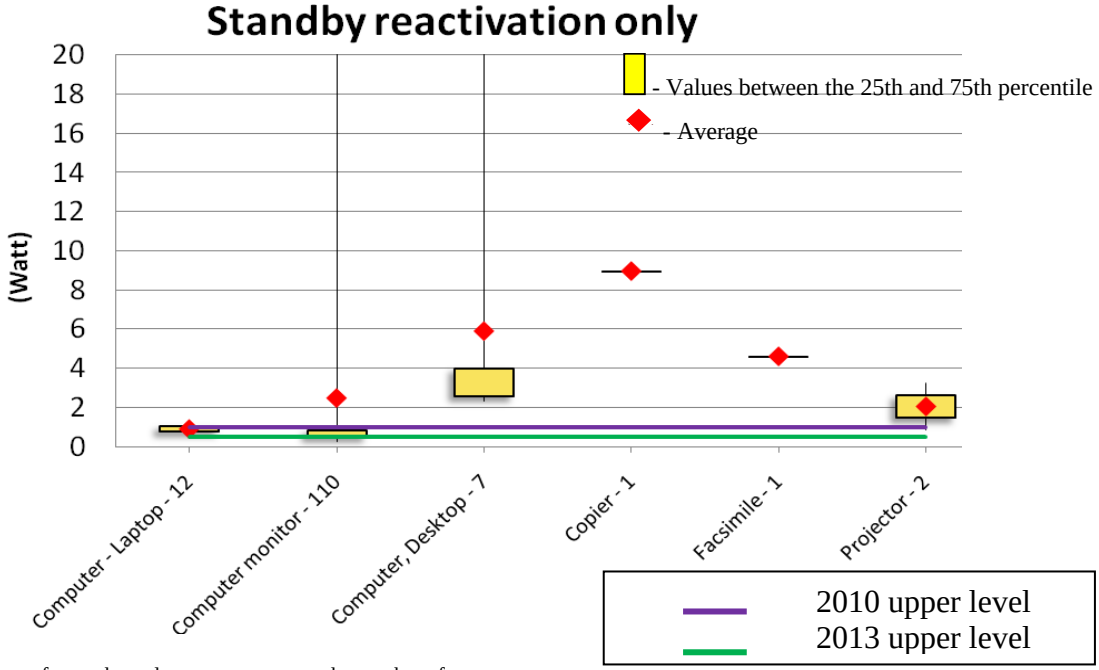
Figure 2: Off-Mode Power Consumption Per Equipment Type



*-The numbers after each product type represents the number of measurements.
**- 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.

In figure 3 are shown the products with only reactivation function.

Figure 3: Standby Power Consumption for Equipments With Reactivation Only



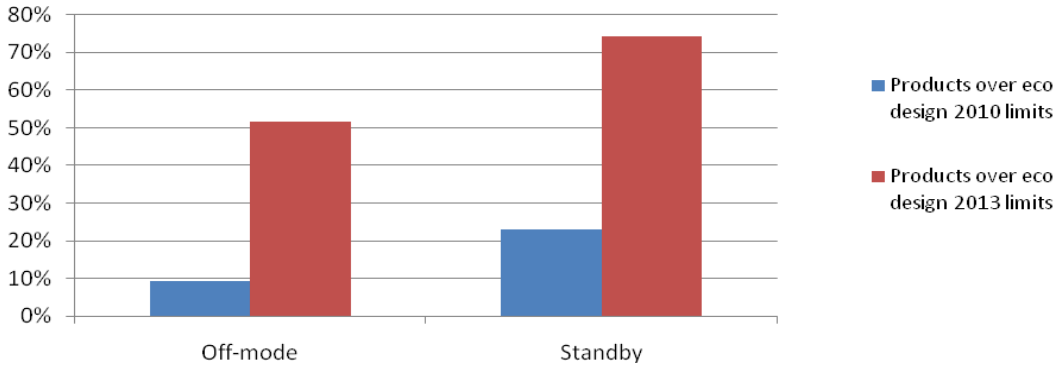
*-The numbers after each product type represents the number of measurements.
**- The yellow bar represents the distribution, where 50% of the measured consumption can be found. The values placed above and below the yellow bar, represented by a solid line, correspond to the other two distributions where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

The maximum recorded value was 49.4 W for a computer monitor model. The measured values show that desktop computers are above the regulation limits for standby power consumption, both in stand-by mode, and in off-mode.

Regarding the products with a display/clock while in standby mode, only 7 facsimiles models had an electronic display. For these products the average standby consumption was 2.22 W, only slightly higher than the Regulation limits (Regulation limit for 2010 equal to 2 W).

Almost every measured product already meets the 2010 directive threshold, with the exception of computer desktops. It should also be reminded that computer laptops, which represent the biggest sample (192 measured products), are in agreement with the 2010 directive limits already since 2009.

Figure 4: Compatibility of the Appliances Low-Power Consumption with the EC 1275/2008 Directive Limits [8]



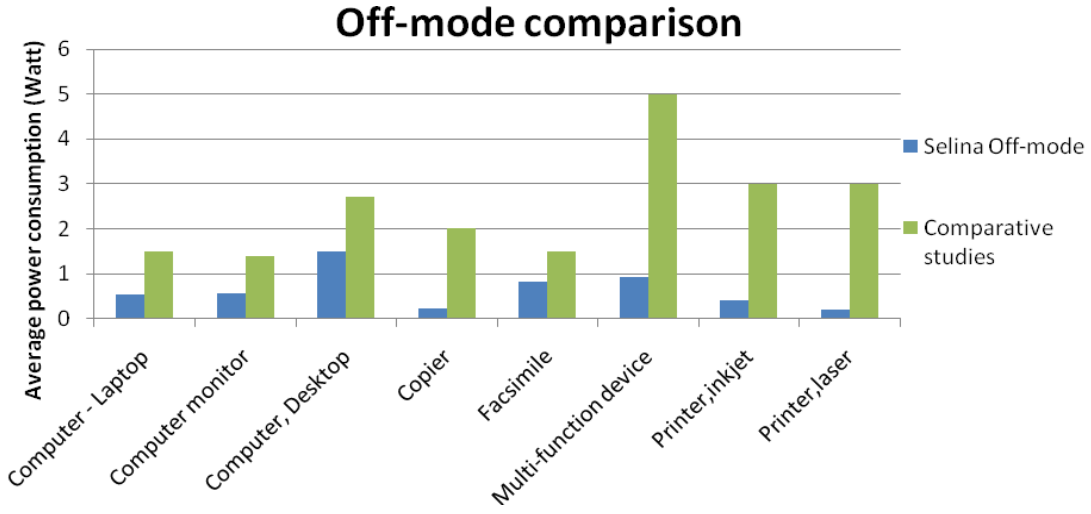
The results of the measurement campaign have shown a promising adaptation of the office equipment to the limits set by the regulation. In general, it can be said that office equipments responded to the 2010 regulation limit the year before it entries into force. However a more precise evaluation of the low power modes will be possible once the 2010 measurements are finished.

The results presented in the Figure 4 appear promising since only 9.3 % of the measured products have power consumption in off-mode above the regulation threshold for 2010. For standby only 22.9 % of products are above the 2010 regulation threshold. However when comparing the measurement results with the 2013 regulation threshold it can be seen that further development is needed in the next few years because, for both off-mode and standby, more than 50% of the measured appliances do not comply with the 2013 regulation thresholds.

Measurement Comparison

Next, a comparison is made between the recorded data and the reference values used in the EuP TREN/Lot 6 [4]. Because there was no available data for multi-function devices, scanners and copiers in the EuP TREN/Lot 6, values from other studies were used [7, 8]. The compared values are averages of the recorded power consumption.

Figure 5: Off-Mode Power Consumption Values Comparison



An average reduction of 70% in off-mode power consumption values can be observed in Figure 5, when comparing the SELINA measurements with other studies realized in 2005 and 2008 [7, 8, 4].

Figure 6: Standby Power Consumption Values Comparison

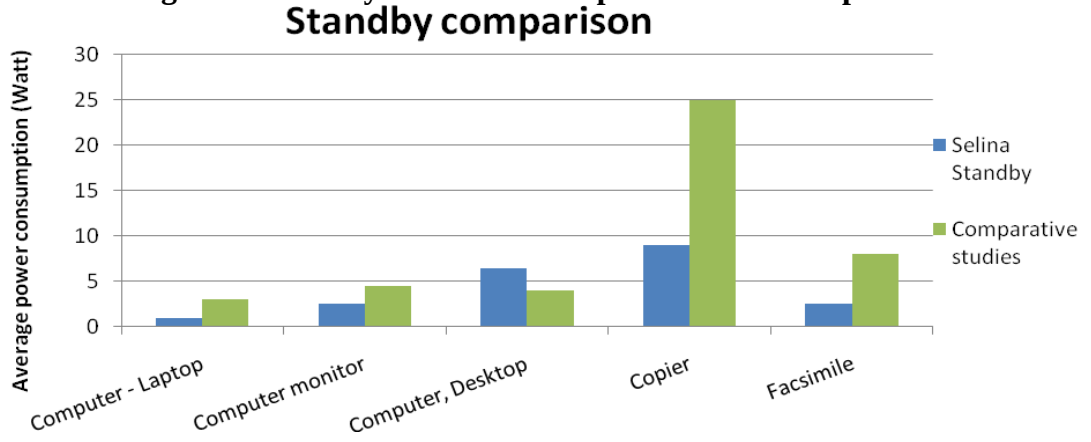


Figure 6 shows that the same trend for standby as in off-mode. An average reduction of 30 % is observed when comparing the SELINA measurements with other previous studies.

As a general outcome of this comparison it can be said that office equipments exhibit a positive evolution over the last few years in terms of low power modes consumption thanks to the implementing measure of the Directive 2005/32/EC on Ecodesign of products, the European Regulation EC 1275/2008.

Retailers Awareness

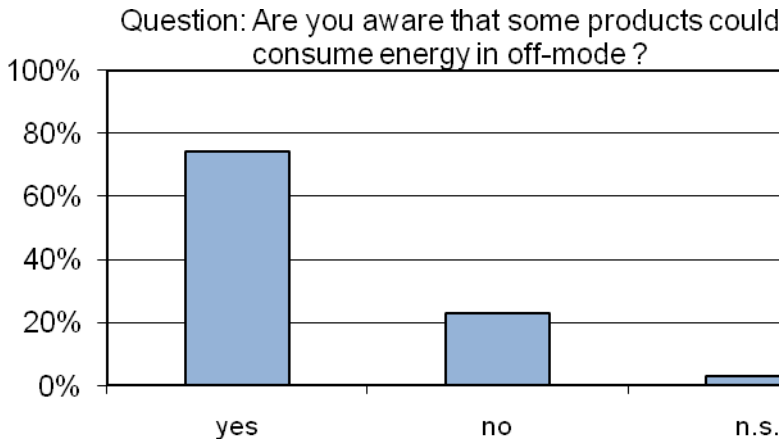
In the SELINA project frame a retailer's awareness survey with a total goal of 300 questionnaires in 12 different European countries is being done. Until now 128 questionnaires were answered by salesmen from Romania, Belgium, and Denmark.

The first results show that 90 % of retailers try to give emphasis to energy savings that could benefit the end-user. However other features like equipment price, brand and design appearance play an important role during equipment sale and for client decision.

In the interviewed retailer's opinion, the use of additional information over what contains the Energy labels, eg energy consumption of the equipment in different modes could change the client decision regarding efficient equipment, i.e. to buy efficient equipments. It has been proposed by some retailers to display the off-mode and standby wattages on energy labels: there is however a risk that the customer may choose the product based on the low power modes consumption rather than based on the total consumption of the product. For products where low power mode consumption and main function consumption are comparable, integrated indices should be adopted.

In Figure 7 it can be seen that 23 % of retailers are still not aware that equipment in off-mode can consume energy.

Figure 7: Retailer's Answers



Policies for Market Transformation

In the European Union, the most important policy tool directed at reducing energy consumption of electrical appliances is the Eco-design Directive (2005/32/EC). It establishes a framework under which manufacturers of energy-using products will, at the design stage, be obliged to reduce the energy consumption and other negative environmental impacts occurring throughout the product life. The Directive was revised and enlarged to all energy-related in 2009 (2009/125/EC). In December 2008, the Commission adopted the Regulation No. 1275/2008 for implementing the Eco-design Directive with regard to requirements for standby and off-mode electric power consumption of electrical and electronic household and office equipment. The regulation, which comprises a wide range of products (household equipment, information and communication technologies, consumer electronics, other products as toys etc.), stipulates that from 2010 power consumption of this equipment in any off-mode condition and in any condition providing only a reactivation function shall not exceed 1 W and equipment also providing information or status display shall not exceed 2 W. From 2013, these limits are further strengthened to 0.5 W and 1 W respectively.

Minimum energy performance standards (MEPS), as they are set under the EU Eco-design Directive, are a suitable policy tool in order to remove the worst performing products

from the market. They are, however, not sufficient to promote the best performing products and to overcome other important market failures and barriers as e.g. information deficits of consumers and retailers. Since this is more relevant for energy consumption in active mode than in standby and off-mode, the analysis of policies for market transformation within the SELINA project is not restricted to polices only focusing on standby, but all operation modes are considered. There is a wide range of additional policy tools in order to bring about long-term market transformation towards more efficient electrical appliances:

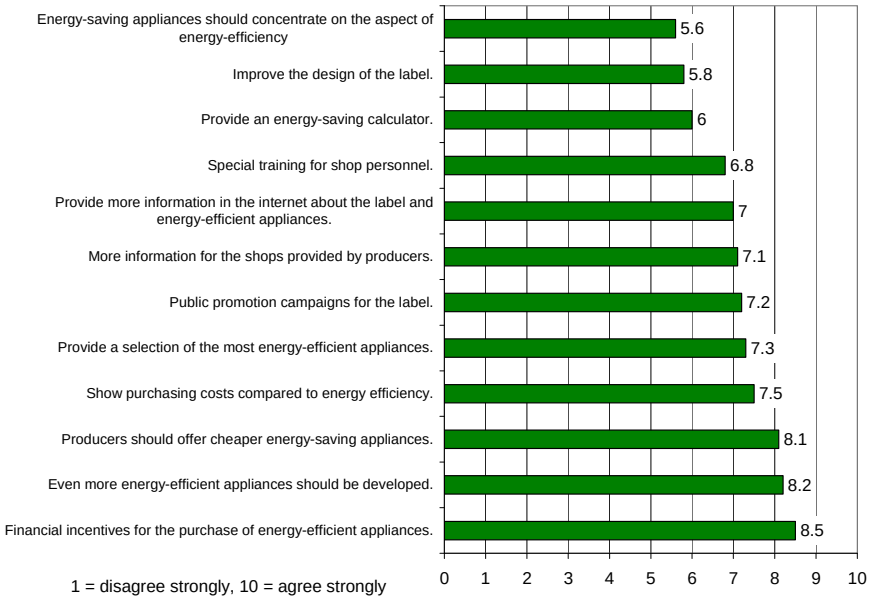
- Mandatory or voluntary energy efficiency labels, which aim to provide consumers and retailers with information at the point of sale and enable suppliers to gain market recognition for efficient products;
- Fiscal and financial measures as e.g. grants or tax reductions for highly efficient appliances, or low interest loans;
- Market-based instruments as the establishment of white certificate schemes creating a market for energy efficiency;
- Co-operative instruments as voluntary agreements with producers of energy-using appliances, voluntary DSM measures of energy suppliers or technology procurement for energy efficient appliances;
- Information and education programs and activities both addressing consumers (as buyers and users of electrical appliances) and retailers.

A first overview of the policy instruments which are used in a country to enhance the market transformation towards energy-efficient appliances can be gained from existing online databases, as e.g. the IEA Energy Efficiency Policies and Measures Online Database1 or the MURE measure database including all EU Member States plus Norway and Croatia[2]. A recent IEA publication about electronic devices [9] also gives on worldwide overview of policies for energy efficient electronics. Nevertheless, these sources mainly refer to general policies addressing energy-efficient appliances at the national level, whereas specific programs and activities addressing consumers and retailers not only at the national level, but also at the level of regions or municipalities, are rarely included.

In a survey among retailers in all EU Member States e.g., many suggestions have been made by the retailers how to motivate consumers to buy more energy-efficient appliances at the point of sale which go beyond the usual policy tools (Figure 8).

[1] http://www.iea.org/textbase/pm/index_effi.asp
[2] http://www.mure2.com/

Figure 8: Suggestions from Retailers in All EU Countries How to Motivate Consumers to Buy More Energy-Efficient Appliances (source [10])



Therefore, one target of the SELINA project is the collection of this kind 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 is 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. The first results of this measure collection, which is still going on, are shown in Table 1. In most countries, information programmes (esp. brochures, leaflets, websites, 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). 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.

Table 1: Examples for Policies and Actions to Accelerate the Market Penetration of Energy-Efficient Electrical Appliances in Selected SELINA Partner Countries

Country	Measure title	Description and results
Austria	Quick-Check	"Quick-check" is an online tool to calculate the electricity consumption of a private household. It was developed by E-Control and the Austrian Energy Agency and shall allow the user to get more information on the energy consumption of all electrical appliances available in the household. In addition, electricity saving options are given and the benefit of these possible savings is calculated in Euro/kWh.
Czech Rep.	"Scrap Premium" on white appliances	In 2009, the CEZ group initiated a 2 month programme in cooperation with two selected electronic retail stores. Customers got a premium of 1000 CZK (ca. 38 Euro) when buying a new most efficient white appliance and handing over the old appliance, which was ecologically recycled. It is estimated that roughly 50% of energy consumption for a given appliance may have been saved by this measure.
Czech Rep.	Prazak family is saving with PRE	This is an activity in Prague which was based on the EU-IEE project REMODECE. Six most "energy wasting" families have been chosen and got an energy advice, resulting in energy savings of 14 to 31 %. The total savings in the families amounted to more than 6 MWh/year. Linked to that, the biggest electricity distributor in Prague, PRE, initiated a large energy saving campaign, in which these families were the actors. The additional savings of the campaign have not been quantified.
Czech Rep.	Discounts and subsidies under EnergiePlus+	Activity of EON, which is a big electricity and gas supplier in the southern parts of the Czech Republic. In cooperation with one producer of white appliances and a special retail chain, a bonus is paid for a purchase of energy efficient white appliances and discounts are given for the purchase of efficient light bulbs and energy saving devices (switch socket power boards, timer).
Denmark	Campaign "Turn off the switch – or spend money on nothing"	In winter 2003/2004, a campaign was carried out giving information on standby consumption and how much money can be saved by turning off the appliances. The campaign was well-known in the population.
Denmark	AutoPowerOff plug banks	Campaign of the Danish Electricity Savings Trust in 2007/2008 promoting the wider use of AutoPowerOff plug banks in cooperation with producers and several major retail chains. The total costs of the campaign amounted to around 1.2 million Euro. The annual savings per household per plug range between 25 and 137 kWh/year.
Germany	Initiative EnergieEffizienz	The Initiative EnergieEffizienz is a nationwide platform for action targeting the efficient use of electricity in all consumer sectors. It is organised by the German Energy Agency (dena) as a public/private partnership project in co-operation with energy supply companies. Retail trade and craftsmen, existing consumer advice centres and regional energy agencies are also integrated in the concept of the campaign. With regard to private consumers the campaign is especially focused on reducing standby losses, supporting efficient lighting with high comfort and raising energy efficiency of "white" household appliances.
Italy	Budget law 2007 and 2008	New installation and/or replacing of high efficiency motors of electric power between 5 and 90 kW, of variable speed drives (inverters) on installations with electric power between 7.5 and 90 kW, replacement of refrigerators, freezers and combinations thereof by similar appliances of energy class not inferior to A+ will have a gross tax deduction equal to 20% of the amounts remaining payable by the taxpayer, up to a maximum deduction of €1500 per motor or inverter (in a single installment) and 200€ per refrigerator. Operation has to be carried out by 31 December 2010.
Italy	Law 166, 20/11/2009	Creation of a 1 Million € fund for public information campaigns (in particular on incandescent bulbs phase-out and stand-by consumption reduction).
Sweden	Technology procurement	Since the 1990s, about 40-50 "technology procurement" projects have been performed in Sweden. Though no projects are going on now, many "technology procurement" inspired working groups have been established with purchasers groups.
Switzerland	Energy label for coffee machines	The Swiss Government introduced a voluntary energy label for coffee machines following the example of the EU energy label.
Switzerland	Subsidies for A++ devices	There are different programs and actions from Swiss utilities to promote highly efficient white appliances by subsidizing A++ devices. As an example, an electricity saving funds of Zuerich pays up to 400 CHF per purchased A++ freezer or refrigerator.

In addition, pilot actions will be carried out within the SELINA project in order to test the new information tools on standby consumption which have been developed within the project

(online database including information on best and worse standby consumption of the appliances measured within the project, internet-based calculator calculating energy savings for each of the appliances in the database, brochure including guidelines of equipment).

Conclusions

It is expected that SELINA project can support the successful national implementation of the regulation implementing the Eco-design Directive with regard to standby consumption by providing information on the present status from the measurement campaign. The project can also help to embed this implementation in a broader national strategy to enhance the market transformation towards energy-efficient appliances since it gives a deeper insight into retailer's attitudes towards energy-efficient appliances and an overview of successful and innovative policy measures at the level of retailers and consumers.

The SELINA project shows very important results both in technological and in market transformation:

- So far, about 70% of the products metered in the project have a better performance in off-mode consumption than recorded in the past three years: the commission regulation appears to work in the right direction and manufacturers to have adapted before the legislation entries into force;
- Regarding standby power, the efficiency increase is lower, (although almost 30% of reduction is observed) and efforts are still required to reach the legislation requirements of 1 W in 2013;
- Both for standby and off mode however, a considerable number of products reaching the thresholds of the European regulation on standby and off mode have already been available at the point of sale in 2009, i.e. before the regulation became effective;
- Despite existing efforts, some more target group specific information about energy consumption both in active mode and in low power modes in shops could further support the market diffusion of energy efficient products.

Acknowledgments

The SELINA Project is mainly supported by the Intelligent Energy Europe Programme of the European Union

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