Framework Service Contract for the Procurement of Studies and other Supporting Services on Commission Impact Assessments and Evaluations

Interim, final and ex-post evaluations of policies, programmes and other activities

Evaluation of the Ecodesign Directive (2009/125/EC)

Final Report

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List of abbreviations

AC - Air Conditioner

ACEA - European Automobile Manufacturers' Association

AD – Abiotic Depletion

ADCO - Administrative Cooperation for Market Surveillance group

AISE - the international Association for Soaps, Detergents and Maintenance Products

ANEC - the European Association for the Coordination of Consumer Representation in Standardisation

AT - Austria

ATLETE - Appliance Testing for Energy Label Evaluation

AUSD - Australian Dollar

BAU - Business as Usual

BC - Battery Chargers

BE - Belgium

BG - Bulgaria

BIO IS - BIO Intelligence Service

CAP - Common Agricultural Policy

CECED - European Committee of Domestic Equipment Manufacturers

CECIMO - the European Association of the Machine Tool Industries

CELMA - Federation of National Manufacturers Associations for Luminaires and Electro-technical Components for Luminaires in the European Union

CEMEP - European Committee of Manufacturers of Electrical Machines and Power Electronics

CEN - European Committee for Standardisation

CENELC - European Committee for Electrotechnical Standardisation

CF - Consultation Forum

CFL - Compact Fluorescent Lamps

CHP - Central Heating Products

CLASP - Collaborative Labelling and Appliance Standards Program

CLITRAVI - Liaison Centre for the Meat Processing Industry in the European Union

CLP - Classification, Labelling and Packaging of Substances and Mixtures

COICOP - Classification of Individual Consumption According to Purpose

COTANCE - Confederation of National Associations of Tanners and Dressers of the European Community

CPR – Construction Products Regulation

CPA - Classification of Products by Activity

CRT - Cathode Ray Tube

CSES - Centre for Strategy and Evaluation Services

List of abbreviations

CZ - Czech Republic

DE - Germany

DEFRA - Department for Environment, Food and Rural Affairs

DG - Directorate General

DK - Denmark

DOE - Department of Energy

EBPD - Concerted Action Energy Performance of Buildings Directive

EC - European Commission

ECEEE - European Council for Energy Efficient Economy

EE - Estonia

EEA - European Economic Area

EEB - European Environmental Bureau

EEC - European Economic Community

EEDAL - Energy Efficiency in Domestic Appliances and Lighting

EEI - Energy Efficiency Index

EFTA - European Free Trade Association

EIRPO - Environmental Impact of Products

ELD - Energy Labelling Directive

EMAS - Community Eco-management and Audit Scheme

EOL - End-of-Life

EPBD - Energy Performance of Buildings Directive

EPS - External Power Supply

ERM - Environmental Resources Management Limited

ES - Spain

ETS - Emissions Trading System

EU - European Union

EUEB - European Union Eco-labelling Board

EUROPUMP - European pump industry

FI - Finland

FR - France

FSC - Forest Stewardship Council

FTE - Full-Time Equivalent

GHG - Greenhouse Gas

GLS - General Lighting Service

List of abbreviations

GPP - Green Public Procurement

GR - Greece

GWP - Global Warming Potential

HD - High Definition

HFC - Hard Floor Coverings

HID - High-intensity discharge

HT - Herbicide Tolerant

HU - Hungary

HVACR - Heating, Ventilation, Air Conditioning & Refrigeration

IA - Impact Assessment

ICT - Information and Communication Technology

IEA - International Energy Agency

IEC - International Electrotechnical Commission

IED - Industrial emissions Directive 2010/75/EU

IEE - Intelligent Energy Europe Programme

IES - Institute for Environment and Sustainability

IIIEE - International Institute for Industrial Environmental Economics

ILCD - The International Reference Life Cycle Data System

IM - Implementing Measure

IPPC - Integrated Pollution Prevention and Control Directive 2008/1/EC

IPTS - Institute for Prospective Technological Studies

ISO - International Organisation for Standardisation

IT - Italy

JRC - Joint Research Centre

LBNL - Lawrence Berkeley National Laboratory

LCA - Life Cycle Assessment

LCC - Life Cycle Costing

LCD - Liquid Crystal Display

LCIA - Life Cycle Impact Assessment

LEDs - Light-Emitting Diodes

LFL - Linear Fluorescent Lamps

LLCC - Least Life Cycle Cost

LPG - Liquefied Petroleum Gas

LT - Lithuania

List of abbreviations

LV - Latvia

MEPS - Minimum Energy Performance Standard

MS - Member States

NF - Environment mark

NGO - Non-governmental Organisation

NL - Netherlands

NMO - National Measurement Office

NRDC -Natural Resources Defence Council

ODYSSEE - ODYSSEE IEE project

OEM - Original Equipment Manufacturer

PEF - Primary Energy Factor

PFEC - Programme for the Endorsement of Forest Certification

PJ - Petajoule

PL - Poland

PM - Particulate Matter

PO - Power Output

PR-PPM - Product-Related Production Processing Methods

PRODCOM - Production Communautaire

PT - Portugal

PVC - Polyvinyl chloride

REACH - Registration, Evaluation, Authorisation and Restriction of Chemical substances

REMODECE - Residential Monitoring to Decrease Energy Use and Carbon Emissions in Europe

RES - Directive on Electricity Production from Renewable Energy Sources

RoHS – Restriction of Hazardous Substances Directive

RO - Romania

SCP/SIP – Sustainable Consumption and Production/ Sustainable Industrial Policy

SDS - EU Sustainable Development Strategy

SE - Sweden

SEAD - Super-efficient Equipment and Appliance Deployment

SELINA - Standby and Off-Mode Energy Losses in New Appliances

SFC - Soft Coverings

SI - Slovenia

SK - Slovakia

SME – Small and Medium-sized Enterprise

List of abbreviations

STB - Set-Top-box

TP - Transitional Period

TWh - Terawatt-hour

UEAPME - European Association of Craft, Small and Medium-sized Enterprises

UK - United Kingdom

UNEP - United Nation Environment Programme

USA - United States of America

USEPA - United States Environmental Protection Agency

VA - Voluntary Agreement

VOC - Volatile Organic Compounds

VSD - Variable Speed Drive

WEEE - Waste Electrical and Electronic Equipment Directive

WMO - World Meteorological Organisation

WTO - World Trade Organisation

Introduction 1

This document contains the Final Report submitted by the Centre for Strategy & Evaluation Services (CSES) LLP in respect of the assignment: 'Evaluation of the Ecodesign Directive 2009/125/EC of 21 October 2009, with reference to Article 21.' under Lot VI of the Framework Contract for the Procurement of Studies and other Supporting Services on Commission Impact Assessments and Evaluations (2008/S146-195858).

1 INTRODUCTION

The objective of the Final Report is to present the findings and the resulting conclusions from the analysis of the evidence collected during the field work conducted by CSES and its partners in the evaluation study of the Ecodesign Directive (2009/125/EC).

The evidence has relied considerably on stakeholder feedback through various mechanisms. This report sets out much of this feedback, where it has been used as the basis for further enquiry and discussion in order either to validate the views expressed and support them with further evidence or to qualify or reject them, if they have proved to have little foundation. The second and third Stakeholder Meetings, in particular, were used as an occasion to report on issues highlighted and views expressed and to solicit further commentary and evidence. The evaluation team is very grateful for the extent of the material provided.

The Report first presents a brief account of the methodological framework of the evaluation and then proceeds to an analysis of the data and other information collected in an order dictated by the central questions of the evaluation that concern the relevance of the Directive, its effectiveness and efficiency and finally its utility and European added-value. Finally, the key conclusions are brought together and a number of recommendations are put forward.

The structure of the report is as follows:

Section 2 – Methodology: describes the key objectives of the evaluation and the tasks involved and briefly presents the methodological framework that provides the basis for the evaluation.

Section 3 – Analysis of findings: analyses the findings from the examination of the evaluation questions concerning the Ecodesign Directive.

Section 4 – Assessment of the extension of the Directive: describes the work undertaken in a series of case studies to provide a preliminary assessment of the scope for extending the Ecodesign Directive to cover non-energy related products and also sets out the conclusions drawn.

Section 5 – Conclusions and Recommendations: Presents the main conclusions and the recommendations of the evaluation**.**

Methodology 2

In this section, we describe the key objectives of the study and present the methodological framework used to evaluate the Directive and assess the feasibility of extending the Directive to cover non-energy related products.

2 METHODOLOGY

The aim of the study has been to conduct a formal evaluation of the Ecodesign Directive, according to the normal practice of the European Commission, and to examine whether, and in what ways, the Directive might be extended to products that are not currently within its scope. The evaluation is in response to Article 21 of the 2009/125/EC Ecodesign Directive that requires the Commission to review the effectiveness of the Directive and of its Implementing Measures, with a view to further legislation, if necessary, that would amend the Directive's provisions and increase its effectiveness.

In view of the requirements of the Directive, the study has had a series of priorities that may be summarised as follows:

- Assess whether the Directive is fulfilling its objectives in terms of reducing energy consumption and relevant environmental impacts for the products in its scope, including complex products and systems of products;
- Evaluate the Directive's effects on the market, on industry's competitiveness and on innovation in the sector concerned;
- Examine whether the criteria and procedures for defining and developing Implementing Measures as described in Article 15 and as implemented by the Commission, are effective and efficient, particularly taking account of the administrative costs involved;
- Examine the effectiveness of the application of the Directive in the EU and the Member States, including issues such as product conformity, the effectiveness of surveillance and the continuing existence of hidden barriers;
- Examine the political, legal and (if appropriate) procedural relationships of the Directive with other EU policies and instruments - the SCP/SIP Communication, environmental legislation and health and safety legislation. The possible integration of product related instruments (Ecodesign, Energy label, Eco-label and GPP) is of particular interest;
- Examine the appropriateness and implications of any extension of the Directive beyond its current scope to also cover non-energy related products.

2.1 Analytical framework

The priorities of the study have helped to formulate a list of evaluation questions, covering the whole range of evaluation topics. These questions have been put within a conventional and well established evaluation framework that is used in standard Commission evaluation methodology. These issues concern:

Relevance and coherence - the extent to which the given legislation is relevant to the identified needs and general EU policy objectives and coherent with other relevant policy tools.

Effectiveness - the extent to which the legislation is achieving its operational, specific and global objectives.

Efficiency – the relationship between financial and administrative inputs related to the implementation and enforcement of the legislation and the physical outcomes and how economically the various inputs have been converted into outputs and results. Linked to this is value for money – could more be achieved with the same level of financial inputs or, conversely, could the same outputs be achieved with reduced inputs?

Methodology 2

As far as the required exercise has the character of an Interim Evaluation, the question of efficiency also arises in relation to the processes and procedures through which the legislation is implemented.

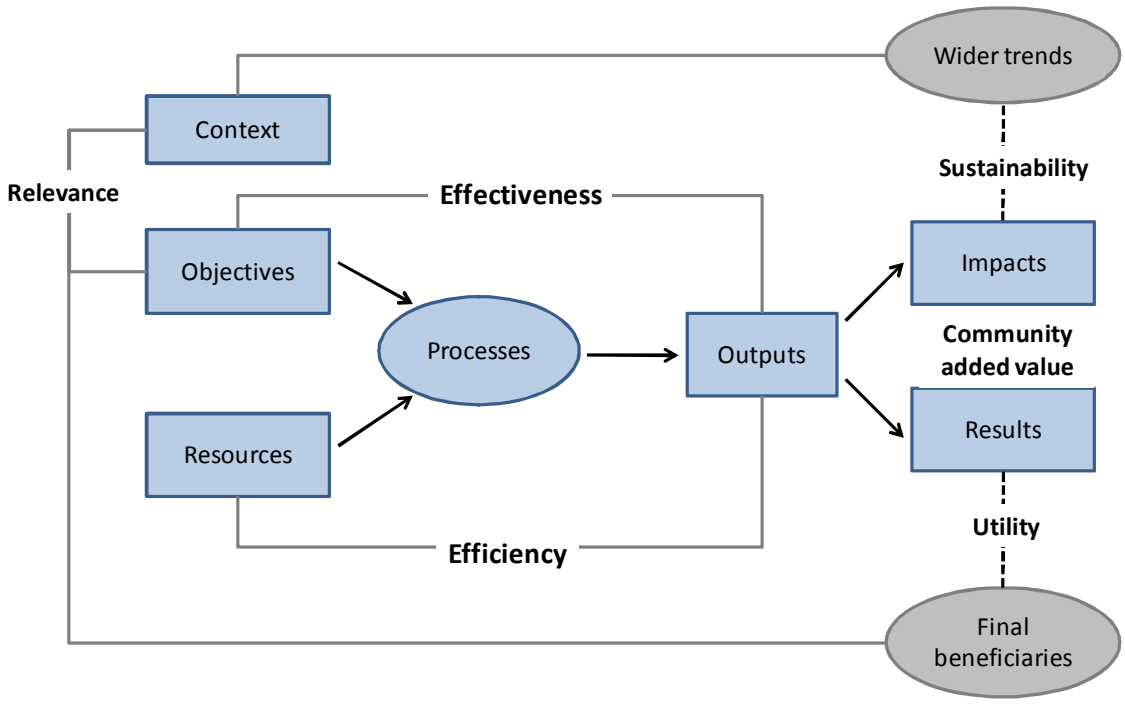
Utility – the extent to which the impacts of the legislation compare with the needs of the target population(s) – including industry, consumers and society more generally (including environmental concerns).

Sustainability - the extent to which positive changes attributable to the implementation of the legislation are expected to be sustainable in view of any additional compliance costs; More specifically in this specific case would it be practical and reasonable to extend the procedures (Implementing Measures, in particular) to cover a larger number of products?

European added value – the extent to which intervention or activities supported at an EU level brings about changes that would not have occurred through Member States acting on their own or cooperating bilaterally.

The differing issues can be thought of, as arising from a focus on particular aspects of a larger process, as is illustrated in the chart below:

Chart 2.1 – Evaluation framework



2.2 Intervention logic

A key process in any evaluation of policy measures is the development of an account of the policy's intervention logic (see diagram in page 7). An intervention logic illustrates the expected linkages and causal relations between the identified needs the policy is addressing and the actions undertaken to address those needs. It shows the links between broader policy goals and the more specific operational objectives of the Directive, and how these are operationalised in the Implementing Measures and the actions of the key actors involved (Commission, Member States authorities, industry and stakeholders). In addition, the intervention logic sets out the nature of the expected achievements of the policy, by describing the

relationship between the Directive's objectives, its specific short term outputs and the expected medium term results and longer term impacts of the actions undertaken. It is thus possible to see more clearly the mechanisms of the Directive, the key parameters of success or failure and the associated indicators at the different levels. The model set out in this way also provides the basis for investigation in the course of an evaluation since it suggests the points in the process that need examining and helps identify the critical indicators of success. In doing so, it highlights the process dimensions of the policy intervention and the efficiency, with which they are carried out, as well as the expected market and industry outcomes and the ultimate environmental impacts.

The account of the Ecodesign Directive's intervention logic was developed on the basis of the analysis of the provisions of the Directive itself, a review of other significant policy documents (e.g. SCP/SIP Action Plan) and initial interviews with key stakeholders. It illustrates, in particular, the expected linkages between the identified needs and broader policy goals (reduction of greenhouse gas emission, security of supply, avoidance of fragmentation in the Internal Market) and the more specific operational objectives of the Directive (the methodology for setting requirements, the mechanisms for ensuring conformity) the Implementing Measures themselves and the actions on the ground of the key actors (Commission, Member States authorities, industry and stakeholders).

In turn these objectives are linked with expected short term outputs that are key elements in the implementation process and the anticipated outcomes in the medium term (results) and long term (impacts).

In the long term the key objective of the Ecodesign Directive is to reduce energy consumption and environmental impacts. Possible variables measuring impacts on the environment include:

- **Total CO_2 emission reductions**. A direct measure of the impact on the environment for a certain product group.
- **Total energy consumption by product group.** Total energy consumption is easier to assess and can be used as a proxy for impact on the environment.

The key medium term outcomes of the Directive are the expected changes in the markets of EuPs towards more energy efficient products. Possible indicators measuring impacts on market and industry include:

- **Composition of the market by class of products on the basis of the energy label or shifts in the market shares across the efficiency classes of products**
- **Average/aggregate efficiency gains achieved as a result of the changes in the market structure**

Furthermore, the Ecodesign Directive can have indirect effects on the market and industry which can affect energy consumption and CO_2 emission:

- **Sales volumes and the prices of EuPs**
- **Product variety and consumer choice.** Ecodesign requirements can force certain types of product to be withdrawn or lead to suppliers of less efficient technologies leaving the market. If new products are not introduced in step with these changes, product variety and consumer choice will diminish.

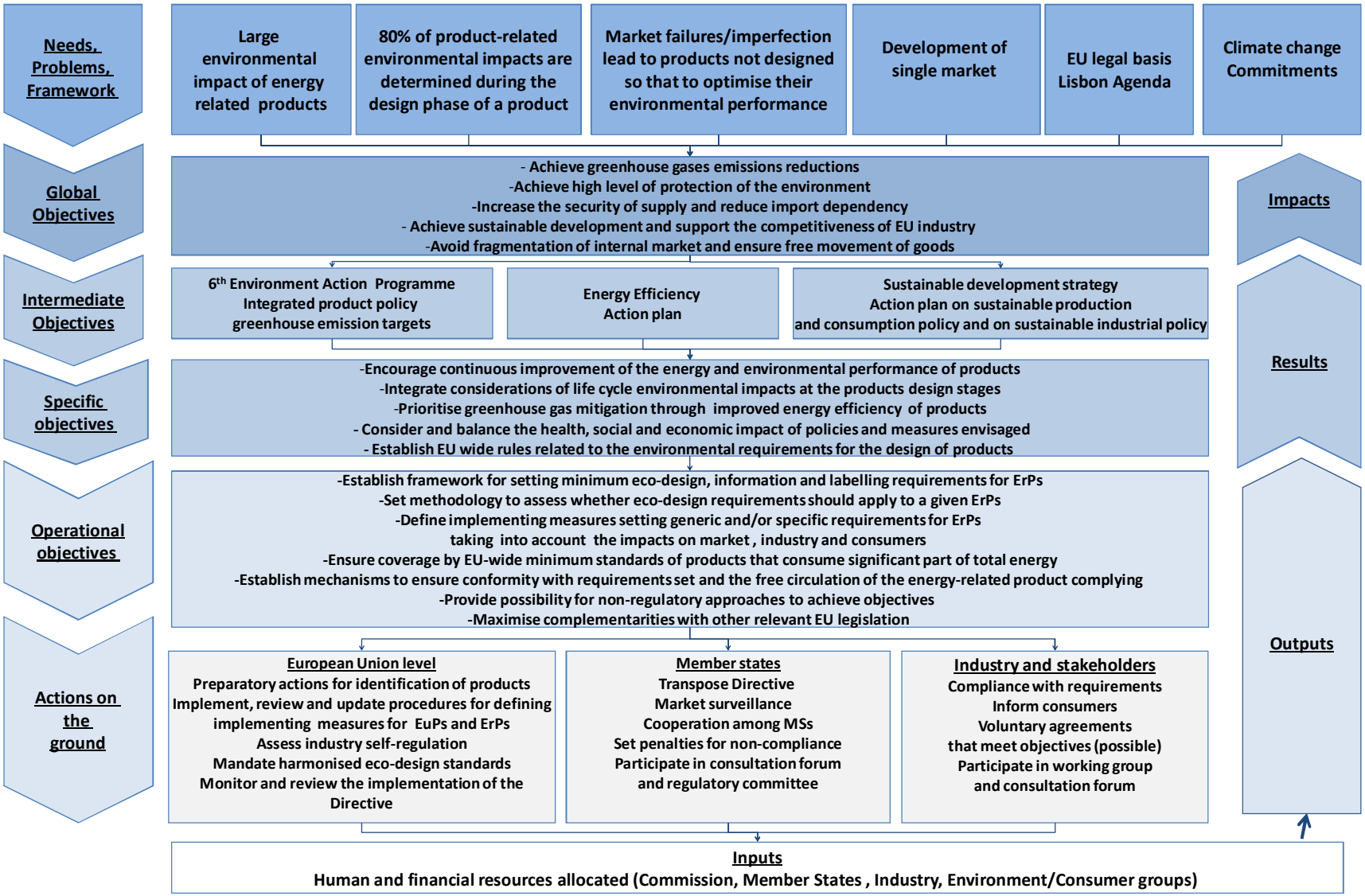
Furthermore, it is important to assess any additional market impacts, including:

- **Effects on trade patterns and the supply chain**: Any shifts in trade or international competition.
- **Effects on competitiveness**: The reported or observed changes in the competitiveness of particular industries.

- **Impacts on third countries**: This could result from market changes or regulatory shifts due to the European policy initiatives.

A critical aspect is the actual compliance with the requirements set by the relevant Implementing Measures. If market surveillance and enforcement is effective a shift in the market and industry performance will occur by definition and will help the transformation towards lower energy consumption for the targeted product group leading to the medium and longer term objectives. However, if market surveillance and enforcement are not equally effective across the Member States this will lead to uneven implementation of the Directive allowing for free riders in the market and providing entry points for non-compliant products, thus affecting the operation of the Single Market.

Methodology



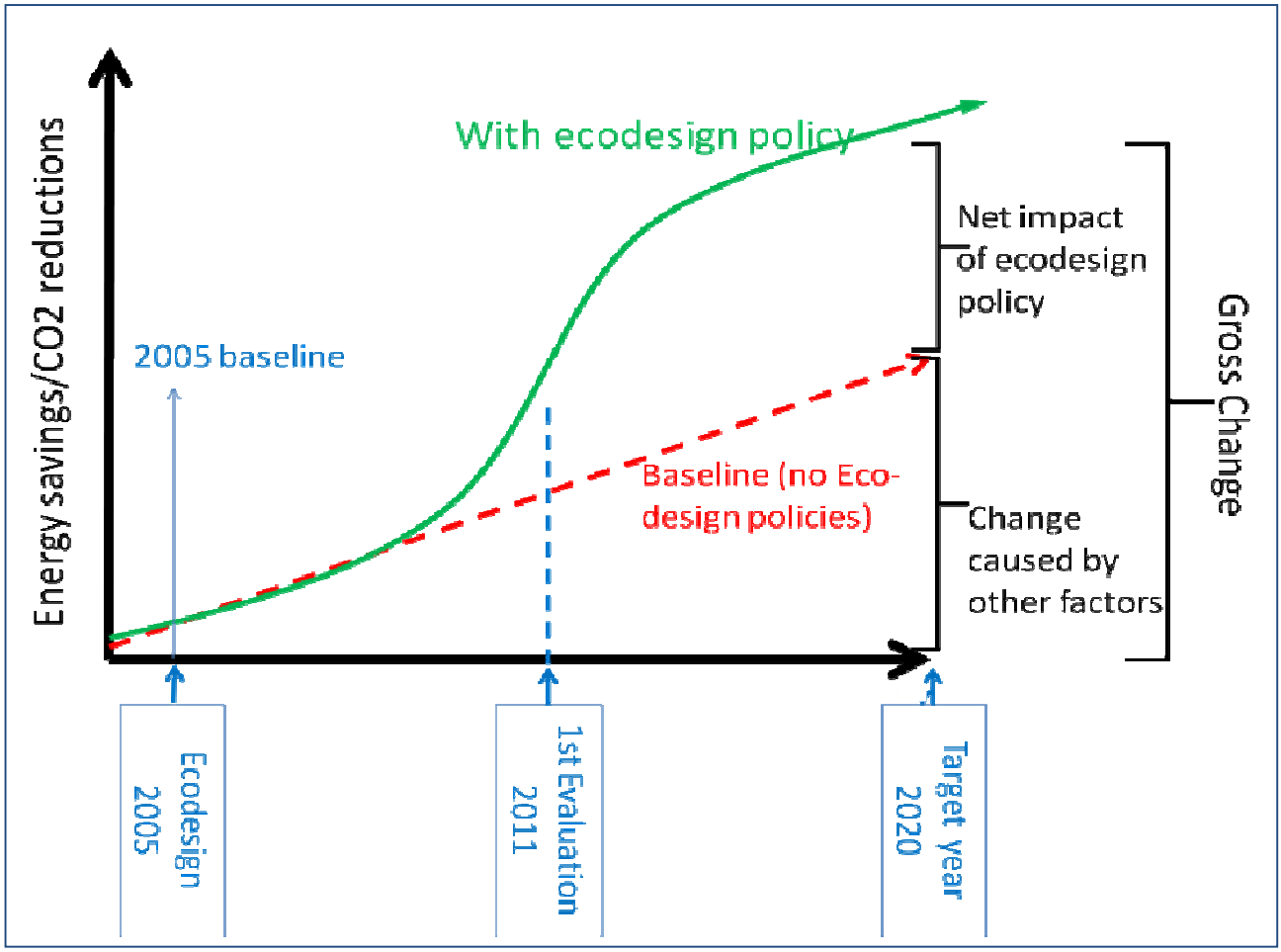
2.3 Development of the baseline for assessing effectiveness

In addition to defining which indicators to use, it is essential to establish when to measure impact and against which baseline. The baseline represents the starting point since it describes the status quo against which the effects of an intervention can be assessed. For the development of a baseline in the case of the Ecodesign Directive and the various Implementing Measures, the corresponding impact assessments of the energy-using products and the respective preparatory studies have been the point of reference.

Chart 2.2 below illustrates how the use of the baseline helps the assessment of the effectiveness of the Implementing Measures developed under the Ecodesign Directive in relation to the longer term objective of reducing greenhouse gas emissions but a similar logic can be applied to other environmental impacts when covered by relevant Implementing Measures. By comparing an outcome indicator such as the overall energy savings of a specific product category over time against a projected business as usual scenario (BaU) of no policy action we can get an indication of the effects of the measure. Of course, the presence of a difference does not by itself substantiate a causal relation. Intermediate indicators can help assess whether the expected process (as described in the intervention logic) is taking place and the use of other sources such as interviews with stakeholders that throw further light on the nature of the change.

Chart 2.2. – Theoretical model for assessing the impact of the Ecodesign Directive on energy savings

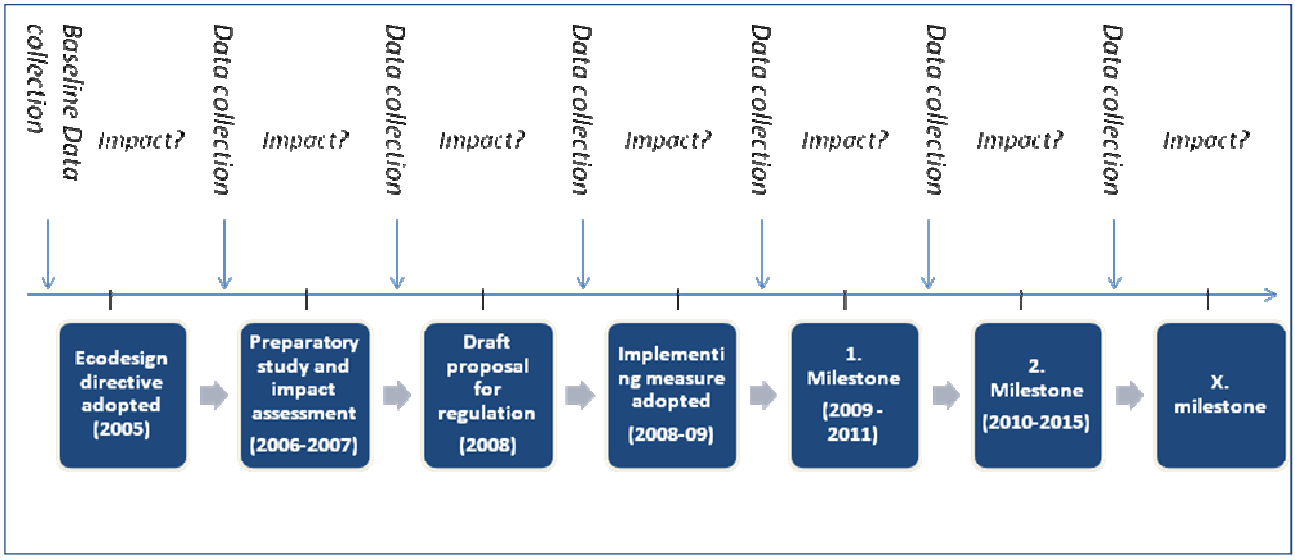
In order for Ecodesign requirements to be set for a product group a number of steps have to be followed.



These include selecting the product group in a Working Plan[1], a preparatory study and consultation with stakeholders, an impact assessment and adoption of an Implementing Measure. In an ideal scenario, the evaluation of the effectiveness would be based on:

- A first baseline measurement prior to the adoption of the Ecodesign Directive.
- Measurements after the preparatory study and the impact assessments are developed, the draft regulation is proposed and the requirements are adopted.
- Several measurements after the requirements come into force.
- A measurement at some point after the Implementing Measure is fully implemented and the desired effects have taken place. In the case of the Ecodesign Implementing Measures this refers to the entry into force of the most demanding requirements.
- Establishment of a control group to control for the developments in the absence of Ecodesign requirements.

Chart 2.3: Ideal data collection to measure effectiveness



Note: the years mentioned are indicative of the process for most of the 11 product groups covered.

For each of the 11 product groups evaluated a timeline is set out specifying the different steps of the process. This will indicate the expected changes for each product group. Because of the limited data available it has not been possible to measure possible impacts after each action as illustrated above. However, the timeline serves as a reference point for the evaluation and for future evaluations when more data will be available.

2.4 Limitations

In contrast to the ideal scenario described above there are a number of important limitations in the actual evaluation of the effectiveness of the Ecodesign Directive currently. Firstly, there is the **timing of the evaluation**. Implementing Measures for the 9 product groups were only brought into force towards the end of 2008 or in 2009, following a phased introduction of measures and a step-by-step strengthening of the minimum requirements. Only one product group has progressed beyond the first set of requirements. For three more products, the Implementing Measures came into force during the last year with no

[1] During the "transitional period" between the entry into force of the Ecodesign Directive in 2005 and the adoption of the first Working Plan in 2008, Implementing Measures were prepared for a number of products identified as priorities in the Ecodesign directive article 16 based in priorities set by the European Climate Change Programme.

requirements yet applicable. Thus, the focus of the evaluation has to be on the individual products covered and effects that can be observed from the relevant Implementing Measures or Voluntary Agreements.

An additional complication is that the requirements set in Implementing Measures only apply to all new products brought to the market and not products already on the market. Since most of the products covered have relatively **long life-cycles,** an important part of the total stock in the market will not be required to fulfil the requirements. This naturally, limits the effect of the Directive.

Even more important are the **data constraints**. There is a lack of data covering the period after the requirements have entered into force. Data from official statistical sources are at least 2-3 years old and, as a result, they tend to be limited to the period before the Implementing Measures were adopted. Furthermore, for some of the nine product groups, it is a challenge to find relevant data, e.g. on energy consumption, for the product groups as they are defined in the Implementing Measure. During the fieldwork period the evaluation team conducted an extensive review of available sources and requested stakeholders to come forward with any relevant data that would provide direct or indirect indications of changes in the market for EuPs. However, stakeholders representing associations have mostly reported that they have no relevant information at this stage.

Beyond the practical aspects, there is also an **issue of causality**. The available data do not solely reflect the impact of the Ecodesign Directive. Other instruments – primarily the Energy Labelling Directive but also other policy tools at the European and Member State level –also play a role in the development of more energy efficient appliances. The way these different policies interact may vary among product categories. In theory the Energy Labelling Directive focuses on the provision of information to consumers on the quality of products and thus helps the operation of the market from the demand side, complementing the supply-side changes brought about by the Ecodesign Directive. As a matter of fact, Energy Labelling requirements are based on the benchmark levels established under the Ecodesign Directive and preparatory studies under the Ecodesign Directive also consider labelling policies. However, there are difficulties in differentiating between the two influences. To establish causality is not only a challenge for this evaluation but a common challenge encountered in evaluations in general. In order to link the development illustrated by the data to the Ecodesign Directive, qualitative information - interviews with industry and other stakeholders who follow the process and the market closely - were also conducted aiming to supplement the quantitative information and to identify the main drivers of change in the level of energy efficiency of appliances. Furthermore, the focus of the analysis was on the lower end of the market, where the minimum requirements are more relevant, and not on the top-performing products that are primarily influenced by the Energy Labelling or other similar tools (e.g. Eco-label).

In addition, it is likely that the effects of the Directive or a particular Implementing Measure may have begun even before they formally entered into force. Interviews with stakeholders have confirmed that the prospective need to change in response to Ecodesign requirements, even at the stage that requirements are still under consideration, already focuses the attention of producers on improving energy efficiency. Thus, even though there were no legal requirements, changes may have started to happen prior to the implementation of the Directive. This anticipatory action is, in fact, a rather common phenomenon associated with the introduction of legislation that aims to set mandatory requirements. However, this **anticipatory effect** may have generated different reactions across the various industries depending on a number of framework conditions (e.g. market structures, availability of new technologies etc.). Some producers have reacted quickly and devoted significant resources to increasing energy efficiency. Others have reacted more slowly. The reaction from industry and the point in time at which changes start to happen had thus to be discussed in more detail under each product group, but, in general, the effects measured are mainly the anticipatory action of forward looking producers and, only to a limited degree, the effects of the entry of the Implementing Measures into force.

Anticipatory effects are referred to as **indirect effects** in this study because they are not caused directly by the requirements set. Effects caused by increased attention to energy efficiency among industry and consumers as a result of the Ecodesign Directive are also referred to as an indirect effect. Effects caused directly by the standards set in the Implementing Measures are referred to as **direct effects**. Thus indirect effects can kick in as soon as a product has been mentioned as a possible target of Ecodesign requirements whereas the direct effect will only happen after the requirements have been set in the Implementing Measures.

On the basis of the problems outlined, it is to be expected that the conclusions on the effectiveness of the Directive refer to only part of the relevant markets. Nevertheless, from indications in the information collected from various sources, it is possible to present a partial picture of the developments in the market and to make a first assessment of effectiveness of the Directive.

Rebound effect

The actual savings and emissions reductions resulting from the implementation of the Directive and the Implementing Measures can be influenced by the presence and extent of the **rebound effect.** A **direct rebound effect** refers to the increased level or frequency of use of products by consumers as a result of the improved levels of energy efficiency and lower costs per use. The effective fall in the price of a resource (the cost to produce one unit of output) can cause an increased consumption of the resource. Thus, while the products in the market become more efficient as a result of technological improvements and the minimum requirements set by the Implementing Measures, the initially expected reductions in total energy and the use of other resources may not be achieved. A rebound effect may also arise from a "feel good perception of being green" that can encourage increased consumption for certain green products. For example, the use of recycled paper (Schneider, 2003) or energy-efficient lighting may lead some people to increase the level of consumption of such products. However, a direct rebound effect requires that the consumer is informed about the greater energy efficiency of its products.

Furthermore, **indirect rebound effects** may arise from expenditure on additional energy using products as a result of the savings from efficiency costs.[2] Establishing such indirect effects requires a broader analysis of the economy and expenditure patterns of consumers. Furthermore, other factors, such as economic growth, overall consumption patterns, can have a much greater influence on both the direct and indirect rebound effects.

Consequently, although the initial intention was to enquire into such effects, the appreciation that the issues are very complex and the subject of an on-going debate, plus the direct advice of stakeholders led to the evaluation team deciding not to pursue these issues further. It should be said, therefore, that any discussion of impacts from the Directive in the following sections has not taken account of any possible rebound effects.

2.5 Assessment of the scope for a possible extension of the Directive to non-energy related products

A rather separate task of the evaluation has been the assessment of the scope and feasibility of extending the Directive to non-energy related products. This has comprised of four sub-tasks that included:

- An identification of relevant non-energy related products and a selection of 5 products for in-depth case studies
- Case studies of representative products

[2] Interim Report of the project "Addressing the Rebound Effect" conducted on behalf of DG Environment, http://rebound.eu-smr.eu/documents/ReboundEffectInterimReportWEBGVSS03022011.pdf?attredirects=0&d=1

- The use of the findings from the cases studies to derive conclusions on the feasibility of extending the Directive to take in broader product groups
- Assessing the appropriateness of an extension of the Directive to non-energy related products and making recommendations on how the Directive should be modified.

This part of the study ran in parallel to the work for the evaluation of the existing Directive (2009/125/EC). A detailed presentation of this work is provided in Section 4.

2.6 Fieldwork and data collection mechanisms

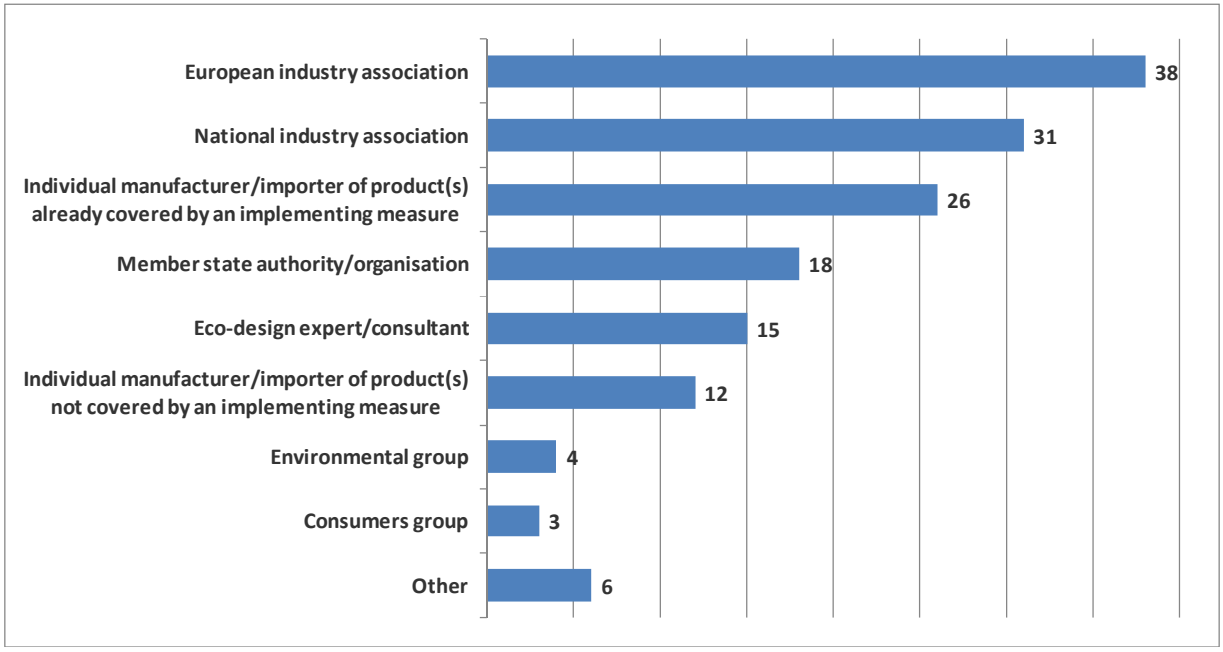
The fieldwork completed during the second phase of the evaluation was based on four main instruments: a stakeholder survey, Stakeholder Meetings, an interview programme and desk research. These are described briefly in the following paragraphs.

Survey

A stakeholder survey was organised during the period of March to May 2011. Stakeholders representing different actors in the market (Member Sstates authorities, industry associations, experts, environmental and consumer groups, individual companies) were asked to provide their feedback through both closed and open questions on almost all evaluation issues. The survey did not attempt to achieve any type of representative sample as the target population is difficult to define. The focus was rather on the collection of as much information as possible.

A total of 152 responses were received although some questionnaires were not fully completed. The following chart provides a breakdown of the respondents by role.

Chart 2.4 – Evaluation study survey responses by type of stakeholder



The respondents were asked to indicate their familiarity with the development of one or more existing or expected Implementing Measures. Among the products already covered, 78 indicated experience with one or more product and for all products listed there were at least 20 that have been or are currently involved. Clearly the level of focus on specific products is different in the case of industry associations that represent a specific sector and concentrate on one or a few products in contrast to Member State authorities or

environmental groups that are usually involved in multiple products. Still, in all products responses from a diversity of stakeholders has been achieved.

Stakeholder Meetings

Meeting with Stakeholders have provided a central reference point for the evaluation. Stakeholders were initially invited to express an interest on a dedicated website and were subsequently invited to meetings in Brussels. Documentation supporting the meetings was made available via the website. The first meeting provided the opportunity to explain the objectives and procedures of the evaluation, to present the first results from the stakeholder survey and to invite commentary and information, The second meeting primarily reported the range of stakeholder opinions derived from the survey, material submitted and interviews, with a view to exposing the views expressed to scrutiny and inviting further evidence, either confirming or challenging them. This resulted in considerable further feedback. The results of this information together with the parallel investigations provided the basis for the Draft Final Report that was discussed during the third Stakeholders' Meeting. The Final Report takes into consideration all comments made during the meeting[3] and the additional feedback provided by stakeholders in the subsequent period.

Interview programme

Subsequent to the stakeholder survey and Stakeholder Meetings a significant interview programme was completed. In some cases, this involved stakeholders that had not participated in the survey but in others it was possible to take up the comments and information provided in the survey and discussed the issues in further detail. Thus, the interview programme operated in a complementary way to the survey. It also covered Commission officials in the key Directorates General in order to provide information on their own experience of the implementation of the Directive so far and to clarify questions on the practical aspects of the legislation as well as on the broader policy framework.

Table 2.1 – Interview programme

Type of stakeholder	Number
EU level	
Commission officials	6
Consumer group	1
Environmental group	3
Expert/consultant	6
Industry association	15
Standard body	2
National level	
Member states authorities	9
National industry association	2
Individual manufacturer/importer	4
Interviews related to the extension case studies	10
Total	**55**

[3] The notes of the meeting are available through the project website (www.cses.co.uk/ecodesign_evaluation/meetings)

Methodology 2

Desk research

Finally the evaluation has been based on extensive desk research that collected information on developments in the market for energy using products, market surveillance activities and compliance levels plus information on relevant policies in third countries.

The various sources of information have provided distinctively different but highly complementary perspectives on the central issues of the evaluation.

Analysis of findings 3

In this section we examine the key evaluation questions and present findings based on the analysis of the views of stakeholders, expressed in surveys interviews, Stakeholder Meetings and written submissions and the data and other information collected.

3. ANALYSIS OF THE EVALUATION QUESTIONS

3.1 Introduction

The objective of this section is to present an analysis of the information collected and the conclusions drawn in relation to each of the key evaluation questions concerning the effectiveness, efficiency, relevance and sustainability of the Directive.

The evidence that is to be presented relies to a large extent on information provided by stakeholders, initially in response to a survey and subsequently in interviews and in comments made during the first two stakeholder meetings. This has been supplemented by reference to a number of published studies and other data sources. Observations made in the initial survey, in interviews and at the first stakeholder meeting, together with information from published sources were summarised in the First Findings Report and discussed at the Second Stakeholder Meeting. The objective at that stage was to state initial positions, expose them to contradiction, to highlight areas where further evidence was required and to seek to validate the emerging conclusions. A substantial number of comments and further evidence were provided after the second stakeholder meeting, especially in response to a series of specific questions. A number of additional interviews were also conducted. The current Report is the result of an examination of the further material assembled as a result of these processes.

The evaluation team has found the open spirit of Ecodesign procedures to be extremely valuable in testing and challenging propositions that appeared to be emerging from the earlier analysis. The team is very grateful for the helpful assistance of many stakeholders in providing comment and evidence directly relating to the issues considered in the following sections.

3.2 Relevance of the Directive

In this section we present the findings of the evaluation, first of all, in relation to the key question of the relevance of the Directive within the broader context of sustainable consumption and production policy and EU policy generally. We also consider how the Directive operates -whether it is complementary or not - to other related policy instruments and if there are synergies or overlaps. In this, the evaluation has aimed to address the following set of questions:

- How does the Directive fulfil its role within the context of the SCP/SIP Communication? Do the other SCP/SIP instruments complement the Ecodesign Directive in terms of efficiently promoting public procurement, incentives, labelling, etc?
- How has the Directive complemented the other relevant policy instruments (Energy Label, Eco-label and Green Public Procurement)? Is it possible to better integrate the product related policy instruments? (e.g. common preparatory studies, stakeholder forums and committees)?
- How do interfaces/borderlines with other relevant energy efficiency legislation (Energy Labelling Directive, the Energy Performance of Buildings, and Energy Services Directives) function?
- How does the Directive interface/overlap with other relevant environmental and health and safety legislation? Are there any problematic areas?

Analysis of findings 3

Background

It is important, for the evaluation as a whole, but especially in making a judgement on its continuing relevance, to be clear about a series of matters relating to its overall orientation. This includes the policy context in which the Ecodesign Directive was proposed, the implications of its legal basis and the nature of its interaction with other policy instruments.

From the adoption of the initial legislation on Energy-using Products[4] in 2005, the Ecodesign Directive has operated as part of a wider range of EU policies. The reduction of energy consumption was considered to be key for achieving the greenhouse gases emissions reduction targets set in the Sixth Community Environment Action Programme. Energy saving measures were also seen as the most cost-effective way to increase the security of supply and reduce import dependency. Similarly, the Action Plan for Energy Efficiency[5] provided for the adoption of minimum eco-design standards to improve the efficiency of energy-using products. In that context the Ecodesign measures were seen as part of a broader set of initiatives to improve energy performance that also included the Labelling Directive, the Energy End-use Efficiency and Energy Services Directive and the Energy Performance of Buildings Directive.

The recasting of the Directive in 2009 and its extension to cover energy related products (ErPs) allowed policy developments in the intervening years to be taken into account. The Renewed EU Sustainable Development Strategy, adopted by the European Council in June 2006 recognised that there had been insufficient progress since the European Council in Gothenburg had adopted the first EU Sustainable Development Strategy (SDS) in 2001. It identified the main challenges as being gradually to change our current unsustainable consumption and production patterns and the non-integrated approach to policy-making.

The Commission Communication on Sustainable Consumption and Production and Sustainable Industrial Policy Action Plan[6] (SCP/SIP) of 2008 sought to provide this integrated approach in an Action Plan for sustainable industrial policy. The aim was to integrate sustainability and the EU's objectives of growth and jobs by establishing a framework both to improve the energy and environmental performance of products and to foster their uptake by consumers.

The Action Plan was accompanied by proposals for a recast of the Ecodesign and Energy Labelling Directives and the revision of the EU Eco-label and EMAS Regulations and the aim was to integrate the potential of all the different policy instruments available. The extension of the Ecodesign Directive to energy-related products, therefore, has to be seen in the context of other measures, notably, on the demand side, labelling, the use of public procurement and incentives and the promotion of smarter consumption.

At the same time, the strategy of the Action Plan aimed to improve the competitiveness of the European economy. Efforts to improve sustainability were seen as potentially being an important source of innovation and an important asset for industry's competitiveness. Implementing Measures of the Ecodesign Directive stipulate minimum requirements that need to be attained by the product in order to be allowed on the Internal Market, but in addition, advanced benchmarks of environmental performance, are intended to provide markets with early indication of highly performing products available on the market and of the possible future evolution of minimum requirements.

[4] Directive 2005/32/EC of the European Parliament and of the Council of 6 July 2005 establishing a framework for the setting of eco-design requirements for energy-using products

[5] http://ec.europa.eu/energy/action_plan_energy_efficiency/doc/com_2006_0545_en.pdf

[6] Communication from the Communication to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on the Sustainable Consumption and Production and Sustainable Industrial Policy Action Plan; COM(2008) 397 final of 16.7.2008

Equally, a key role of the Directive, according the Action Plan's impact assessment[7] was to address market failures and the imperfections that prevent market mechanisms from reaching an optimum in terms of the balance between consumption and production and environmental impacts. Market failures are evident in products that are not designed so that their environmental impacts over their life cycle are optimal from a social point of view. The extension to energy related products was due to the fact that energy using products are responsible for only 31-36% of total environmental impacts. The Commission considered that the limited scope of the Directive had previously represented an important restriction on the potential impact of the EU's Integrated Product Policy.

The point at which the Ecodesign instrument is brought to bear then is in the market, where Regulations exclude products with the worst performance in terms of energy use and other environmental considerations. The legal basis for the instrument is the Treaty provisions relating to the Internal Market. As Article 1 of the Directive explains, it establishes a framework for setting eco-design requirements 'with the aim of ensuring the free movement of such products within the internal market'. In spite of the fact that the Ecodesign Directive departs from the usual 'New Approach' procedures in some significant respects, this Internal Market characteristic of the legislation still determines the basic way that the Directive is implemented and also enforced and this is a key consideration for any evaluation.

However, as a result of the integrated nature of the approach adopted under the SCP/SIP Action Plan it is also necessary for any assessment of the Directive to take into account the other tools deployed. These include:

- **The Energy Labelling Directive (ELD)** – This mandatory Directive aims to provide consumers with information on the energy and environmental performance of household products helping them to identify the most energy efficient products and thus pull the market towards the best performers. The scope of the Energy Labelling Directive was extended in May 2010[8] to cover energy related products with significant impact on energy consumption during use. Furthermore the ELD harmonises performance levels for environmental requirements in public procurement and in Member States incentives in order to further increase the uptake of the best performing products.

  The ELD is the main demand side counterpart to the Ecodesign Directive as a supply side instrument. In combination with the Ecodesign Directive it is expected to bring energy savings and a reduction of environmental impacts through the combination of the push effect of the Ecodesign Directive and the pull effect of the ELD. In addition, practical synergies with the Ecodesign Directive include the use of the findings of the preparatory studies of the Ecodesign Directive for the update of the Energy Label requirements and classifications.

- **The European Eco-label -** This voluntary approach applies to products and to services and sets rather demanding environmental criteria so that only a small share of the very best products available on the market actually meets them. The European Union Eco-labelling Board (EUEB) is responsible for developing, publishing and promoting criteria for product groups. It is made up of the Competent Bodies from each Member State and other interested parties that form the Consultation Forum. There are a number of possible overlaps and synergies with the Ecodesign Directive including the process of determining relevant product categories, collecting information in the context of the preparatory studies and assessing the level of priority and establishing performance criteria[9].

[7] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=SEC:2008:2116:FIN:EN:PDF

[8] http://eur-lex.europa.eu/smartapi/cgi/sga_doc?smartapi!celexplus!prod!DocNumber&lg=en&type_doc=COMfinal&an_doc=2008&nu_doc=778

[9] http://ec.europa.eu/environment/Eco-label/Eco-labelled_products/categories/pdf/report.pdf

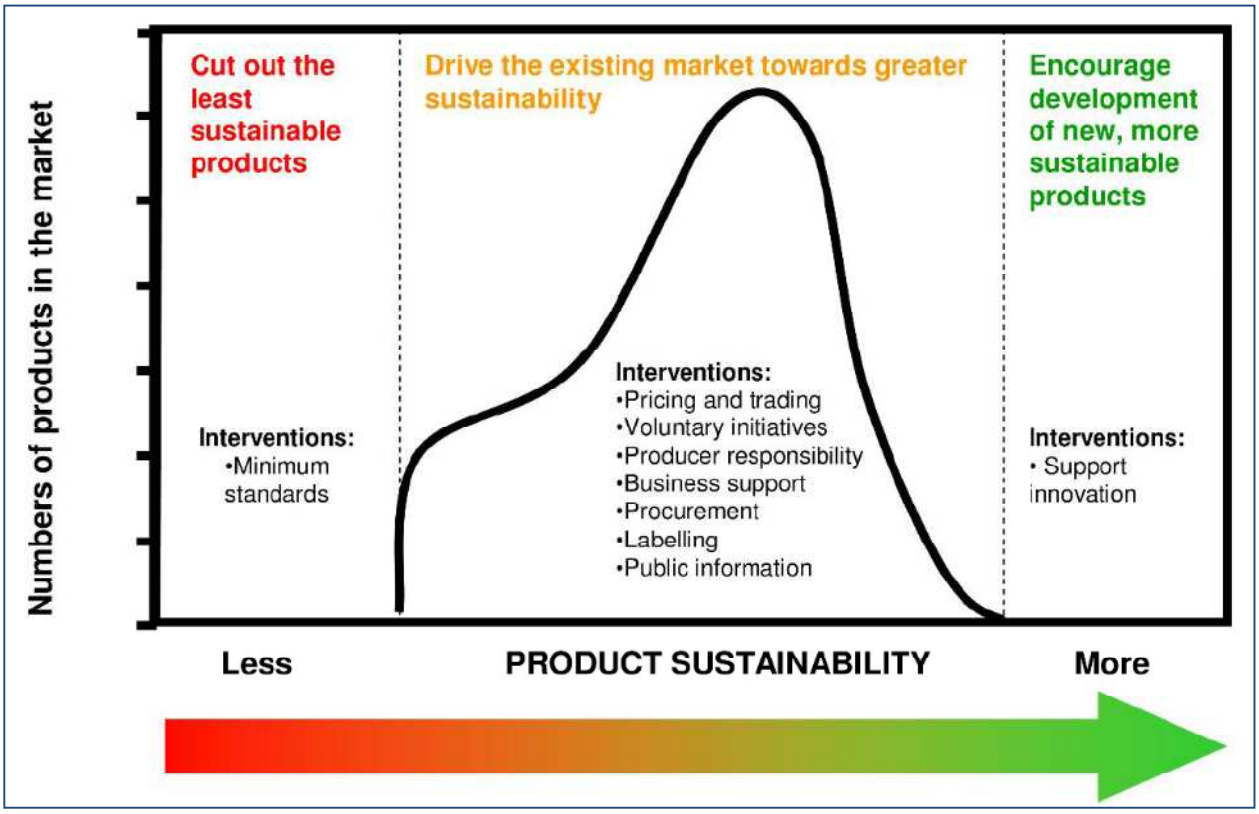
Besides the Eco-label, there are a number of other labelling schemes at national and international level[10] [11].

- **Energy Star** - The Energy Star is a global label that aims to facilitate trade in office equipment. In principle, Energy Star sets rather demanding efficiency standards that are regularly updated so that no more than 25% of the models in the market may qualify; even though in practice it is not always possible attain this objective. A particular way that the Energy Star Regulation[12] has an impact, however, is that it obliges EU institutions and Member States to purchase office equipment to specific levels of energy efficiency.
- **Green Public Procurement (GPP)** is a voluntary scheme at an EU level. Public authorities seek to procure goods, services and works with a reduced environmental impact throughout their life cycle when compared to goods, services and works with the same primary function that would otherwise be procured. It promotes the application of life cycle costing (LCC) in public purchasing rather than looking only at initial purchase costs. Many Member States have adopted their own approaches at a national level for supporting green procurement. There already are synergies between criteria development for Eco-label and GPP and those could be extended to Ecodesign and, to a certain extent, the Energy label, including the process of determining relevant product categories, collecting information for preparatory studies and assessing the level of priority and establishing performance criteria
- The Commission has recently proposed an Energy Efficiency Directive which would make Ecodesign Energy Efficiency benchmarks mandatory for public contracting authorities[13] in the absence of Energy Labelling measures covering the same product. If adopted this measure would considerably reinforce the impact of GPP, as far as energy use is concerned. The proposed Directive would not, of course, apply to non-energy aspects.
- In addition to that a number of Member States have introduced financial and other incentive programmes (in the form of tax credits or subsidies) to encourage the uptake of energy and environmentally performing products.
- **Construction products legislation** - The extension of the Directive to energy-related products has also increased the potential overlap with other regulation. The **Energy Performance of Buildings Directive** (2002/91/EC), for instance, may have provisions (at a building level) that have to be reconciled with Ecodesign Implementing Measures (at product level), if these were to be introduced for energy related construction products used in buildings. This can be complicated by different legal bases and forms and possibly different policy objectives.

The chart below summarises how the policy tools are expected to operate in a synergetic manner. The Ecodesign Directive is intended to act on the red side of the diagram by setting minimum standards that should operate as a mechanism to eliminate the least sustainable products from the market while the other policy tools aim to drive the market towards better performing products.

[10] The study for preparing the first working plan concerning energy-using products identified 22 such schemes at the European and international level.
[11] Extensive list: http://www.Eco-labelindex.com/Eco-labels/
[12] http://www.eu-energystar.org/downloads/legislation/20080213/l_03920080213en00010007.pdf
[13] An Annex of the EED proposes that '*Public bodies that purchase products, services or buildings shall:...where a product (...) is covered by an implementing measure under Directive 2009/125/EC adopted after the entry into force of this Directive, purchase only products that comply with energy efficiency benchmarks specified in that implementing measure*'.

Chart 3.1 – Role of different policy tools towards product sustainability



Source: DEFRA

In addition to these tools the life cycle approach of the Ecodesign Directive means that it interacts – and is expected to operate in a complementary manner - with other Community instruments including **the WEEE Directive** (2002/96/EC) concerning the management of waste of electrical and electronic equipment and the **RoHS Directive (**2002/95/EC) that regulates the presence of certain hazardous substances in products, including energy related products. The provisions from these Directives need to be taken into account in the preparatory studies for developing Implementing Measures. However, according to Article 15 of the Ecodesign Directive, any requirements set should not duplicate already existing EU legislation. There are also possible connections with the **REACH Regulation** concerning the registration, authorisation and evaluation of chemicals. They concern the requirements for information communication across the supply chain set by the two pieces of legislation. But there may also be issues related to the authorisation or restriction of chemicals the use of which may affect the energy efficiency of products. Some products may also be covered by the F-Gas Regulation (842/2006), which provides a basis for restrictions on the use and marketing of fluorinated greenhouse gases and measures for controlling leakages. Finally, many categories of energy-related product fall under the scope of **Community legislation concerning safety** (e.g. Low Voltage Directive, Machinery Directive, Construction Products Regulation). These set requirements in terms of content and format of conformity documentation to which the Ecodesign Directive adds the environmental aspects.

Finally, in terms of the context of the Directive, there should be a brief reference to current policy developments, since the question of the relevance of the legislation relates not only to how the legislation and the measures that implement it relate to the original policy objectives, but also whether they continue to be relevant to those that are currently being pursued. Here a relatively cursory reference to major policy

statements, such as Europe 2020 and the 'Resource efficient Europe' Flagship Initiative[14], makes it abundantly clear that not only do the original overall objectives continue to apply, but their centrality in European policy has been even further reinforced. In terms of implementing these overall commitments, the 'Roadmap to a Resource Efficient Europe'[15] proposes a specific milestone for sustainable consumption and production, envisaging that by 2020 'citizens and public authorities have the right incentives to choose the most resource efficient products and services' and that minimum environmental performance standards will be set 'to remove the least resource efficient and most polluting products from the market'. Furthermore, a sense of urgency is communicated. One need only cite the very clear statement of the Europe 2020 document: 'Climate and resource challenges require drastic action'.

Beyond the 2020 targets, the Energy Roadmap 2050[16] towards a competitive low carbon economy identifies energy efficiency as key priority to control the costs of transforming the energy system. Improvements in the energy efficiency of appliances through more stringent minimum requirements and an extension of the products' life cycle are among the key mechanisms identified and are directly linked to the Ecodesign Directive.

Analysis of evidence

The evidence collected in relation to the evaluation questions in this area set out above is based primarily on the input of stakeholders through the survey, the interview programme and submissions following the second Stakeholder Meeting, supplemented by examination of the wealth of documentary evidence and studies on particular aspects of the legislation's application. In broad terms the process has been one in which issues identified in the survey and interviews served to define areas on which more systematic evidence was sought.

Relevance

The main conclusion of the discussions is that the Ecodesign Directive does indeed play a key role and is well placed within the context of the SCP/SIP Action Plan. The main purpose of removing the worst performing products from the market is appropriate and this is a view shared by the great majority of stakeholders.

Opinions diverge as to the extent that in its current form and implementation the Ecodesign Directive serves the whole range of objectives of the SCP/SIP. Some criticism, coming primarily from some Member States and environmental groups, concerns the perceived focus of the Implementing Measures, on the energy use aspect of the products covered. Thus, while it is broadly recognised that the energy efficiency aspects of the SCP/SIP Action Plan and of EU resource efficiency policy can be served by the Ecodesign Directive and the Implementing Measures, it is also suggested by some Member State representatives and by environmental NGOs that there have been missed opportunities as a result of the limited coverage in Implementing Measures of other environmental aspects.

This is a key issue that was addressed directly at the second stakeholders' meeting. On the one hand, there is clearly a widespread perception on the part of environmental groups and some Member State officials that the Ecodesign Directive has focused primarily on energy use to the neglect of other environmental factors. Some have even said that an opportunity has been missed to use the Directive to develop a significant and consistent product-based pillar for environmental policy. On the other hand, it is not clear if

[14] http://ec.europa.eu/resource-efficient-europe/index_en.htm
[15] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions 'Roadmap to a Resource Efficient Europe' COM(2011) 571 final of 20.9.2011
[16] http://ec.europa.eu/energy/energy2020/roadmap/doc/com_2011_8852_en.pdf

anything more is being said than the incontrovertible statement that the Ecodesign Directive has so far concentrated on energy-using or energy-related products.

Further investigation of this question led to instances being cited where it appeared that opportunities had been missed to include environmental considerations other than energy in the existing Implementing Measures. Stakeholders have provided examples including the lack of provisions in the Regulation on simple set top boxes for improving recyclability and the collection of end-of-life boxes, NOx emissions for boilers and water heaters, noise and refrigerants with Global Warming Potential (GWP) for air conditioners, mercury for lamps, water consumption for washing machines and dishwashers. However, examination of these issues revealed that many of them have already been covered - water consumption in the case of washing machines – or are still under discussion - NOx-emissions for boiler and water heaters, noise restrictions in case of air conditioners.

More systematic evidence on these questions is provided by, a study for Defra in the UK[17] , which analysed EuPs Preparatory Studies and examined wider literature and stakeholder views in order to assess the past performance and future potential of Ecodesign legislation for addressing non energy in use impacts. The results of the study are summarised below.

'Review of EuP Preparatory Study Evidence: Does it support development of non-energy related Implementing Measures ?' – a study conducted for Defra in the UK

The study identified 13 product categories in which there are significant non energy in use impacts, and a number were judged to offer important improvement opportunities :

- *Improvements in materials efficiency*: these were seen to be possible in relation to washing machines and dishwashers, TVs, PCs, imaging equipment, lighting, motors, laundry driers, vacuum cleaners, simple and complex STB and DVDs/video/games consoles, because of their significant materials and End of Life impacts, including substitution (for hazardous/limited substance avoidance), lifetime extension, miniaturisation, durable modular designs to minimise resource use/waste, reuse and recycling.
- It was also concluded that at present, existing mandatory instruments do not provide the platform for enabling these improvements.
- *Associated consumables*: where environmental benefits could be realised in relation to the use of associated consumables with a significant impact e.g. paper for printers.
- *Refrigerants :* There are significant impacts from AC and refrigerating and freezing equipment, refrigerants with Global Warming Potential/ozone depleting impacts

Aspects of these impacts are being addressed under separate instruments already, but the study concluded that there are still opportunities for material substitution to green refrigerants that could considerably reduce these impacts. In addition, improved EOL management for fixed installation refrigerators and resource efficiency benefits for Refrigerated Display Cabinets, presented opportunities.

A more detailed analysis was conducted of 5 energy related products (TVs, imaging equipment, PCs and computer monitors, commercial refrigeration and lighting) in an approach addressing the criteria of the Ecodesign Directive and also considering enforceability issues.

In all these cases, a range of potential non-energy in use improvements were identified that could be addressed by the Ecodesign Directive and/or related legislation (principally WEEE and RoHS). An economic assessment indicated that there is good potential to real environmental improvements without incurring significant long-term economic costs, and in many cases net lifecycle benefits are possible.

[17] Global View Sustainability Services Ltd, Fraunhofer IZM and Collingwood Environmental Planning 'Review of EuP Preparatory Study Evidence: Does it support development of non-energy related Implementing Measures?' May 2011

The explanation offered for the failure of Implementing Measures to have provisions covering non-energy considerations involved three factors :

- Policy focus: the initial focus of the policy measures on energy matters has been reinforced by interpretation of the 'significant environmental impact' criterion for selecting products (Article 15) being expressed in energy- related terms (indicatively > 1,000 PJ/year).
- Other instruments: Compliance with existing instruments (REACH, WEEE, RoHS, etc.) is largely assumed when considering environmental improvement scenarios in Preparatory Studies and Implementing Measures.
- Enforcement concerns: the lack of suitable methods to support enforcement, with particular concerns relating to improvements to lifecycle stages that take place outside the EU.

The conclusions of this study for DEFRA would appear to give considerable weight to the more general feedback that opportunities are being missed to address non-energy matters under the Ecodesign Directive. However, there are other perspectives on a number of the issues identified.

First, it should be noted that a large part of the DEFRA study is related to products that are still under consideration. Indeed an aim of the study was to provide evidence for ongoing discussions. In some instances, the draft Implementing Measure has yet to be made available. This is the case for boilers and water heaters, for example.

Furthermore, it is clear that in some cases non-energy considerations have in fact been taken into account in the legislative stance adopted:

- Water consumption of domestic washing machines has been covered by Ecodesign specific requirements (Tier-1 and Tier-2) and Ecodesign benchmarks under Regulation 1015/2010. This was complemented by Energy labelling requirements set under Regulation 1061/2010, which covers water consumption.
- Similarly, water consumption of household dishwashers was analysed during the preparatory study (ENER lot 14) and has been covered by Ecodesign benchmarks under Regulation 1016/2010 and by energy labelling requirements under Regulation 1059/2010.
- The refrigerants and noise impacts of air conditioners were analysed by the Preparatory Study and the impact assessment and in the latest version of the draft Regulation specific Ecodesign requirements are included as mandatory requirements.
- The Preparatory Study on household lamps did consider mercury content and also demonstrated (as underlined by recitals in the Regulation) that through electricity savings, the total mercury content of household lighting will decrease, even without reducing the mercury content of compact fluorescent lamps. Mercury content was then taken into account in the Ecodesign Regulation[18]. It is subject to product information requirements and Ecodesign benchmarks, but beyond that was considered to be properly regulated under the RoHS Directive, where under a review of the Annex on exemptions in September 2010, the mercury content allowed in compact fluorescent lamps the European Commission was halved, after taking account of technical progress.-
- The direct greenhouse gas emissions from refrigerants used in several EUPs has been analysed by the relevant preparatory studies and are addressed, for instance, in the draft Ecodesign Regulation on air-conditioners. However, there are questions about whether refrigerants are best addressed through Ecodesign requirements and there are issues to do with the position of any provisions in Ecodesign

[18] See recitals 7 and 9 of Regulation 244/2009

Implementing Measures in relation to the F-Gas Regulation and ongoing discussions on the Montreal Protocol.

It has been pointed out by the European Commission that, particularly where there is other relevant EU legislation, the fact that there are not specific Ecodesign requirements covering non-energy impacts cannot be immediately interpreted as a missed opportunity resulting from a gap in the technical analysis and/or a failure in the decision-making process. Rather it should be seen as a matter of policy choice by the EU institutions - the Commission assisted by the Ecodesign Consultation Forum and Regulatory Committee. It should also be remembered that Article 15 of the Directive sets certain criteria concerning the significance of the improvement potential but also requires consideration of the impact on the competitiveness of industry – with particular attention paid to SMEs – and the resulting administrative burden. Thus, the final decision of the aspects to be covered should be seen as a matter of policy choice by the EU institutions - the Commission assisted by the Ecodesign Consultation Forum and Regulatory Committee.

Nonetheless, many of the arguments raised in the Defra study, remain relevant to Implementing Measures that are still under consideration. Certain wider considerations have also been brought to the evaluation team's attention relating to the role that non-energy requirements under the Ecodesign Directive can have in pursuing the objectives of the SCP/SIP Action Plan:

- There may be greater scope for the provision of information on the presence and content levels of hazardous substances in EuPs in Implementing Measures. Such information can be of considerable importance for the effective operation of end-of-life treatment operators and can make a significant contribution to the sustainable recycling of EuPs. It has been suggested that the introduction of information requirements for chemicals through the Ecodesign Directive could be more effective than existing policy tools (e.g. WEEE Directive or the REACH Regulation), since it could help in the development of harmonised requirements for all products. We should point out that the Ecodesign Directive does have provisions referring to the composition of components (Article 11) that could be the basis of such requirements. The key issue is the extent to which possible benefits outweigh the administrative burden that may arise from such a requirement that will require communication along the supply chain and may also create certain overlaps with the REACH Regulation.
- The issue of information requirements points to a broader question raised by some stakeholders, of the use of generic Ecodesign requirements, in line with the provisions of Annex I of the Directive that envisages requirements relating to the supply of information or the development of an ecological profile. So far, there has only been some limited use of information requirements for a few products. Our analysis points to two main reasons. On the one hand, Annex I stipulates that '*the method referred to in this Annex must be applied when it is not appropriate to set limit values for the product group under examination*'. For the products covered so far it was possible to establish limit values for the energy efficiency requirements meaning that Annex II has been given priority. In addition, there are diverging views on the availability of a methodology to support analysis over the whole life cycle and the appropriateness of the MEErP methodology for this purpose.
- Although this is examined further in section 3.4, it should also be mentioned at this point that the metals industry argues that the recyclability of materials is not properly considered in the MEErP methodology.

Finally, another consideration raised at a late stage in the evaluation process and one that it has not been possible to discuss in the stakeholder meetings is the claim by certain manufacturers that the Ecodesign requirements may operate as an obstacle to the development of the market for remanufactured EuPs[19].

[19] Remanufacturing is a form of a product recovery process which differs from other recovery processes in its completeness: a remanufactured machine should match the same customer expectation as new machines

Analysis of findings 3

Evidence has been provided to the consulting team on one product category for remanufactured EuPs. In this case, although remanufactured products have higher levels of energy consumption during the use phase than new products, as a result of the much reduced consumption of energy in the production phase, they can achieve significant energy savings and carbon emissions reduction –up to 50% - over the life cycle. At the same time, remanufactured products have high levels of re-use of materials bringing additional benefits in relation to resource efficiency. However, manufacturers of printers/copiers have reported that remunfactured products are not able to meet the stricter Tier II requirements concerning consumption during the use phase and thus are not allowed to enter the market. Under such circumstances, strict requirements could present a significant obstacle for the development of the market for remanufactured products. On that basis, it is suggested that there is a strong case for the introduction of exemptions for such products or the possibly of introducing less stringent requirements. The example of the exemption from the RoHS Directive of reused parts when the reuse takes place in auditable closed-loop business to business systems (Article 4) is also indicated as an illustration of the feasibility of implementing exemptions in such cases.While the evaluation was not able to conduct a proper assessment of the merits of this argument or assess its relevance to other product categories, we consider that it should be looked into further and the feasibility of introducing exemptions and the implications of such an exemption assessed.

The current situation, therefore, appears to be as follows:

- There are possibilities for promoting non-energy in use improvements in a significant number of the products that have been or are being considered under legislation already in force.
- In relation to products where there are already Implementing Measures (for example, televisions), there may have been non-energy improvements that have not been addressed as a result of the product scope, policy choices or the underlying technical analysis.
- In a number of instances, issues can possibly be addressed through other related legislation (principally the WEEE and RoHS Directives); choice and application of the right instrument becomes an issue that also has practical aspects such as the close co-ordination required, especially between the Commission officials responsible, that will need further consideration subsequently.
- There are a range of products still under consideration where there are issues concerning possible non-energy related improvements. The analysis of the Review of EuP Preparatory Study Evidence for Defra in the UK identifies a number of these.
- Resolution of a series of issues would increasingly be facilitated, by a set of developments that would make the specification of requirements more practicable for those responsible for placing the product on the market and also for those enforcing the legislation. These developments include more extensive collection and management of data, development of certification and auditing schemes and the further development of relevant standards.

In all of this, it is clear that there has been an institutional learning process that has accompanied the development of a series of Implementing Measures. The household lamps case may be said to be illuminating in this context. This was one of the first product groups to be tackled under the Ecodesign Directive where other environmental aspects than energy in the use phase were found to be significant in the lifecycle analysis of the Preparatory Study. The same issue was raised under various pieces of EU legislation (Ecodesign, RoHS, Eco-label) and it took some time in the decision-making process for all stakeholders, including the Commission, to move up the learning curve and manage potential contradictions or overlaps between the RoHS Directive (amendment of the Annex on exemptions) and the Ecodesign Regulation on domestic lamps. More recent approaches in the case of solid state lighting (LEDs) - in the context of consultations on the 2020 Digital Agenda – are reported to show a more consistent approach with good co-ordination between all the relevant Commission services and early interaction with other stakeholders.

This learning process associated with the Directive needs to continue. It is also wider than the issue of better co-ordination between the officials and the stakeholders involved in different aspects of the policy and legislation. Because the Directive has focused on energy-related matters and initially energy-using products, the development of methodologies has primarily been directed to energy efficiency questions, including the collection of the relevant data. In some cases, when other environmental impacts have been deemed significant, these have been analysed by the Preparatory Studies and the Impact Assessment and discussed during the decision-making process, leading, when appropriate, to provisions in the Regulation. In other cases, however, the consideration of other environmental impacts may suffer from a chicken and egg problem. The Preparatory Studies are not able to suggest any requirements relating to other environmental impacts, if the necessary data do not exist, including where suitable measurement methods and testing standards are not available. On the other hand, finding data on other environmental impacts is not considered an urgent priority, if these are not identified as being significant and if there is no envisaged legal requirement, there is no incentive to develop the metrics and collect the data, especially on more complex environmental issues.

Complex products and systems of products

A further issue of relevance has become more significant with the extension of the Directive to energy related products. This concerns the appropriateness of legislation with a focus on products to deal with situations where there is an interaction between various elements in a system. There is significant apprehension, for instance, from the representatives of the construction sector concerning the possible application of the Directive to products used in construction. The Action Plan document indicated that EuPs represent 31-36% of energy use and that the extension was necessary to serve the SCP/SIP policy objectives. However, the construction sector stakeholders argue that the focus on the product level is not appropriate for products used in buildings where energy optimisation should be at the level of the whole building and where different climatic conditions mean that EU wide measures may not be appropriate.

There are several issues raised by this and similar examples. There is first the question of complex products. One piece of HVACR equipment (Heating, Ventilation, Air Conditioning & Refrigeration), for instance, might be used for heating and cooling the space and for ventilating and filtering the incoming and outgoing air. A products based approach might lead to separate Implementing Measures covering only the heating part or just the cooling or the ventilation parts, while a fourth might govern motors and a fifth the fans inside the equipment. Problems of this sort are more likely to arise with intermediate products than with products for end consumption, but the possibility clearly arises of incompatibilities between the different regulations and almost certainly a high degree of regulatory complexity.

Furthermore, it is possible that the interaction of the various parts is such that the most efficient levels for particular parts may not be the most efficient for the system as a whole. The problem of complex products can therefore easily become a problem of systems. And this in turn can involve a third aspect of the overall problem, which arises if the system or parts of it are covered by other forms of regulation, mandated CEN standardisation processes or voluntary processes. In the case of construction products, the industry considers that the existing legislation –the Construction Products Regulation and the Energy Performance of Buildings Directive – provides adequate tools to address energy and other environmental issues and establishes the framework for setting eco-design requirements through CEN standards.

At the same time, there are examples of products, such as air-conditioners and boilers that have been or are soon to be covered by Ecodesign and Energy Labelling measures that are used in buildings, but are cases where separate provision is useful and generally accepted. In addition, it is argued that, even when interaction between products has to be taken into account, it can still be useful to have certain minimum standards at the individual product level, especially in view of the important variations in how the EPBD Directive is applied among Member States.

Overall, the question is one of regulatory efficiency. It is a basic principle of good government that regulation should achieve its policy objectives in the most straightforward, transparent and direct way and at the least cost for those who are directly and indirectly affected by the regulatory provisions. It should be asked: "at what level is the intervention most effective, in terms of maximising its intended impact, at the least cost for those regulated, while also avoiding regulatory overlap and redundancy?" And it may be that there is more than one regulatory or other policy instrument available.

The best place to begin to address such questions and provide responses is in the Working Plan. This develops an overview of a range of products and might be extended to consider both the appropriate intervention level, especially for systems, and the alternative approaches, including the possibility that there could be Ecodesign elements in the overall solution. In this, it will be necessary to remember that the primary objective of the Working Plan is to define the scope of the product categories which will be investigated through Preparatory Studies and that this scope has to remain flexible, prior to the detailed work to be undertaken in the Preparatory Studies. Nonetheless, the Working Plan should take 'system boundaries' into account and can 'flag up' issues relating to complex products and systems at an early stage.

At the same time, the overall situation also suggests that working by 'product family' could be an appropriate response from within the Commission, with strong coordination between all the policy officers working on interrelated products and a significant requirement for effective communication with industry including after the adoption of legal requirements.

Coherence

As well as the direct relevance of the Ecodesign Directive as an instrument for addressing basic policy aims, an evaluation also has to assess whether the instrument is doing this in a coherent fashion and avoiding overlap and conflict with other instruments. It has been seen that the Ecodesign Directive is a key instrument within the SCP/SIP policy package and its coherence with the other policy instruments (mandatory and voluntary Environmental Labelling, Green Public Procurement and financial incentive programmes) is critical for the success of Sustainable Consumption and Production and Sustainable Industrial Policy.

Among the different measures, the interaction with the Energy Labelling Directive is clearly central, as far as the energy efficiency aspects are concerned. Almost all stakeholders recognise the strong potential complementarities of the two pieces of legislation operating as push and pull mechanisms in the market. In practice, for most products these complementarities seem to work effectively since the requirements of the Implementing Measures are harmonised with the energy label levels. In general, the same official is responsible for drafting both the Ecodesign and Energy Labelling requirements. However, in the case of TV sets, some of the lower energy classes were empty, since they were below the minimum requirements. Only TVs labelled with 'A' class or better will therefore remain on the market.

The adoption of the Lisbon Treaty also poses challenges for the coordination and synchronisation of the Ecodesign and Energy Labelling Directives. In the recently revised ELD that followed the adoption of the Lisbon Treaty the regulatory committee stage has been removed, in contrast to the Ecodesign Directive that still operates under the Nice Treaty framework. This led to the adoption of Delegated Acts for certain products (fridges, TVs, etc.) before the adoption of the corresponding Ecodesign requirements.

In view of these practical problems, improved coordination between the two instruments should be pursued, if possible as part of a single process. The objective should be that Ecodesign requirements and energy labelling classes are reviewed simultaneously to ensure consistency, avoid cases of empty classes and ensure that labels reflect changes in the market and thus allow real differentiation with respect to the most efficient products. It should be noted here that the recast Energy Labelling Directive of 2010 includes a review clause that refers to assessing the need for amending current provisions on the design and

content of the label, including the issue of 're-scaling'. Moreover, according to the SCP/SIP Action Plan, labelling categories are expected to be set as an outcome of procedures in the Ecodesign Directive. Article 10 (3) (a) of the ELD says that the Commission shall consider environmental parameters set out in Annex I, Part 1, of the Ecodesign Directive, which go beyond energy efficiency and integrate all environmental aspects over the product life cycle. Thus, the general legal and policy framework encourages co-ordination between both Directives.

In relation to coherence with other complementary policy tools – the EU Eco-label and Green Public Procurement (GPP) – the evidence available indicates that existing interfaces are less than optimal. One clear example of failure is the case of TVs where the EU Eco-label was provided to class B products because there was no effective sharing of information with the relevant preparatory study on market developments. Similarly, due to the different time schedule for revisions, the Eco-label requirements for air conditioners and heat pumps have been set at a lower level than the Ecodesign requirements. In relation to GPP, the Commission Communication "Public Procurement for a better environment"[20] made reference to the environmental performance benchmarks developed under the Implementing Measures of a revised Ecodesign Directive as a source for future GPP criteria. In practice, stakeholders' input indicated rather conflicting experiences in relation to the actual use of the information created in the preparatory studies and the co-operation of Commission officials in the Directorate Generals responsible for the two measures.

Most agree that greater coordination and sharing of methodologies and data is necessary to ensure coherence and avoid duplication of effort. We should note though that there is also an indirect connection as the Energy Labelling Directive provides the option to Member States to use "green" public procurement to procure products which are in the respective highest energy efficiency class only.

The other area where the question of coherence is highly significant is in the relationship between the Ecodesign Directive and other legislation that directly addresses environmental concerns, such as the WEEE, RoHS, REACH and EBPD and the Construction Product Regulation. This is an area where a variety of policy tools also means that there is an increased risk of insufficient co-ordination, not least because of the differing legal base of the WEEE Directive.

At a relatively early stage, a Report for the European Environment Bureau (EEB) by the International Institute for Industrial Environmental Economics (IIIEE) at Lund University[21] warned of the potential for problems to fall between the various possible stools. The study pointed to a tendency for preparatory studies to refer to the RoHS Directive or REACH as more suitable instruments to deal with toxicity issues. These references need to be followed up to ensure that the intended provisions are actually implemented through RoHS or REACH.

Stakeholders also pointed to the problem whereby the Implementing Measure on washing machines states that the end of life related requirements concerning product design (recyclability) is to be covered by the WEEE Directive (Article 4)[22], while in the context of the WEEE Directive stakeholders claimed that it was thought that eco-design requirements should be addressed under the Ecodesign Directive. This has in practice led to the absence of any relevant provisions. The discussions with most stakeholders suggest that the interface of the two Directives seems to be unclear. A few Member States suggest that in practice the

[20] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2008:0400:FIN:EN:PDF

[21] International Institute for Industrial Environmental Economics (IIIEE) at Lund University 'Designing Greener Electronic Products: Building Synergies between EU Product Policy Instruments or Simply Passing the Buck? A for the European Environment Bureau (EEB)

[22] Article 4 of WEEE states "Member States shall encourage the design and production of electrical and electronic equipment which take into account and facilitate dismantling and recovery, in particular the reuse and recycling of WEEE, their components and materials."

development of provisions under the WEEE Directive by Member States would not be appropriate as it would have to be very product specific and, crucially, would jeopardize the harmonisation of product requirements. The Ecodesign Directive is, in that respect, a much more appropriate tool. There has already been reference to the uncertainty until a late stage in the decision-making process prior to the adoption of Ecodesign requirements, about whether provisions relating to mercury content for household lamps would be covered by the Ecodesign provisions or RoHS. On the other hand, this led to the setting of mandatory information requirements on the mercury content of compact fluorescent lamps under the Ecodesign Directive combined with mandatory limit values under the RoHS Directive, showing the potential for complementarity between various pieces of legislation. In general, since issues potentially covered by other legislation have so far been relatively limited, it is more a matter of anticipating the possibility of future problems and asking how they can be dealt with more effectively.

In this context a UK study for Defra, by Environmental Resources Management Limited (ERM)[23], highlighted a series of potential conflicts or areas for resolution in relation to the original Directive. These included the different weights attached to environmental priorities, arising from the WEEE Directive's focus on reuse and material recovery in contrast to the Ecodesign Directive's perceived emphasis on greenhouse gas mitigation through increased energy efficiency and the different metrics employed in the different legislation - mass at end-of-life for WEEE, toxic mass for the RoHS Directive and various indicators across the complete life-cycle for the EuP Directive This suggests that there are two levels of co-ordination required – the substantive level, where there can be real aspects of the problem to be reconciled and the procedural level, where a consistent approach to the application of the appropriate policy tool is necessary.

Finally, in relation to safety regulations, no particular issues or problems have been raised. What is reiterated is that in all cases any Ecodesign requirements should not lead to a trade-off between environmental performance and safety, very much in line with the provisions of the Directive (Article 15).

Concluding, it is clear that there are issues in relation to the interface between the Ecodesign Directive and other environmental regulation which could lead to less that optimal development of policies and exploitation of complementarities. As far as the other SCP/SIP tools are concerned the issues and inefficiencies are primarily related to weaknesses in co-ordination, exchange of information or timing. The evaluation team considers that the recent changes introduced, along with the building of experience and a closer level of co-ordination among the relevant departments in the Commission, should help co-ordination reach the level required for a really integrated use of the available instruments.

Conclusions on the Relevance and Coherence of the Ecodesign Directive

A basic question for any evaluation is whether or not the objectives of a policy action are well-formulated and coherent, given the context in which they were initially articulated. There is then the question of whether or not the objectives continue to be relevant and consistent with other policy and policy instruments.

In the case of the Ecodesign Directive the evaluation team has reached the following conclusions:

- The Ecodesign Directive remains a highly relevant policy instrument for addressing the challenges identified in the Commission Communication on Sustainable Consumption and Production and the Sustainable Industrial Policy Action Plan.
- The continuing relevance of the objectives and approach of the SCP/SIP Communication is evident in high level EU policy statements, notably the Europe 2020 strategy and in particular its "Sustainable

[23] Peter Garrett,et al, Environmental Resources Management Limited, 'Environmental Tradeoffs of the Energy-using Products (EuP) Directive and Product Policy'

growth" pillar that includes the "Industrial Policy" and the 'Resource efficient Europe' flagship initiatives.

- The SCP/SIP objective of better integration of policy instruments is still a highly significant issue and needs to retain a high profile as a guiding principle. Its effective application requires continuing efforts and there is scope for more integrated work with the Energy Label, the Eco-label, Green Public Procurement, the WEEE and RoHS Directives, and the CPR, EPBD and REACH acquis. There is, of course, a legal obligation to avoid duplications, contradictions and overlaps between various pieces of the EU acquis.
- The Ecodesign Directive offers a broad framework for addressing environmental issues relating to products and there are possibilities for promoting non-energy in use improvements in many of the products that have been or are being considered under legislation already in force. In a number of instances, issues can and should be addressed through related legislation (principally the WEEE and RoHS Directives) but this requires close co-ordination, especially between the Commission officials responsible.
- The relative focus on energy efficiency issues since 2005 resulted from various factors, notably the product scope of the 2005 Directive (energy using products), policy choices by the European Union on the basis of technical analysis in preparatory studies, and available data.
- As regards Implementing Measures already adopted (for example, televisions), some potential non-energy improvements have not been covered by regulation as a result of policy choices and the underlying technical analysis. These aspects can be reconsidered when the relevant Implementing Measures are reviewed.
- In relation to products still under consideration (such as ICT products), the Review of EuP Preparatory Study Evidence for Defra in the UK identifies some possible non-energy in use improvements. In some cases, initial analysis suggests that these would qualify for Ecodesign Implementing Measures against the criteria of Article 15 of the Framework Directive. In others, the improvements would be better achieved through other pieces of EU legislation. Addressing non-energy in use impacts, such as consumption of raw materials, would require appropriate measurement methods. In particular, methods for measuring the material efficiency of products are necessary to support appropriate technical analysis.
- New issues will arise, including the best way to achieve co-ordination with other initiatives, especially in terms of information requirements, and developments such as the growing availability of re-manufacturered products. The procedures for developing Implementing Measures need to remain flexible enough to take these developments on board.
- The collection and management of relevant data, development of certification and auditing schemes and a further development of relevant standards are important steps towards achieving a better definition and resolution of non-energy issues that would make the specification of requirements more practicable for those responsible for placing the product on the market and assist with the enforcement of the legislation.
- The lack of metrics and data is a major constraint, possibly inhibiting the technical analysis of other environmental considerations, but it is also argued that the metrics will not be developed and the data collected unless mandatory requirements can be envisaged making it necessary to do so.
- There are still issues to resolve in relation to complex products and systems. These are issues of regulatory efficiency. At what level is the intervention most effective, in terms of maximising its

intended impact, at the least cost for those regulated, while also avoiding regulatory overlap and redundancy?

There is now a substantial body of experience regarding the preparation and adoption of product requirements under the Ecodesign Directive. An important theme in the current evaluation is the qualified success of the Directive in playing a part in the broader policy framework envisaged by the SCP/SIP. Other parts of the evaluation report will provide further perspectives on this function. It is therefore a theme that will need to be revisited in the overall conclusions of the Report

At this stage, a range of possible actions arise from the conclusions on the relevance and coherence of the Ecodesign Directive. These are described in the following text box.

Possible actions arising from the conclusions on the relevance and coherence of the Ecodesign Directive

- The pursuit of the SCP/SIP objective of a better integration of policy instruments needs to be continuous, especially in the co-ordination of the Ecodesign Directive with closely related instruments.
- In relation to co-ordination with the EU Eco-label the Commission should aim to have consistent methods used and the relevant data shared when setting both Ecodesign requirements and the most ambitious Eco-label provisions.
- Evidence relating to potential non-energy related improvements through requirements in Ecodesign Implementing Measures, through information requirements or by using other related instruments, needs to be actively considered. This applies both to products that are still under consideration and also to those for which a review of the Implementing Measures is expected in the coming period.
- The collection and management of relevant data, the development of appropriate certification and auditing schemes and the further development of relevant standards should have a high priority. These are very significant for helping to identify and measure non-energy related improvement potential, for developing clear specifications of requirements which provide clear targets for industry and for allowing enforcement of the legislation to be as effective as possible..
- Practical guidance should be developed – following consultation with stakeholders - that will clarify the interface between the Ecodesign Directive and other policy tools including WEEE, RoHS and the Construction Products Regulation. The objective should be to identify the synergies and overlaps and set out in clear terms which policy tools have priority in addressing these aspects. The procedural steps needed to arrive at consistent decisions should also be set out.
- Further consideration should be given to the implications of the Ecodesign requirements for the development of re-manufacturered products and the appropriateness and feasibility of introducing an exemption for such products.

3.3 Effectiveness of the Ecodesign Directive and Implementing Measures

3.3.1 Introduction

One of the key evaluation issues is the effectiveness of the Directive in achieving the expected energy savings targets as well as any other expected environmental improvements. The evaluation examined the evidence available in relation to the following questions:

- What is the evidence concerning the achievement of the objectives in terms of reducing energy consumption and other relevant environmental impacts for those EuPs for which Implementing Measures have been adopted?
- To what extent can the results achieved be attributed to the Directive?
- How do improvements compare to results from policies in third countries?

In parallel to that, the study examined the existing evidence on the impacts of the Directive on the operation of the market in relation to a number of key issues:

- Effects on the market as a result of the Directive and the relevant Implementing Measure for each of the EuPs in terms of:
  - shifts in the market shares within different classes of products
  - changes in sales volumes, prices, product variety and consumer choice
  - shifts in levels of intra-EU27 and extra-EU imports and exports
- Effects on the competitiveness of the various market operators (EU industry, importers, large companies, SMEs), on domestic and international markets.
- Effects on the production costs and profit margins for regulated products.
- Effects of the Directive on the market structure (i.e. relations between actors in the supply chain, for example distribution channels; relationships between manufacturers and distributors, retailers or installers; competitive situations of the different market players; market shares of SMEs etc.).

In the following section we present the evidence collected. The first part focuses on the evidence in relation to the 11 products covered by Implementing Measures already in force by the end of 2010. These are:

1. Stand by and off mode electric power consumption (horizontal measure)
2. Circulators in buildings
3. Televisions
4. Domestic refrigerators and freezers
5. Simple set-top boxes
6. Domestic lighting (general lighting equipment)
7. External power supplies
8. Tertiary lighting
9. Electric motors 1-150 kW
10. Domestic washing machines
11. Domestic dishwashers

Analysis of findings 3

The product-by-product analysis focused on the analysis of evidence concerning the developments in the market in relation to the energy efficiency of EuPs. Energy efficiency was the main impact area considered in the evaluation. In the case of washing machines and dishwashers we also attempted to assess the impact on water use. However, the data available were rather limited.

Based on the most recent publicly available data we have compared developments against the business as usual scenario and the expected policy results, as these were indicated in the impact assessment of each Implementing Measure. Data availability varies from product group to product group. For some product groups time series of market shares of energy efficiency classes according to the Energy Label were available. In other cases we relied on data for the development of average energy consumption, total energy consumption or share of products complying with the requirements specified in the Implementing Measures. The data analysis was complemented by input from various stakeholders, most often qualitative, that helped us reach conclusions on the effect, if any, of the Implementing Measures of the developments in the market up to now. Where available, data from the policies of third countries were used either to compare the results or, in the absence of comparable evidence from the EU, to indicate possible future outcomes.

The product-by-product analysis is followed by an analysis of the existing evidence or any other indications concerning the impact of the Directive on innovation for EuPs, the prices of products, the different market actors (producers, importers and distributors) and on the market structure in general. We also examined the possible global impacts of the Ecodesign Directive. On the basis of the above, an assessment of the overall impact on the competitiveness of the European industry was made.

3.3.2 Analysis of evidence in relation to individual Implementing measures

1. Standby and off-mode electric power consumption

Introduction

Standby energy is one of the largest individual end uses of electricity in the residential sector and accounts for approximately 10% of electricity use in Europe, Australia and in California and 1% to 2% of global electricity consumption. IEA expects the energy use from standby and off mode losses to increase to 15% of energy consumption in the residential sector in 2030. The Implementing Measures on the standby and off mode energy consumption is limited to products corresponding to household and office equipment intended for use in the domestic environment.

As opposed to the other product groups covered in this evaluation, standby and off mode energy consumption is a horizontal measure not limited to one product group but cuts across a wide variety of different products such as radios, video cameras, ovens, electric toothbrushes, dish washers and coffee machines. Furthermore, the product scope also covers equipment that is not yet available on the market but has similar functionalities to the products explicitly named in the Implementing Measure.[24] Additional requirements on standby and off mode may also be set out in product-specific Implementing Measures. If so, they should not be less ambitious than those set out in the standby and off mode Regulation.

Timeline

Standby and off mode were considered for eco-design measures in the 2005 Ecodesign Directive and the preparatory study was initiated in 2006 and completed in 2007. In October 2007 the first proposal (working

[24] A more detailed definition of the scope of the Implementing Measure and the terms standby and off mode can be found in the Implementing Measure: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:339:0045:0052:EN:PDF

document) for standby and off-mode regulation was discussed at the consultation forum and the Implementing Measure was adopted by the end of 2008.

Table 3.1 – Timeline for setting eco-design requirements

Preparatory Study		First proposal for regulation discussed at Consultation Forum	Impact assessment published	Implementing measure adopted
First stakeholder meeting	Study published			
September 2006	October 2007	October 2007	18/12/2008	17/12/2008

Source: ECEEE and European Commission DG Energy

The requirements are phased in over two stages of which one has come into effect. The timing of the stages is set to balance negative impacts related to the functionality of equipment and cost impacts for manufacturers with a timely achievement of policy objectives. The key dates with the respective requirements for the off mode and the stand-by mode are summarised in the table below.

Table 3.2 - Dates for implementing the Ecodesign Directive and the requirements set

Mode	Maximum power consumption from January 07, 2010	Maximum power consumption from January 07, 2013
Off-mode	1.00 W	0.50 W
Standby mode without display	1.00 W	0.50 W
Standby mode with display	2.00 W	1.00 W

Source: Implementing measure

There are certain challenges specific to the assessment of the impact of the Implementing Measure on the standby and off mode energy consumption. The impact of this Implementing Measure for standby and off mode energy loss cannot be measured by looking at a particular product group. Effects can vary from one product group to another so ideally data for several products should be collected and combined.

Furthermore, existing Community Programmes such as the Energy Star programme for office equipment, the Eco-label and the Commission's Codes of Conduct also address standby and off mode. This makes it more difficult to isolate the effect of the Ecodesign Directive. Finally, product specific measures often set requirements related to standby/off-mode for individual product groups.

Currently, there is no energy labelling scheme of standby and off mode energy consumption.

Baseline

The preparatory study states that standby functionalities and off-mode losses occur for the majority of electrical and electronic household and office equipment products sold in the EU.

The study also concluded that significant cost effective improvement potentials exist in the case of stand-by. According to the "base case" of the preparatory study, standby/off-mode power consumption levels of electric and electronic household and office equipment were typically several watts higher than would be the case if readily-available improved technologies were to be used (computer 3.6 Watt/2.2 Watt, DVD player 4.8 Watt/1.5 Watt, washing machine 5.7/1.2 Watt). It concluded that although the technologies for achieving the requirements are available, the majority of products on the market did not meet them because there was little or no incentive for manufacturers to make additional investments in technologies

leading to low standby/off-mode electricity consumption for a single product. This barrier prevents market take-up of cost-effective technologies with improved environmental performance.[25]

Annual electricity consumption related to standby functionalities and off mode losses was estimated to be 47 TWh in 2005. Without taking any specific measures, the consumption was expected to increase to 49 TWh by 2020 while the number of products having standby mode and off mode was expected to increase to 4.6 billion in EU27. The application of cost effective existing technologies meeting the Ecodesign requirements for standby and off mode losses should, according to the Implementing Measure, reduce energy consumption with an estimated energy savings of 35 TWh annually in 2020, compared to a business-as-usual scenario. Thus, total energy consumption is expected to decrease from 47 TWh in 2005 to 13.6 TWh in 2020.

Table 3.3 - Standby and off-mode losses - 2005 baseline and projected impact until 2020

	2005	2010			2020			
	Baseline	BAU	Policy	Annual savings	BAU	Policy	Annual savings	Accumulated savings
Number of products (bln.)	3.7				4,6			
Energy Consumption (TWh)	47	49.9	49,9	0	49	14	35	194
Electricity Costs (bln. €)	6.4			0				26.4
CO_2 emissions (Mt)	19			0				77.6

Source: Impact Assessment, European Commission

As illustrated in table 3.3, under the baseline scenario, changes are expected to happen only after the requirement has taken effect. The improvement in 2010 is therefore estimated to be zero.

Existing evidence on the effects of the Directive

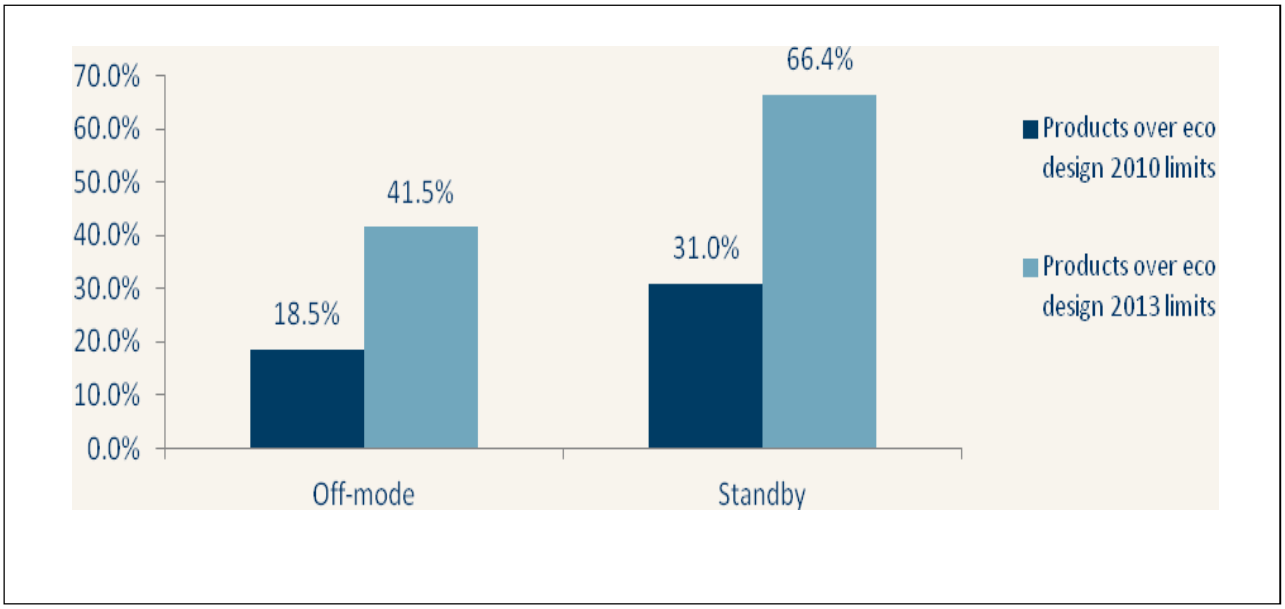
At this stage, data on the effects of stand-by requirements are rather scarce. One relevant source is the SELINA project (Standby and Off-mode Energy Losses in New Appliances Measured in Shops) that measured the standby and off mode energy consumption of almost 6000 products in shops in 12 countries in 2009 and 2010, thus both before and after the requirements entered into force. This allows some assessment of the changes in the composition of new products placed on the market both in absolute numbers and in terms of market shares.

It is important to note, however, that the products measured after the first set of requirements took effect in January 2010 could have been placed on the market before the requirements applied. If so, they are compliant with the Directive even though they might be sold to the customer after the requirements took effect and use more standby or off-mode energy than would otherwise be allowed as of January 2010.

According to the data collected, approximately 18 % of the off-mode and 31 % of the standby products did not live up to the requirements taking effect from 2010. Furthermore, in relation to the requirements which take effect from 2013, at this stage 41 % of the products do not fulfil the requirements in off-mode and more than 60% in standby mode.

[25] http://ec.europa.eu/energy/efficiency/Ecodesign/doc/legislation/sec_2008_3071_impact_assesment_en.pdf

Chart 3.2 – Share of products complying with Ecodesign requirements for standby and off-mode in 2009-2010 – Results of SELINA project



Source: SELINA Study

Compared to the situation when the preparatory study was carried out - at which point the majority of products on the market did not meet the requirements – significant improvements seem to have taken place, with 18% not meeting the off-mode requirements and 29% the standby requirements for 2010. In relation to the 2013 limits, in 2010 around half of the products did not meet the requirements and had to be improved. Thus, significant additional improvements can be expected.

The SELINA study also compared the measured average energy consumption in standby and off mode with the values from the preparatory studies.[26] An average reduction of 70% for off-mode power consumption and of 30% for standby energy consumption was observed. The study attributes the positive development to the Implementing Measure for standby and off mode energy consumption.

A comparison between the 2009 and 2010 data from the same study shows that the number of products found to be over the EU regulation threshold was almost unchanged from 2009 to 2010. For standby mode, an additional 2.8 % of products did not comply with the 2010 limits and an additional 2.3% did not comply with the 2013 limits after the Implementing Measure entered into force. For off-mode an additional 4% complied with the 2010 limits and 0.9% fewer complied with the 2013 limits in 2010.[27] This indicates a gradual movement towards fulfilling the minimum requirements and not a rapid change in market composition around the time when the requirements come into force.

The SELINA project conclusions provide some indications of the effect of the requirements but most tests were conducted before the requirements came into force and they included products to which standby

[26] This analysis was conducted at an early stage of the project when around 3700 of the 6.000 measurements had been made. Because there was no available data for multi-function devices, scanners and copiers in the preparatory study, values from other studies were used for these.

[27] Selina project study does not control for the potential influence of difference in products tested in 2009 and 2010 and when products were placed on the market. Thus, if different types of products were tested in 2009 and 2010 this could influence the results. In addition, possibly, products tested in 2009 could have been placed on the market before the products tested in 2009.

and/or off mode requirements do not apply (e.g. imaging equipment). Furthermore the tests were not performed in laboratories and did not use the agreed testing methodologies but easier and less precise tools. However, so far no producers have objected to the measurements carried out by the SELINA study which indicate that measurements are accurate. In addition, another study carried out for the Danish Energy Agency, using a simplified method to measure standby energy consumption in 2009, found similar results. Of 314 products measured in 6 shops, 35% of the products did not comply with the 2010 limits.[28]

Interviews have also indicated that the extent to which the improved energy efficiency can be attributed to the standby and off mode requirements varies from product group to product group. For a product group like Televisions, it has been argued by stakeholders from industry that there was already an increasing focus on energy consumption in standby mode which had led to high levels of energy efficiency. Thus, a positive development would most probably have taken place even without the first stage of requirements coming into force.[29] For other product groups however, there was very little attention paid to energy consumption and no or little movement towards energy efficiency was observed before the preparatory study was initiated. Cooking appliances like microwave ovens or coffee machines have been mentioned as examples. For these product groups a larger part of the increased energy efficiency can be attributed to the Implementing Measure for standby and off mode energy consumption.

A continuation of the SELINA project is currently under consideration and could provide valuable input for assessing the future impact of the standby and off-mode requirements. An additional initiative is the Standby Power Annex under the international collaborative programme to promote wider use of more energy-efficient electrical equipment called Efficient Electrical End-Use Equipment (4E) which is expected to deliver important outputs which will be useful for future evaluations.

Since 1999, Japan has used a range of policy measures to tackle standby power. Several home entertainment, ICT and kitchen products covered by the Top Runner program have mandatory requirements which include limits to standby power consumption. In addition, voluntary agreements have been made with relevant industry associations to meet a target of 1 Watt or lower for new products. Despite the increasing average number of devices found to be in standby mode, the average household standby power consumption is estimated to have fallen. This fall in standby power consumption is explained by a combination of factors: a reduction in power consumption for many individual new appliances, and an increase in the hours where devices were switched off (by the householder).[30]

In 2000, Australia embraced the International Energy Agency's goal of reducing standby power consumption to less than 1 watt. This covered all electronic products and has led to substantial improvements in standby power consumption.[31] The Australian Household Intrusive Survey, which has been conducted since 2001 and measures the standby consumption of appliances offered for sale in the Australian market, shows that average standby consumption has decreased from 5.7 W in 2001 to 1.1 W I 2010/2011. At the same time, however, for most product groups at least 25% of products do not meet the one watt target. Many such products as DVD recorders, microwaves subwoofers and portable stereos did not meet the targets. This has been one of the main arguments for introducing legally binding legislation on standby power consumption. The legislation will be aligned with the Ecodesign requirements.

In the United States the government has also focused on reduced energy consumption from standby power throughout the past decade. In July 2001 the Executive Order Energy Efficient Standby Power Devices was issued requesting government agencies to only purchase products that consume less than 1 watt in standby

[28] Danish Energy Agency, Markedsscreeninger for: standbyforbrug, eksterne strømforsyninger, tv-apparater
[29] See for example: http://www.initiative-energieeffizienz.de/fileadmin/InitiativeEnergieEffizienz/dachmarke/downloads/Standby/Vortrag_Oppermann.pdf
[30] http://www.iea.org/textbase/npsum/Appliances_Ellis06sum.pdf
[31] http://www.energyrating.gov.au

mode, while encouraging independent agencies to do the same. Although this initiative did not set universal standards for all private purchases, it signaled the government's commitment to reduce standby power consumption.

In 2004 Korea became the third country after Australia and the US to embrace the 1 Watt standby policy and in 2005 they established a roadmap to limit standby power below 1 Watt by 2010. The policy has been based on a combination of the introduction of a mandatory warning label indicting products failing to meet the standards set combined with a voluntary energy efficiency label for those products that meet standards. A 2011 survey indicated significant level of reduction of average standby power per appliance by 45% in the period 2003-2011 and nationwide total reduction of 25% energy consumption despite an increase in the total number of appliances. Furthermore, the number of appliances in store which meet the standards exceeds 80% of the total[32].

Conclusions

The requirements for standby and off-mode losses only entered into force for products "placed on the market" in January 2010 and will not be fully implemented until 2013. Partly as a result of this, common data collection efforts are not fully developed.

The evidence available suggests that the role of the Ecodesign requirements on standby varies among the different types of electrical appliances and the attention given by the relative industry prior to the Ecodesign Directive. However, overall, the data available does indicate that significant improvements in energy efficiency have taken place from the time of the preparatory study to the most recent studies. Experience from Australia also indicates that though improvements can be achieved through promotion of certain goals, binding minimum energy performance standards are a more effective means to improve energy efficiency for the least efficient products. Given that around half of the products placed on the market in 2009-2010 did not meet the 2013 requirements, an increased impact of the Ecodesign Directive in terms of energy efficiency can be expected for the coming period.

2. Circulators in buildings

Introduction

Circulators in buildings are used primarily for pumping water in central heating systems. Less than 4% of the total market output is used for applications other than pumping water, such as solar water heating or chilling systems. They range in size from 25W – 2500W, and are always sold as an integrated pump motor assembly. There are around 140 million circulators in the EU-25, and Europe remains the primary market and production base for the industry.

Circulators consume much of the energy used in heating systems in buildings. The energy used by circulator pumps is equal to about 2% of the overall electricity consumption of the EU and causes CO_2 emissions of more than 30 million tons per year, according to data from 2011.[33] A large fraction of the primary energy consumed in buildings is used for heating and cooling functions: for residential buildings, this fraction is 60-70%. When considering all kinds of buildings, on average this fraction is around 50-60%. This means that 20-30% of the total primary energy consumption in the EU-27 is used in the heating and cooling of buildings. This quantity is approximately equal in absolute terms to the total energy used for transport in the EU.[34]

[32] KIM,N.K.,(2011), 2011 Standby status in Korea, Presentation during the IEA 4E Standby Power Annex Meeting,
[33] http://www.topten.info/uploads/File/Recommendations%20Circulation%20Pumps%20March%2011.pdf
[34] http://susproc.jrc.ec.europa.eu/heating/docs/1%20IPTS%20Scope%20Draft%201%20-%20Heating&Cooling%20Systems.pdf

Analysis of findings

The Lot 11 preparatory study showed that energy consumption in the use-phase dominates the life-cycle impact of circulators. Generally, there are three different technologies available to the industry to improve efficiency:

1. improved (standard) circulator
2. variable speed (induction motor)
3. variable speed (permanent magnet motor)

Prior to an initiative by the industry to improve performance, speed-controlled circulators represented no more than 20% of all circulators sold on the European market in 2005.[35] To improve efficiency, the industry needed to shift from the standard model of circulators to a variable speed motor. However, market barriers exist that hamper a larger market penetration of energy efficient circulators, including purchase price differences between high-efficiency models and established models, split incentives between the consumer and the equipment installers, as well as the uncertainty of long-term savings.

Timeline

Circulators in buildings were considered for the eco-design measures in the 2005 Ecodesign Directive. The preparatory study was initiated in 2006 and completed in February 2008. In May 2008 the first proposal for circulators regulation was discussed at the consultation forum and the Implementing Measure was adopted in September 2009

Table 3.4 - Timeline for setting Ecodesign requirements for circulators in buildings

Preparatory Study		First proposal for regulation discussed at Consultation Forum	Impact assessment published	Implementing measure adopted
First stakeholder meeting	Study published			
June 2006	February 2008	May 2008	22/7/2009	22/9/2009

Source: ECEEE and European Commission DG Energy

The phase-in of the minimum requirements will take place in three stages, described in table 3.5. The first requirement sets a limit for standalone glandless circulators at a value not exceeding 0.27 on the Energy Efficiency Index (EEI). As of August 2015, the EEI limit will be lowered again to 0.23, and then will also apply to glandless circulators which have been installed in newly installed heat generators or solar stations (integrated pumps). In the last implementation stage, the specifications applicable as of 2020 will also apply for the replacement of integrated pumps in existing heat generators and air-conditioning.

Table 3.5 - Implementation schedule of Implementing Measure for circulators in buildings

Date	Requirement
1 January 2013	The Energy Efficiency Index (EEI) of standalone glandless circulators must not exceed a value of 0.27 (some A* and below will be phased out) (except standalone glandless circulators designed especially for primary circuits of thermal solar systems and heat pumps).
1 August 2015	The Energy Efficiency Index of standalone glandless circulators and glandless circulators integrated into OEM products must not exceed a value of 0.23 (most A* and below will be phased out).
1 January 2020	The Energy Efficiency Index of replacement pumps for glandless circulators integrated into OEM products must not exceed a value of 0.23 (most A* and below will be phased out).

[35] Europump plan "To improve the energy performance of Stand-Alone Circulators Through the setting-up of a Classification Scheme In relation to Energy Labelling" http://work.sitedirect.se/sites/europump/europump/p4180/files/Industry_commitment_Circulators-no_annexIV_rev_July_2009_bis.pdf

Source: Timetable of ErP Directive in EU - The Future is High-efficiency[36]

The current Ecodesign requirements were developed for glandless standalone circulators and glandless circulators integrated in products (Implementing Directive 2005/32/EC) followed by the Implementing Measure (under Directives 2009/125/EC and 2010/30/EU).

In response to early discussion on new requirements to be set by the Ecodesign Directive, the circulators industry, through its central organisation Europump, developed a voluntary classification and energy labelling scheme, which was implemented in 2005. The goal of the scheme was to support the uptake of variable speed motors, which constituted only 20% of the market in 2005. Seven companies with a total market share of more than 80% committed to the agreement. By 2011, 13 companies representing 95% of the market have committed to the voluntary measures.

A key difference between the voluntary agreement and the Implementing Measure is that the Implementing Measure applies to Europe as a whole and a firmer timeline is set in place. Circulators not meeting the new standards are to be withdrawn from the market. As a result, the voluntary agreement will become obsolete once the provisions of the Ecodesign Directive are implemented in 2012.

The effectiveness of the Ecodesign Requirements is rather difficult to measure in the case of circulators due to the long implementation schedule. Moreover, building circulators tend to have a long product lifecycle, which results in significant lag time between the implementation of new regulations and the effect on the stock of building circulators. Moreover, much of the early change set out in the section that follows is derived from changes due to the voluntary initiative, which is an indirect yet strong outcome of the Ecodesign Directive.

Baseline

In the preparatory study and the impact assessment data from 2005 were used to establish the baseline. The number of circulators was estimated at 140 billion and the total energy consumption is estimated at 53.3 TWh for EU27. The total CO_2 emissions were estimated at 80 Mt. In terms of long-term impacts on consumption of electricity, the preparatory study and the impact assessment estimated that the baseline 'no policy' scenario would lead to an overall energy consumption of circulators of 55.3 TWh (stand alone and boiler integrated circulators) in 2020. With the implementation of the Directive, energy consumption is expected to be reduced to about 28.7 TWh (stand alone and boiler integrated circulators) representing a 42% reduction by 2020, compared to the baseline scenario[37].

Table 3.6 - Circulators in buildings – Expected impact of the Ecodesign requirements in comparison to business as usual

	2005	2010			2020			
	Baseline	BAU	Policy	Annual savings	BAU	Policy	Annual savings	Accumulated savings
Number of products (mln.)	140							
Energy Consumption (TWh)	53.2	52.2	51.2	1.0	55.3	28.7	26.6	
Electricity Costs (bln. €)	-							
CO_2 emissions (Mt)	80							

Source: Impact Assessment

[36] Timetable of ErP Directive in EU- The Future is High-efficiency: http://www.wilo.co.uk/cps/rde/xchg/gb-en/layout.xsl/1250.htm

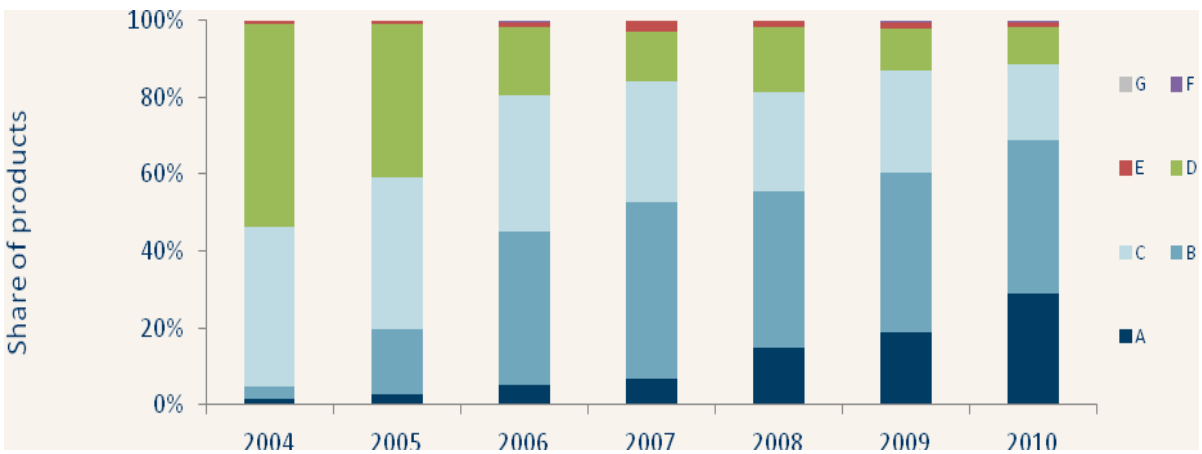
[37] Circulator Regulation Impact Assessment, http://ec.europa.eu/energy/efficiency/Ecodesign/doc/legislation/sec_2009_1016_part1.pdf

Existing evidence on the effects of the Directive

As already mentioned, there has been a significant shift in the composition of the market for circulators that predates the implementation of the Ecodesign Directive. However, according to Europump, the early discussions about the Ecodesign Directive – even though they took place at a time when it was unclear how demanding the requirements would be- had a positive role in pushing the voluntary initiative forward. It is thus a possible "anticipation effect" that contributed to a change in the composition of the market and pushed the industry towards greater energy efficiency.

The voluntary initiative implemented in 2005, drove an immediate rise in the share of B class circulators, which more than doubled in the following year but has since levelled off to around 40% of the market (see Chart below). At the same time, the remainder of the market has been increasingly filled by the A class circulators from only a small share of the market up to 2007 to the current point where it is the second most common type of circulator, accounting for nearly 30% of the market with a steady increase in the market uptake.

Chart 3.3 - Market share of circulators of different efficiency classes (period 2004-2010)



Source: EUROPUMP; Note: A* and A** did not exist under the voluntary agreement and therefore no data for these groups exist.

At the bottom end of the efficiency scale, the most significant change has been in the decline of the D class which accounted for over 50% of the market but less than 10% in 2010. The E and F class have retained their limited shares in the market (<2%). These classes will be eliminated from the market with the introduction of the first minimum requirements.

The voluntary approach that included an energy label generated significant improvements in energy efficiency but accelerated market change is needed to reach the 2013 requirements only allowing A* and A**. The A class circulators increased their market share from around 5 % in 2006 to almost 30 % in 2010. If the increase of around six percentage points per year continues the market share of A-labelled products and above will only be around 50% in 2013. Thus, the Ecodesign requirements will most likely drive a market change that would otherwise not have happened.

At the time of the adoption of the Implementing Measure, the best available technology on the market for circulators had an EEI ≤ 0.20. Achieving the targets would not require the development of new technology; rather the adoption of existing technologies. At the same time, the proposed Ecodesign requirements are expected to lead, *de facto*, to a technology shift from standard induction motor driven circulators to

variable speed permanent magnet circulators. This will require some manufacturers to update production lines of less efficient circulators.[38]

It thus appears that the technologies for achieving the minimum efficiency levels are available, but the majority of products currently on the market do not meet them. In the absence of specific requirements, it is likely that a portion of the market would still be composed of the least efficient circulator models of circulator.

The impact assessment suggested that the implementation of the Ecodesign requirements would help create a level playing field and ensure easier access to the Single Market. Europump has stated that one of the most significant impacts has been a reduction in trade barriers and the opportunity for the most advanced companies to consolidate markets through the introduction of more energy efficient products throughout Europe. The industry states that this market change has occurred and will continue. Moreover, the industry has started to market products as EuP ready, indicating that there has been a general acceptance of the minimum standards. [39]

Conclusions

Based on the projected energy use associated with each class, the change in the composition of the circulator market towards greater efficiency levels which has occurred as result of the voluntary agreement has already reduced energy consumption by approximately 25% from the baseline.

The voluntary agreement was created and implemented in the context of discussions concerning the development of the Ecodesign regulations. Thus, although the requirements of the Implementing Measure for building circulators have yet to take effect, the policy signals from the early rounds of consultation generated an anticipatory impact on the sector. The Ecodesign requirements will have an even stronger impact and will accelerate the market change as we approach 2013. By 2010 class A circulators made up 30% of the market. Thus, at least an additional 70% of the circulators will need to shift to variable speed technology between 2011 and 2013 to meet the A* requirements set out in the Implementing Measure.

3. Televisions

Introduction

Televisions contribute significantly to the electricity use of European households. Studies have estimated this to be at least 10%.[40] Televisions are characterized by rapid technological and market change, including the development of new types of televisions. Traditional CRT (Cathode Ray Tube) televisions have been abandoned almost completely in EU 15 and LCD (Liquid Crystal Display) and Plasma televisions have been taken their place. LCD televisions are expected to be the dominant technology on most European markets in the future. LED[41] backlight LCD televisions have proven to be energy efficient while plasma televisions have proven to be less energy efficient.[42]

The preparatory studies highlighted three main market failures where a significant potential for energy savings from televisions exists:

[38] http://www.eup-network.de/fileadmin/user_upload/Produktgruppen/Lots/Working_Documents/Lot11_Circulators_WD.pdf
[39] See, for example: http://www.grundfos.com/about-us/news-and-press/news/the-eup-ready-range.html
[40] http://www.coolproducts.eu/product_tvs_3106.aspx
[41] Light Emitting Diod
[42] See for example http://www.comparison.com.au for rating of energy efficiency that controls for screen size. The best plasma TVs score 5½ in energy efficiency. The best LED and LCD TVs score 8 and 7 respectively in energy efficiency. See also http://mappingandbenchmarking.iea-4e.org/shared_files/110/download

- the electricity consumption of televisions has not been a decisive factor for the purchasing decisions of consumers
- information on electricity consumption, related running costs and potential electricity savings available has not been easily accessed and understood
- few incentives exist for manufacturers to optimise the electricity consumption.

Timeline

Televisions were identified as a candidate for eco-design measures in the 2005 Ecodesign Directive and the preparatory study was completed in August 2007. The draft regulation was first discussed at the consultation forum in October 2008 and the Implementing Measure for televisions was adopted in July 2009 under Commission Regulation EC/642/2009.

Table 3.7 - Timeline for setting eco-design requirements

Preparatory Study		First discussion for IM at Consultation Forum	Impact assessment published	Implementing Measure adopted
First stakeholder meeting	Study published			
March 2006	August 2007	October 2008	22/7/2009	22/7/2009

Source: ECEEE and European Commission DG Energy

The requirements for televisions will be introduced in four steps starting August 2010. The Implementing Measure contains a number of requirements of which the main ones are mentioned below.[43] The exact limits for on-mode power consumption of televisions are dependent on the screen size of the televisions and are determined by a formula and not by a specific value.

Table 3.8 - Implementing Measure requirements for Televisions

Date	Target
From January 2010	Power consumption of televisions in any off mode condition shall not exceed 1.0 Watt. Power consumption in standby-mode shall not exceed 1.0 Watt (2.0 Watts in case of information or status display).
From August 2010	The minimum energy performance requirements are set so that all TVs must be more efficient than the 2007 sector average.
From August 2011	Power consumption of televisions in off-mode condition shall not exceed 0.3 Watt (certain exceptions apply). Power consumption in standby-mode shall not exceed 0.5 Watt (1.0 Watts in case of information or status display).
From April 2012	Standard television sets must be 20% more efficient and full-HD sets must be 30% more efficient than the 2007 sector average.

Source: Implementing Measure

In addition, in September 2010 an A-G energy labelling scheme for televisions was adopted and will be introduced in 2012. In 2014, 2017 and 2020 the efficiency classes A+, A++ and A+++ will be introduced. The labelling scheme aims to create market transparency for consumers and provide incentives for manufacturers to innovate and make investments in energy efficiency.

Baseline

Energy consumption among TV models varies significantly. A Swiss study of 8 televisions measured the average energy use by full HD ready televisions with screen sizes typically used in living rooms. Average

[43] For a full list see: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32009R0642:EN:NOT

electricity costs over a 10 year period were € 230. For the best model electricity costs were € 146 and for the least energy efficient it was around € 346.[44]

Likewise, a study by GfK Retail and Technology shows that for 42 inch LCD TV on average almost one third of total life cycle costs for the consumer is caused by energy consumption. Out of total life cycle costs of €1198, the purchase price is on average € 828 and average energy costs are € 370.[45] Thus, the energy saving potential in the case of TVs is significant.

The preparatory study predicted that the total stock of televisions would increase from 35 million annual sales with a total of 303 million sets in 2005 to €47 million in annual sales with an accumulated total of 429 million television sets in households in 2020. Accumulated electricity savings for the period 2005-2020 are estimated at 83 TWh, generating accumulated electricity cost savings of € 12.5 billion.

Despite Ecodesign requirements and energy labelling being adopted to increase energy efficiency of televisions, a significant growth in energy consumption was expected. Without Ecodesign requirements, energy consumption was expected to reach 132 TWh in 2020. With Ecodesign requirements, growth in energy consumption was expected to be limited to 104 TWh in 2020 (28 TWh reduction).

Table 3.9 - Standby and off-mode losses - 2005 baseline and projected impact until 2020

	2005	2020			
	Baseline	BAU	Policy	Annual savings	Accumulated savings
Number of products (mln.)	303	429	429		
Energy Consumption (TWh)	54	132	104	28	83
Electricity Costs (bln. €)	-				12.5
CO_2 emissions (Mt)	24				34

Source: TV sets preparatory study and impact assessment

An important consideration related to the effects of the Ecodesign requirements for TV sets concerns the role of LED-based technology. At the time when the preparatory study and the impact assessment were carried out, LED-backlit LCD televisions were considered to be a niche market. Since then, the rapid development and uptake of this technology has led to improved energy efficiency which was not anticipated by the impact assessment.

Effects of the Directive

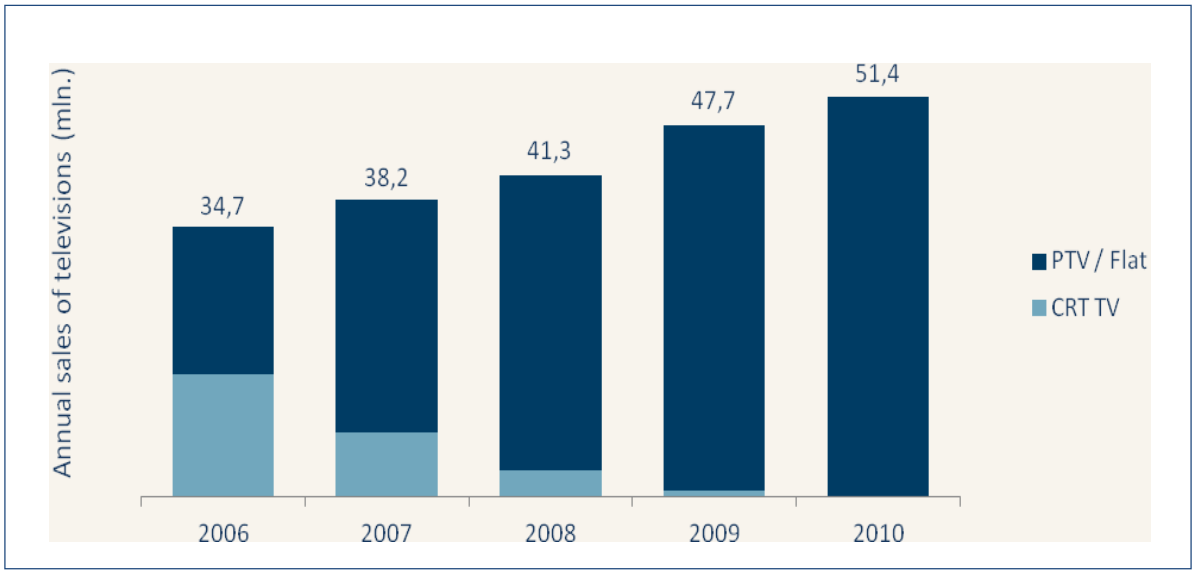
The total energy consumption related to televisions is being affected by a number of parameters, which include:

- The growing number of televisions in EU households (higher penetration rates)
- The increasing viewing time per day
- The increasing average size of TV screens
- The introduction of new and more energy efficient types of televisions

Annual sales of televisions in EU-15 rose from 34.7 million in 2006 to 51.4 million in 2010.

[44] http://www.topten.info/uploads/File/S.A.L.T.%20TV%20study%202009%20EN.pdf
[45] Presentation by Thilo Heyder at the 2011 EEDAL conference. Assumption are: 4 hours per day ON MODE + 20 hours per day STANDBY, life cycle 7 years, costs per 1 KWh in Germany = Euro 0.253

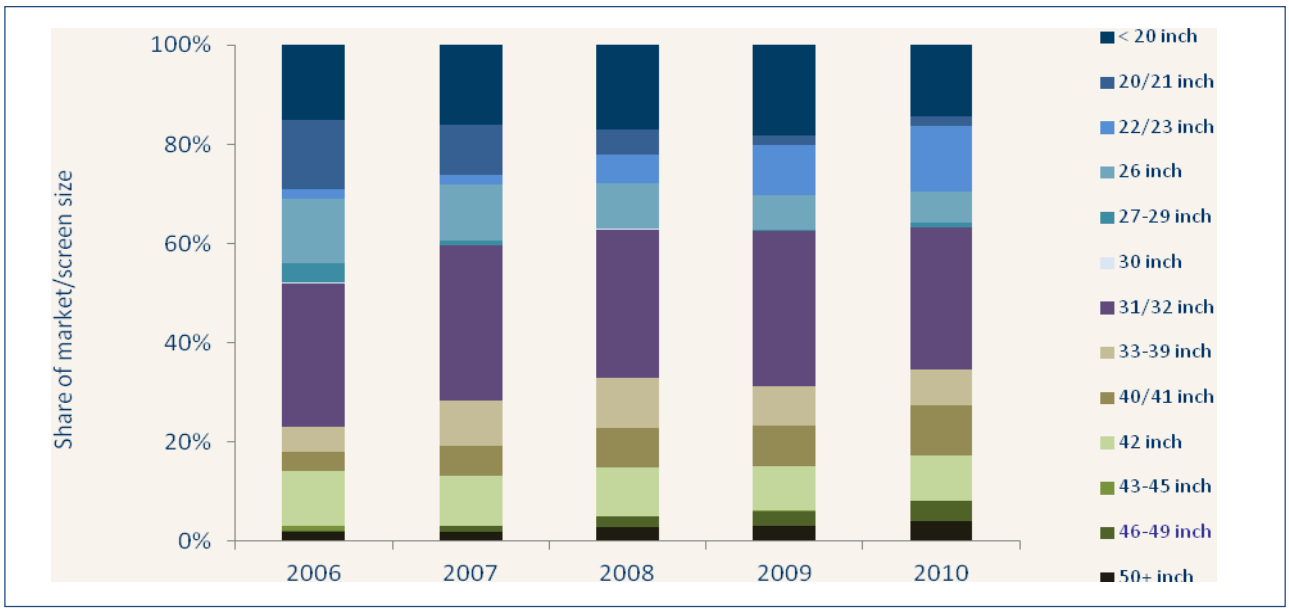
Chart 3.4 - Annual television sales in millions, EU-15 - Period 2006-2010



Source: Gfk Retail and Technology

In relation to the above stated factors, the developments in the market have been quite different from what was expected in the preparatory study. CRT televisions were expected to retain a share of around 15% in 2010. However, new types of televisions, especially LED-backlit LCD televisions but also regular LCD televisions and, less so, plasma televisions - all more energy efficient than CRT televisions – already cover almost 100% of the market. Similarly, while the preparatory study expected annual television sales in Europe to be around 36.5 millions in 2010, it far exceeded it, reaching at total 51.4 million. In contrast, the increase in the average size of TV sets was less than expected. Screens of 40 inches or larger reached a total of 27% in comparison to 33%, as was predicted in the preparatory study.

Chart 3.5 - Development of screen size for new televisions, EU 15, 2006-2010

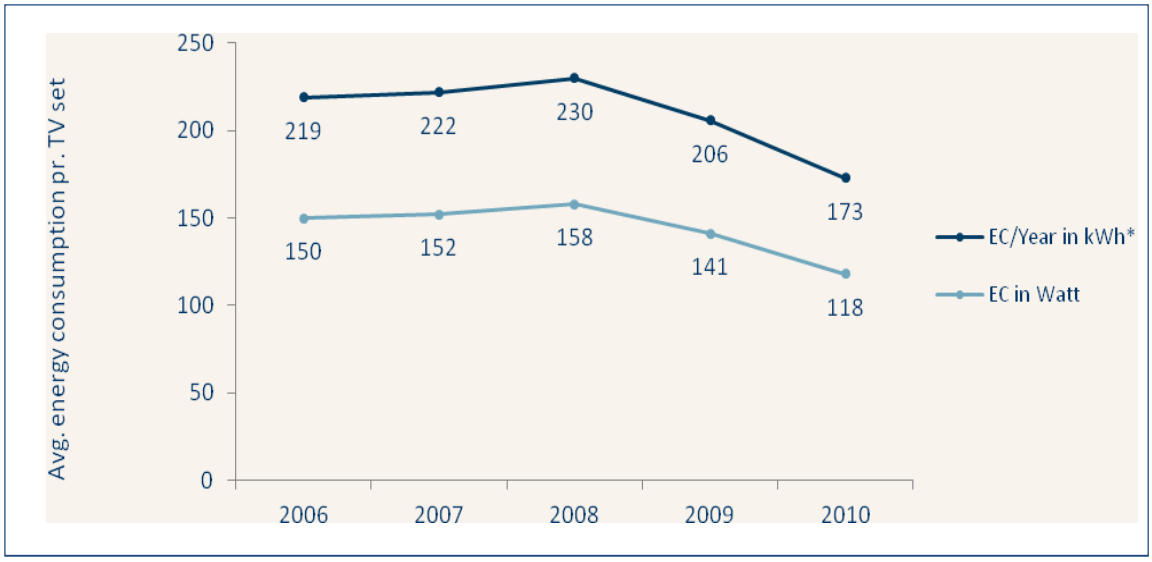


Source: Gfk Retail and Technology

Consumer behaviour has also changed. In addition to the introduction of new types of televisions to the market and consistently increasing screen sizes, people are watching television for longer periods of time

each day.[46] Televisions are also increasingly used for other purposes such as playing game consoles or watching DVD. At the same time, energy efficiency of TV sets has increased and the average energy consumption per television set has decreased over the period 2008-2010 by around 25%. This was a reverse of a trend up to 2008 when energy consumption was increasing.

Chart 3.6 – Average energy consumption per television set



Source: GfK Retail and Technology, based on 4 hours on-mode and 20 hours standby per device and day.

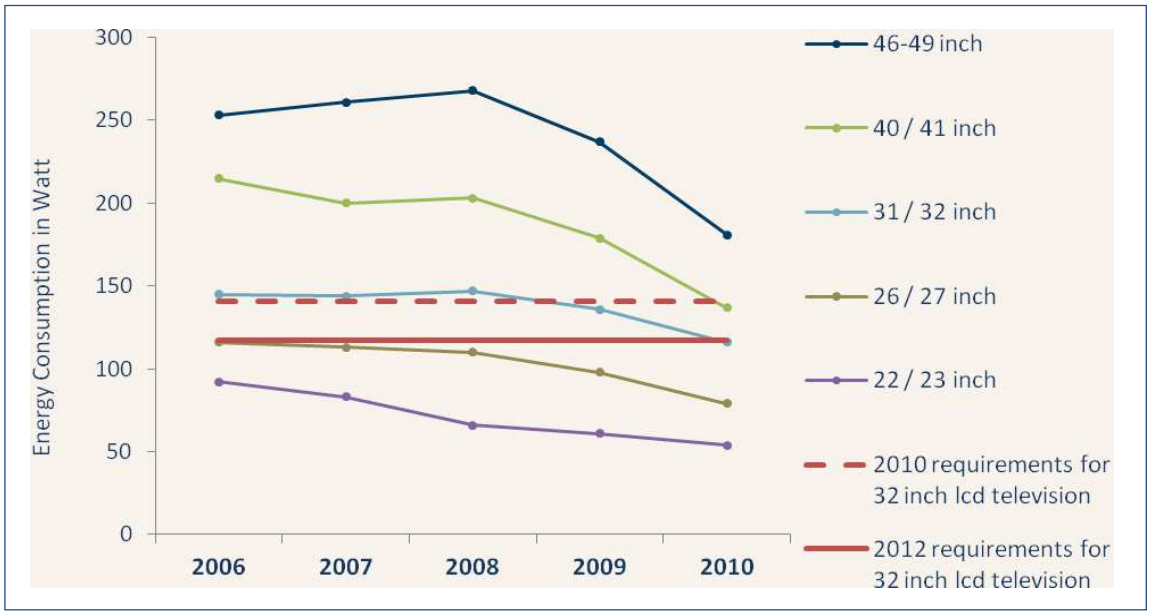
Furthermore, for the first time in 2010 there was a decrease in the total energy consumption for televisions. The increased energy efficiency of TVs has managed to off-set the negative effect caused by higher number of sales, increased viewing time and larger screen sizes.[47]

The improvement of energy efficiency concerns TV sets of all screen sizes. The following chart shows a sharp decrease of energy consumption for every screen size in the period 2006-2010. Already by 2008 the average 32 inch LCD Television sets were meeting the 2010 requirements and by 2010 the 2012 requirements.

[46] According to IP Network the average viewing time in minutes per person in EU 26 went up from 225 minutes in 2007 to 231 minutes in 2009.

[47] GFK Retail and technology, Presentation by Jürgen Boyny at IFA messe Berlin 2011. Data for EU-15

Chart 3.7 - Average energy efficiency of TV sets by screen size, 2006-2010



Source: Adopted from GfK Retail and Technology

There is a clear improvement in the energy efficiency of televisions, particularly since 2008, the year when the draft regulation was first discussed at the consultation forum, indicating a degree of impact of the process on the development of the market. However, industry representatives have suggested that the new and more energy efficient televisions were already entering the market before 2005 and the increased energy efficiency levels should not be directly attributed to the Ecodesign requirements. Instead, the introduction of new types of television was mainly driven by consumer demand for increased picture quality and improved design. An increased focus of some of the main producers on sustainability has also been a driver.

Thus, the introduction of new types of television with higher energy efficiency seems to have happened largely independently of the Ecodesign requirements. The interviews do not indicate that producers pushed forward with the new energy efficient technologies faster than planned in order to meet Ecodesign requirements. Nonetheless, stakeholders from industry have indicated that regulations that promote energy efficiency, such as the Ecodesign Directive, are useful internally as a tool to promote the need to become sustainable.

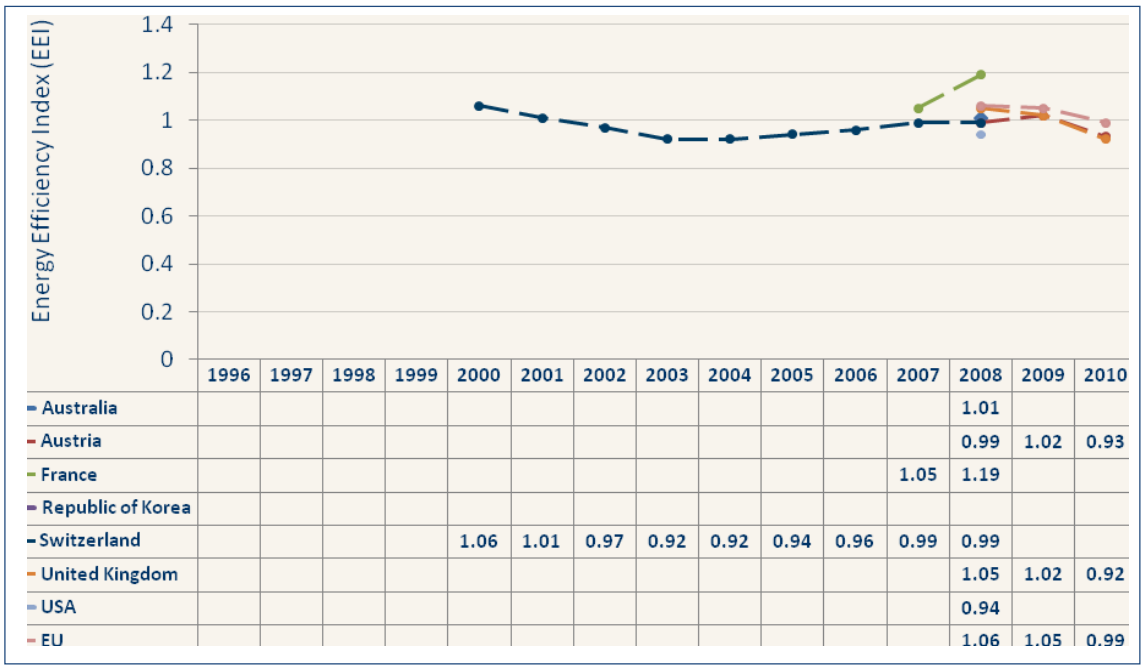
The available data refer only to the average energy consumption and not the share of non-complying products. Anecdotal evidence from interviews with stakeholders confirms that technological developments are at such a fast pace that many products from the leading producers, would have met the same on-mode energy efficiency levels even in the absence of Ecodesign requirements. In that respect, the effect of the Directive has mainly been on cheap televisions from discount producers and on inefficient forms of plasma televisions which did not fulfil the requirements and would have otherwise stayed on the market. The same holds true for the standby requirements that came into force in August 2011, although large producers scrapped a few models that did not meet the requirements (maximum power consumption of 0.3 Watt in off mode and 0.5 Watt in standby-mode).

Due to the rapid technological development, the requirements set in the Implementing Measures have been criticized for not being ambitious enough. As illustrated earlier, in 2010 the energy consumption of an average 32 inch LCD television had dropped to a level equivalent to the requirements that will be introduced in 2012. The study commissioned by the Coolproducts for a Cool Planet campaign concluded that the 1st stage requirements for a 32 inch television (148W) were only slightly more demanding than the

average television in the market in 2008 (152W) and were much higher than the most cost-effective television already in the market (118W). Even the second tier requirements that will come into force in 2012 (117W) will be much higher than the most cost efficient television already in the market in 2009 (60W in on-mode).[48]

The market developments described above for Europe follow broader global market trends. Data from the 4E mapping and benchmarking exercise conducted by the International Energy Agency (IEA) indicate that for all countries examined, on mode energy consumption for LCD televisions dropped by 8% between 2009 and 2008 (from 146W to 134W)[49] and that the EU has achieved a similar level of average energy efficiency levels as in other countries.

Chart 3.8 - Average efficiency of all televisions sold



	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Australia													1.01		
Austria													0.99	1.02	0.93
France												1.05	1.19		
Republic of Korea															
Switzerland					1.06	1.01	0.97	0.92	0.92	0.94	0.96	0.99	0.99		
United Kingdom													1.05	1.02	0.92
USA													0.94		
EU													1.06	1.05	0.99

Source: 4E benchmarking Document, 2010.

Furthermore, efficiency requirements have been introduced in a number of countries. Both Australia and the US have - like the EU - focused on improving the energy efficiency of televisions. The requirements are more demanding than the implementing Measures in the EU.

In the US, the voluntary Energy Star television specification was introduced in January 1998, covering only standby consumption. On mode power consumption limits came into effect in October 2008. By 2009, a large majority of televisions on the market met the revised Energy Star specification. Revised Energy Star television specifications were established in 2009; the first step came into effect in May 2010 and second will come into effect in 2012. The requirements are significantly more demanding than the Ecodesign requirements but since Energy Star identifies and promotes the most efficient and not the least efficient products, this is not surprising. California introduced mandatory requirements in January 2011 which will be strengthened in January 2013. The Tier 1 requirements from 2011 was slightly more demanding than the

[39] http://www.coolproducts.eu/resources/documents/EnergySaving-in-Practice.pdf

[49] 4E Mapping and Benchmarking. http://mappingandbenchmarking.iea-4e.org/matrix?type=product&id=2

tier 2 Ecodesign requirements to be introduced in 2012 while the 2013 Tier 2 requirements in the state of California will be significantly more demanding.[50]

Voluntary energy labelling of televisions was introduced in Australia in July 2008. The labelling scheme became mandatory on 1 October 2009. In addition, all models have been required to meet mandatory Minimum Energy Performance Standards (MEPS) since 1 October 2009. A second tier of MEPS is planned to be introduced in October 2012 that will not be as demanding as those in California, though still more strict than the Tier 2 Ecodesign requirements in Europe.[50]

Conclusions

The developments of energy efficiency for televisions have been rather positive and have exceeded the expectations in the preparatory study. Energy consumption per television dropped by around 25% in the period 2008-2010 and managed to offset the similar increase in the volume of sales, screen size and viewing time. If this trend continues the total energy consumption in 2020 will be lower than in 2005 rather than double the amount of 2005 as forecasted in the baseline scenario. Still, it is too early to say if it will be possible to meet the targets set under the policy scenario.

Despite these rather positive developments, the analysis does not indicate an important contribution of the efficiency requirements set under the Ecodesign Directive, since the majority of the TV sets met the requirements quite some time before they entered into force. While the positive developments in the market coincided with the introduction of the first Ecodesign requirements, the input from industry indicates that other factors – availability of relevant technologies, demand for improved picture quality and design as well as competition – have been the underlying forces.

The analysis also suggests that the requirements for televisions could have been more demanding or that the Tier-2 requirements could have been introduced earlier than 2012. As a result of technological developments that were not considered in the development of the Implementing Measure, most products already met the 2012 requirements in 2010.

The effect of the Ecodesign Directive has been limited to pushing a small number of cheap, inefficient televisions off the market. Furthermore, it may have helped indirectly in the sense that the mandatory energy performance standards strengthen the position of those people in companies that are responsible for making products more sustainable. Thus, as far as televisions are concerned the direct effects of the Ecodesign requirements appear relatively limited.

4. Domestic refrigerators and freezers

Introduction

Cold appliances (refrigerators & freezers - which are covered under the same Implementing Measure) account for around 15% of residential electricity consumption and are the largest source of energy use together with heating systems/electric boilers.[51] In total, Europeans used 122 TWh of electricity in 2005 to power their fridges and freezers - equivalent to the total residential consumption of the UK.[52]

For a long time, there has been a positive development in the energy efficiency of cold appliances entering the market. Due to early efforts at energy labelling, voluntary agreements and minimum efficiency requirements that came into force in 1994 and 1996 domestic refrigerators and freezers are seen as one of

[50] http://www.iea.org/papers/2010/global_market_transformation.pdf
[51] Presentation by Bettina Hirl, JRC, EEDAL Conference 2011.
[52] http://www.coolproducts.eu/product_fridges_and_freezers_3164.aspx

the success stories of EU energy efficiency policy. In the period 1959-1970, the average consumption of a refrigeration unit was 839 kWh/year, which was reduced to 292 kWh/year by 2005. As stated in the preparatory study[53] in 2005, these improvements occurred through product improvements and the introduction of new product lines. However, according to the Implementing Measure, while the projected energy consumption of household refrigerating appliances is expected to decrease by 2020, the rate of this reduction is expected to slow as a result of outdated requirements and energy labels. Cost-effective energy-savings potential would therefore not be achieved if no further measures were to be introduced to update the existing Ecodesign requirements.

The energy efficiency of absorption-type refrigerators and thermoelectric cooling refrigerating appliances, such as mini drink chillers, can all be significantly improved. Appliances that have consequently been included under the Implementing Measure include:

- refrigerating appliances that are primarily powered by energy sources other than electricity, such as liquefied petroleum gas (LPG), kerosene and bio-diesel fuels;
- battery-operated refrigerating appliances that can be connected to the mains through an AC/DC converter, purchased separately;
- custom-made refrigerating appliances, made on a one-off basis and not equivalent to other refrigerating appliance models;
- refrigerating appliances for tertiary sector application where the removal of refrigerated foodstuffs is electronically sensed and so that information can be automatically transmitted through a network connection to a remote control system for accounting;
- appliances where the primary function is not the storage of foodstuffs through refrigeration, such as stand-alone ice-makers or chilled drinks dispensers.

Timeline

Domestic refrigerators and freezers were considered for eco-design measures according to the 2005 Ecodesign Directive. The preparatory study was initiated in the autumn of 2006 and published in December 2007. The first proposal for the regulation was discussed at the Consultation Forum in December 2008 and the regulation was implemented in July 2009. In addition, in December 2010 the Commission introduced a new energy label for refrigerating appliances where the scale was extended upwards and new classes were introduced.

Table 3.10 - Timeline for setting eco-design requirements

Preparatory Study		First discussion for IM at Consultation Forum	Impact assessment published	Implementing Measure adopted
First stakeholder meeting	Study published			
September 2006	December 2007	December 2008	22/7/2009	22/7/2009

Source: ECEEE and European Commission DG Energy

The Regulation on cold appliances sets out a series of performance targets for the industry, outlined in the table below[54].

[53] ISIS. 2005. LOT 13: Domestic Refrigerators & Freezers Final Report [Preparatory Study]: http://www.ecocold-domestic.org/index.php?option=com_docman&task=doc_view&gid=125&Itemid=40
[54] Domestic refrigerators and freezers Implementing Measure, http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32009R0643:EN:NOT

Table 3.11 - Domestic refrigerators and freezers specific requirements - Energy Efficiency Index (EEI)

Date	Absorption-type and other-type refrigerating appliances	Compression-type refrigerating appliances
1 July 2010	EEI < 150 (class F or better)	EEI < 55 (class A or better)
1 July 2012	EEI < 125 (class E or better)	EEI < 44 (class A+ or better)
1 July 2014		EEI < 42 (class A+ or better)
1 July 2015	EEI < 110 (class D or better)	

Source: Implementing Measure, European Commission. Note: The energy efficiency classes for refrigerating appliances will be revised in July 2014 and the EEI for energy class A+ will be reduced from 44 to 42. Compression-type refrigerating appliances are "standard" refrigerators and freezers and by far the most common. Absorption type refrigerating appliances are mini-bars, mini-coolers, wine coolers, etc. Due to a different cooling technology these types of refrigerators consume more energy.

The requirements that took effect in July 2010 state that the Energy Efficiency Index (EEI) for products must be smaller than 150 for absorption type and 55 for compression type appliances, equivalent to energy class A or better for compression type appliances. The requirements that take effect in July 2012 will ban class A products.[55]

Baseline

The preparatory study suggested that the refrigerator industry had improved significantly in terms of electricity consumption in the 30 year period leading up to the introduction of the new regulations in 2009.In 2008, the EU-27 refrigerator stock in the residential sector was estimated to be 191 million units and the freezer stock stood at 84 million units. The combined annual electricity consumption was estimated to be 122 TWh in 2005, corresponding to 56 million tonnes of CO_2 equivalent.

Based on the targets set, it was estimated that by 2020 electricity consumption will fall to 79 TWh and CO_2 emissions will amount to 38 Mt from cold storage appliances, a decrease of 33% in comparison to 2005. Moreover, the regulations are expected to have significant implications for consumer spending. The annual purchase and running costs for the total stock is expected to drop by around € 400 mln/year in 2025 when compared to 2005. In relation to the no Ecodesign policy scenario, the expected savings in 2020 is 4 TWh and the accumulated savings until 2020 is 12 TWh. A drop in energy consumption in 2020 in comparison to 2010 is explained by market saturation and a long lasting trend towards increased energy efficiency.

Table 3.12- Cold appliances - 2005 baseline and projected impact until 2020

	2005	2010			2020			
	Baseline	BAU	Policy	Annual savings	BAU	Policy	Annual savings	Accumulated savings
Number of products (mln.)	R: 191* F: 84*							
Energy Consumption (TWh)	122	105	105	0	83	79	4	12
Electricity Costs (bln. €)	-							2
CO_2 emissions (Mt)	56					38		5

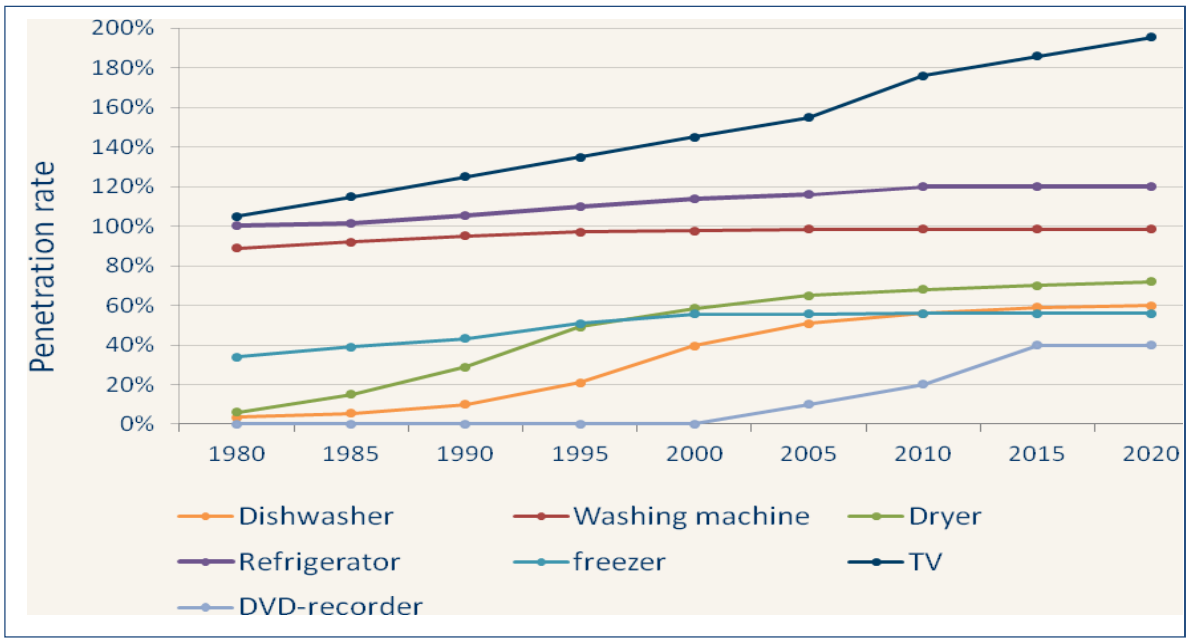
[55] EEI for compression type refrigerating appliances most be lower than 44 to get A+. In July 2014 this will be lowered to 42 Http://www.eceee.org/Eco_design/products/domestic_fridges_and_freezers/Final_Regulation_Labelling

Source: preparatory study and impact assessment * Note: 2008 numbers

Existing evidence on the effects of the Directive

Refrigerators appear to have reached market saturation with a penetration rate of around 100% in the EU27. The freezer market has a lower penetration rate – around 60% but has been rather stable since 2000. Lately freezers have even registered a decreasing tendency due to the increased use of combined refrigerator/freezer appliances. Thus, energy consumption by this product group is not driven by a growth in the market. However, the increase in the average size of refrigerators over recent years has effected total energy consumption negatively.

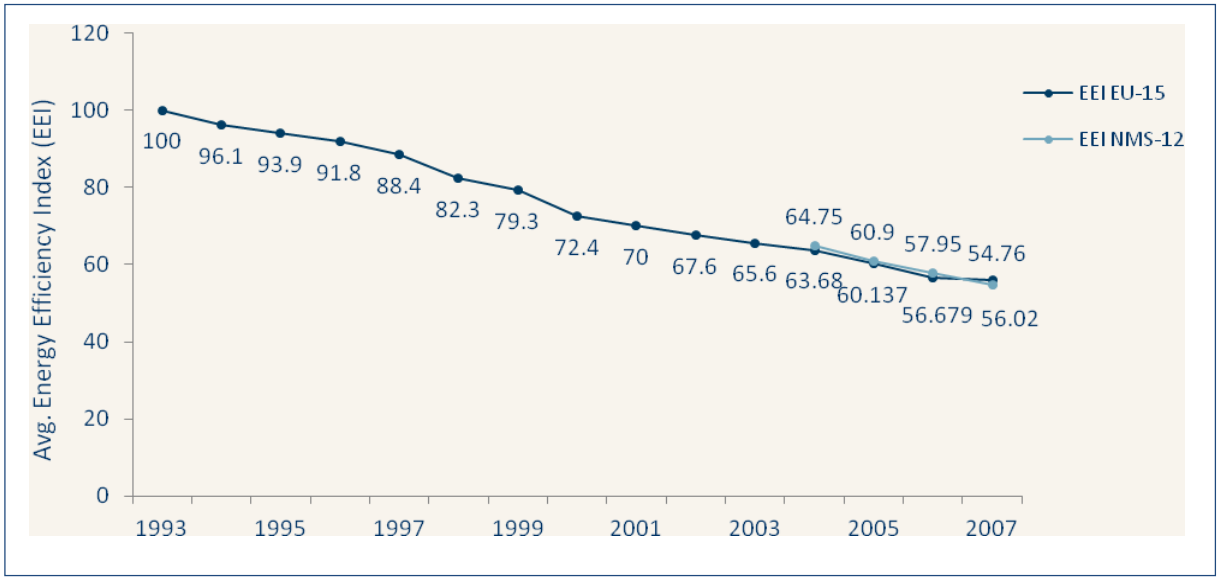
Chart 3.9 – Actual and projected penetration rates of home appliances



Source: Hans-Paul Siderius, Presentation at EEDAL Conference 2011, Note: data for the Netherlands

Available data going back to 1993 show that average energy efficiency levels for cold appliances in EU-15 has almost doubled in the period up to 2007. These improvements have partly been facilitated by the increasing size of refrigerators since it is easier to make large refrigerators energy efficient.

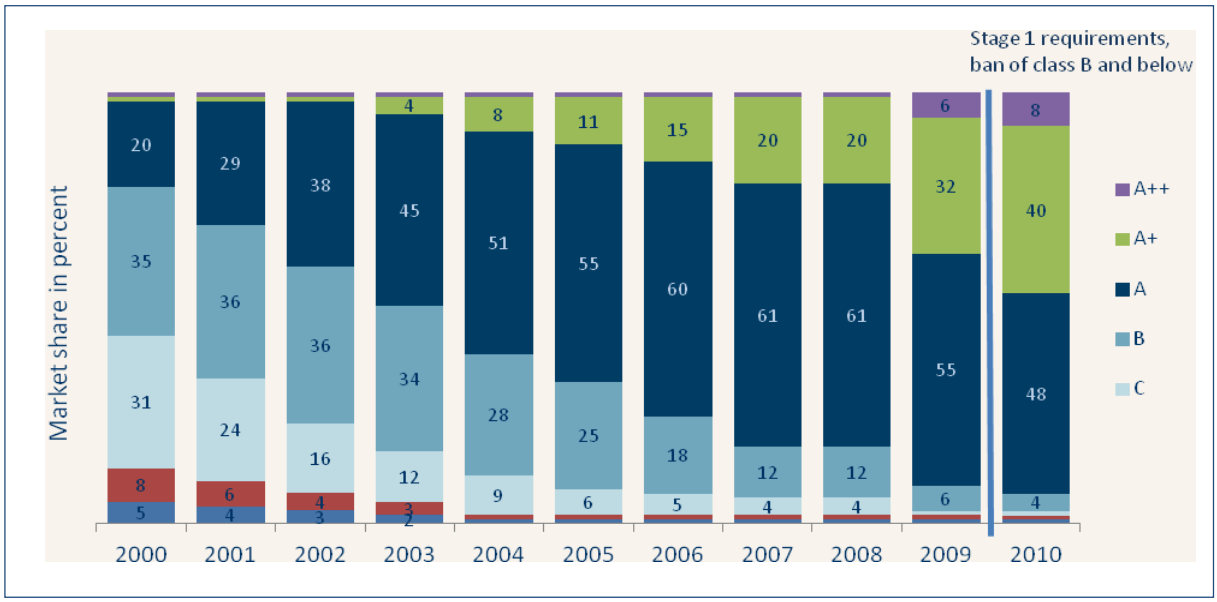
Chart 3.10 – Average Energy Efficiency Index (EEI) for cold appliances for EU-15



Source: Bettina Hirl, JRC, presentation at the 2011 EEDAL Conference

The increasing energy efficiency in the EU is also reflected in the market shift towards cold appliances with higher energy efficiency labels. In 2000 products with label A or better represented around 20% of the market while B and C-labelled products were the most common. In 2010, products labelled A to A++ made up around 96% of the market. A+ and A++ products had a market share of nearly 50%.

Chart 3.11 - Market share of cold appliances (refrigerators and freezers) by energy class (2000-2010)

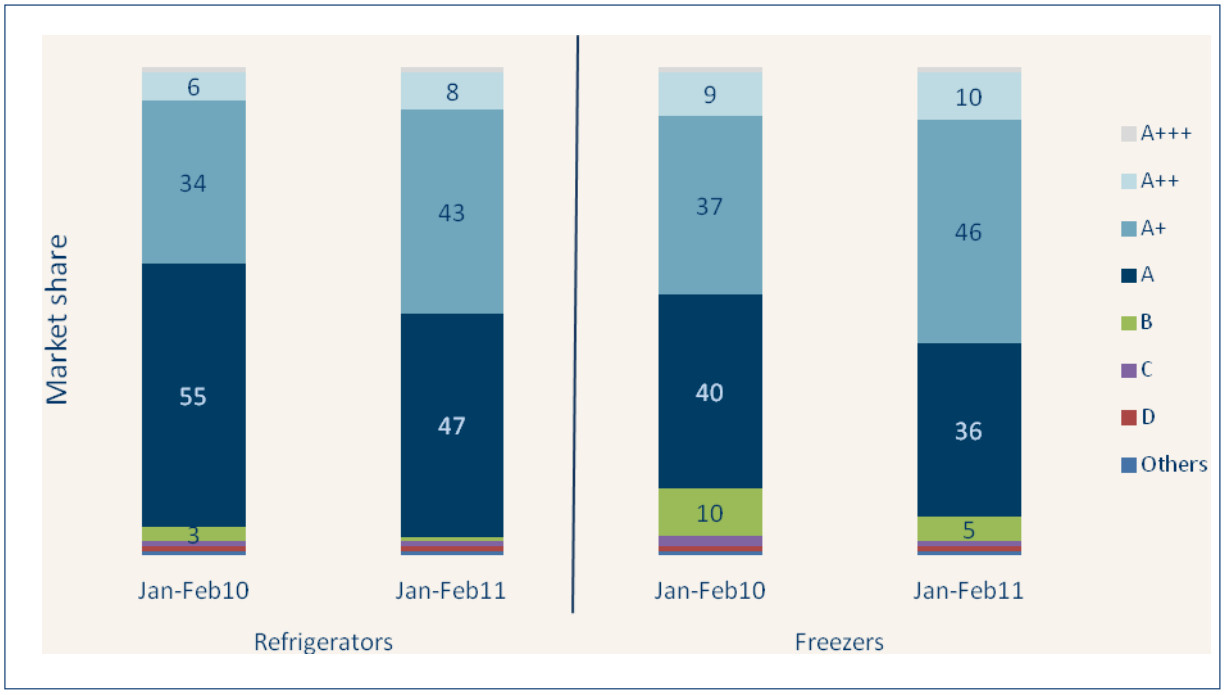


Source: GfK, Presentation by Anton Eckl at the AtLETE workshop - Note: Data for EU-10, AT, BE, DE, ES, FR, GB, IT, NL, PT and SE.

The developments in the energy efficiency of cold appliances were already in progress by the time that cold appliances were indicated in the Ecodesign Directive as products to be considered in the transitional period. At that time products of class B or lower - namely products non-compliant with Tier-1 requirements - had a market share of more than 30% in 10 EU countries but this had significantly declined from over 75% in 2000. By 2007, when the preparatory study was published this was down to 18% and further reduced to 7% by 2009. The developments in the market continued in 2010 and 2011. According to the most recent

data in the beginning of 2011 the market share for refrigerators of energy class B or lower in 13 western and central EU Member States was around 2 % whereas it was around 8 % for freezers.[56]

Chart 3.12 - Market share of cold appliances divided by energy class (2010-1011)



Source: GfK, Presentation by Anton Eckl at the AtLETE workshop - Note: Data for EU-13, central and Western Europe.

Thus, the requirements have removed energy classes which were already declining when the preparatory study was published and which only had a marginal market share when the requirements came into force. This is also supported by the fact that Miele, one of the leading producers, phased out class B to D models several years before the requirements came into force.[57]

Considering Tier 2 requirements, which will ban products of class A and below as of July 2012, the picture is rather different. A significant increase in the market share of class A+ products would be necessary in order to meet the minimum requirements. Lately the market share of A+ and more efficient products have increased with around 10 percentage points a year. Still, a significant acceleration of change will be needed to meet the requirements.

Table 3.13 - Market share of domestic refrigerators and freezers meeting the Tier 2 requirements for 2012

	2005	2006	2007	2008	2009	2010
Marked share of Class A+ or better (% of total)	12	16	21	29	38	48
Change from previous year		4	5	8	9	10

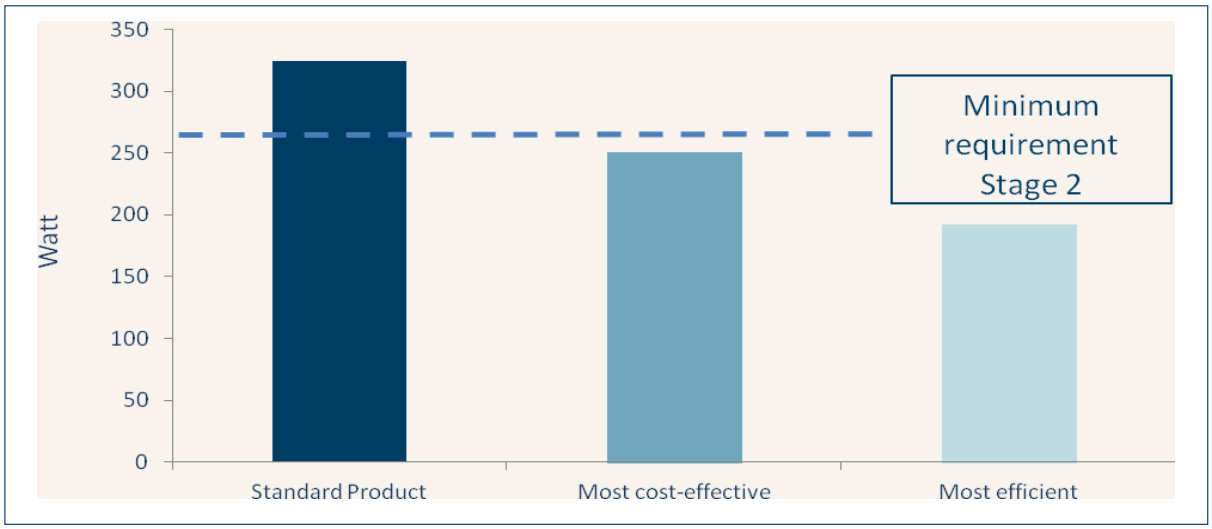
Source: CSES and Oxford Research based on GfK Retail and Technology

[56] As long as the products are placed on the market before the requirements come into force they can still be sold by shops after the requirements come into force even though they do not fulfil them.
[57] On the basis of information from interviews.

Even though Tier-2 requirements are more ambitious, Bosch, another leading producer in energy efficiency, phased out A class models in 2011; roughly a year before required. Miele has also indicated that fulfilling the 2012 Tier-2 requirements are not a major challenge for them. This indicates that the requirements will mainly lead to the removal of models from producers which focus less on energy efficiency.

There has also been criticism from environmental NGOs that the requirements are not ambitious enough and allow products which are less efficient than the most cost-effective product in 2009. It is suggested that most of the developments would have happened even in the absence of the Implementing Measure and that only a small share of products has been removed from the market. More importantly, it has also been claimed that manufacturers have access to the necessary technologies before the entry of the Implementing Measures into force, and that any improvements are designed to marginally surpass the minimum requirements.

Chart 3.13 - Stage two requirements entering into force in 2012 compared to a standard refrigerator, the most cost efficient refrigerator and the most energy efficient



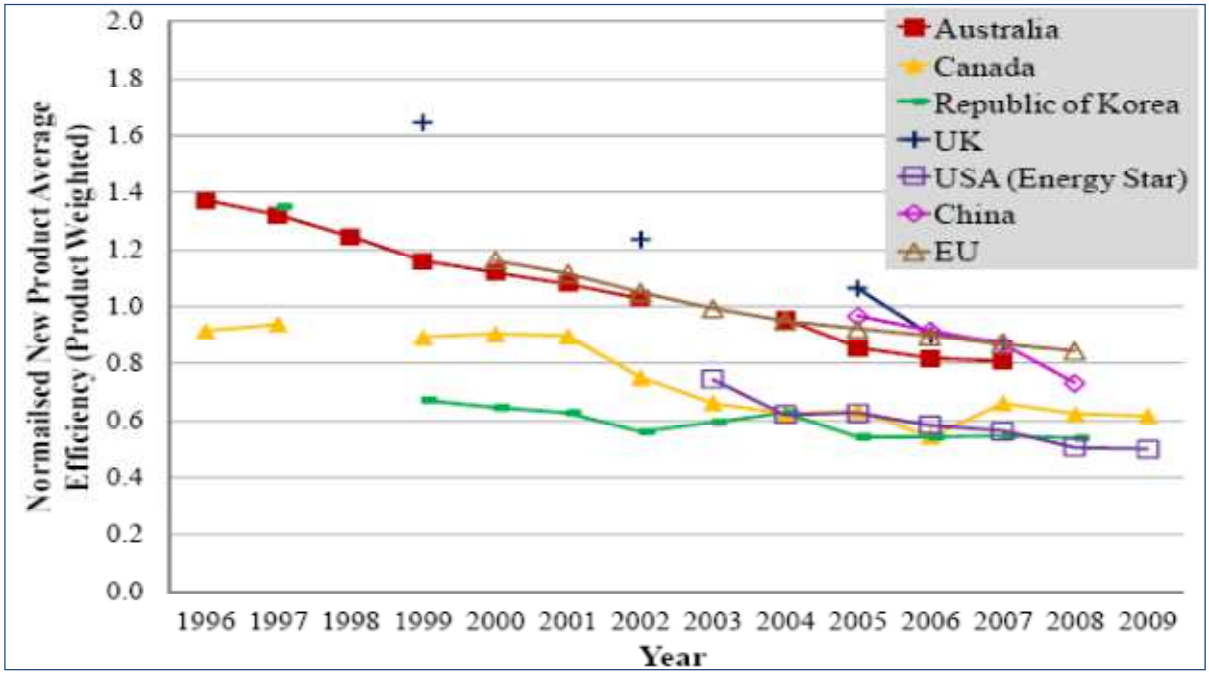
Source: Coolproducts for a Cool Planet

We have not been able to verify this claim but the data presented above illustrate that Tier-1 requirements are not very ambitious. Also, Switzerland has introduced the same requirements as the Ecodesign requirements but tier-1 came into force in January 2010 and the requirements which will come into force in the EU in July 2014 took effect from January 2011.

In addition, evidence from countries outside the EU shows greater energy efficiency levels of refrigerator/freezer combinations sand supports the idea that more efficient technologies are already available. While there are issues of direct comparability, a first view of the data collected as part of the 4E Mapping and Benchmarking Annex shows higher efficiency levels in place in Australia, Canada, Korea, China and the US. At the same time, the total annual consumption in the EU is among the lowest (due to smaller average volume).

Chart 3.14 - Benchmarking electricity efficiency trends for cold appliances[58]

[58] Figures have been normalized to account for different volumes



Source: Hans-Paul Siderius, presentation at the EEDAL conference

Canada, Korea and the USA, where mandatory labelling and MEPS were introduced earliest (1990-1995) and are revised regularly (three or four times), have the best performing products.

MEPS for refrigerators and freezers were first introduced in Canada in 1995. Since then, a number of amendments have been made to the MEPS for refrigerators and freezers. Amendments have introduced either a new product or greater stringency on existing regulations with respect to the refrigerator/freezer category. In the US MEPS for refrigerators and freezers were first introduced in 1990 with revisions in 1993, 2001 and 2014. Around the time when the 1993 and the 2001 MEPS requirements were introduced, the average energy consumption dropped by approximately 20% on each occasion.[59]

Conclusions

Cold appliances, refrigerators and freezers, have seen significant improvement in energy efficiency in the last decade and energy class A has become the dominant class and more and more products are moving up to even higher energy classes. As the size of the market has remained more or less stable, total energy consumption has gradually decreased.

The role of the Ecodesign Directive in these developments is not clear. The development in the market started long before 2005 when the Directive was introduced - although one also needs to consider the fact that certain requirements for those appliances were in place even before 2000. In that respect, the Ecodesign requirements can be seen as a continuation that helped sustain and reinforce the pace of the market transformation.[60] Furthermore, meeting the Tier-2 requirements in 2012 will mean a significant change in comparison to 2010 levels. However, there is also support for the view that especially stage 1 requirements are rather weak when the existing technologies are taken into consideration.

[59] http://www.iea.org/papers/2007/appliances_ellis.pdf

[60] Several evaluations have shown that the market transformation previous to 2005 was accelerated by Minimum Energy Performance Standards. See for example deLaski et al, 2009, Ka-boom, the Power of Appliance Standards and Harrington, 2002, Matching World's Best Regulated Efficiency Standards – Australia's success in adopting new refrigerator MEPS.

Either way, on the basis of the existing developments on stocks and the reaching of minimum requirements set, the policy target of 12 TWh savings in accumulated energy consumption by 2020 should be expected to be achieved. On the basis of certain evidence available, an even greater level of savings would be possible.

5. Simple set top boxes

Introduction

Simple set top boxes (hereafter SSTBs) have the primary function of converting digital input into analogue output signals. During the ongoing transition from analogue to digital broadcasting, TV sets not adapted to receive digital signals will need to be accompanied by SSTBs. Analogue broadcasting will be switched off in the EU in 2015, hence, the sales and aggregated energy consumption of SSTBs are expected to dramatically increase. In 2009, it was expected that a total European consumption of up to 10 TWh/yr could be attributed to SSTBs[61]. In order to minimize the environmental impact of SSTBs it was thus considered important that the electrical efficiency should be maximized within a short timeframe.

The Impact assessment report states that SSTBs have great improvement potential due to the fact that existing cost-effective technical solutions allow the electricity consumption of these devices to be reduced significantly. Moreover, it was suggested that there is no correlation between the prices of different SSBTs with the same functionalities and their energy consumption.

Prior to the Ecodesign Directive Implementing Measures, voluntary agreements already existed at the Community level and at the Member State level which were taken into account in the preparatory phase of the implementation of the Ecodesign Directive. Two EU and national initiatives addressing the energy consumption of SSTBs were identified. At the Community level, the Joint Research Centre (IES) has been running a voluntary Code of Conduct which sets energy efficiency criteria. At the level of Member States, the UK has been running an endorsement label programme for SSBTs managed by the Energy Saving Trust.

However, the impacts of the voluntary initiatives were limited due to the lack of incentives for manufacturers to focus on decreasing the power consumption of SSTBs.[62] Furthermore, a study carried out in 2007 by the Swiss Agency for Energy Efficiency found that the Code of Conduct was not ambitious[63]. The study found that existing technology should enable manufacturers to reduce the energy consumption well below the defined maximum levels in a cost effective manner[64].

Timeline

Simple set top boxes were identified for the development of eco-design measures in the 2005 Ecodesign Directive. The preparatory study was initiated in June 2006 and it was completed in December 2007. The first proposal for simple set top boxes was discussed at the consultation forum in 2007 and the Implementing Measure was adopted in December 2008.

[61] Bertoldi, Paolo & Atanasiu, Bogdan 2009: Electricity Consumption and Efficiency Trends in European Union, Joint Research Centre Institute for Energy, European Commission, EUR 24005 EN
[62] http://ec.europa.eu/energy/efficiency/ecodesign/doc/legislation/sec_2009_114_impact_assesment_en.pdf
[63] http://standby.iea-4e.org/files/otherfiles/0000/0021/Schlussbericht-Settop-Boxen-V14_EN2-total.pdf
[64] Out of 80 analysed products 68 % were already well below the defined maximum level.

Table 3.14 – Timeline for developing the Implementing Measure

Preparatory Study		First discussion for IM at Consultation Forum	Impact assessment published	Implementing Measure adopted
First stakeholder meeting	Study published			
June 2006	December 2007	February 2008	5/2/2009	4/2/2009

Source: ECEEE and European Commission DG Energy

The requirements for simple set top boxes will be introduced in two steps. In the case of the SSTBs there were limited options available and they are expected to be made redundant through the growth of new TV sets capable of receiving digital signals. If the savings potential is to be captured, the Ecodesign requirements have to be implemented before the peak use of SSTBs.

Table 3.15 - Simple set top boxes: Implementing Measure requirements[65]

Date	Target
February 2010	The simple set top boxes on the market, excluding SSTB's with integrated hard disk and/or second tuner, should not exceed consumption limits of 1.00 W for standby mode and 5.00 W for active mode.
February 2012	Simple set top boxes on the market should not exceed 0.50 W for standby mode and 5.00 W for active mode.

Source: Impact Assessment, European Commission; Note: the requirements allow additional energy consumption for functions like decoding HD signals and hard disk.

Baseline

According to the impact assessment a total of 90 million set top boxes were estimated to be sold in 2010 using a combined 6 TWh of energy. The number of SSTBs in EU households are expected to rise from 90 million in 2009 to 178 million in 2014. Annual savings in energy consumption are expected to peak in 2014 representing an expected reduction of 64% in terms of energy costs (€1.4 billion in today's electricity prices) and abatement of 4 Mt of CO_2. Approximately 6TWh out of a savings of 9TWh would come from reducing the power consumption in the standby mode. From 2015 onwards, the electricity consumption is expected to decrease, as old TV sets will be replaced by new ones and SSTBs will be removed from the market. The total estimated savings in accumulated energy consumption would amount to approximately 47 TWh until 2020 compared to a no-action scenario. This amounts to a € 7.2 billion and a 17Mt CO2 reduction. Beyond 2020, the electricity consumption of SSTBs is expected to be negligible[66].

[65] Simple set-top boxes Implementing Measure, http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32009R0107:EN:NOT

[66] Simple set-top boxes impact assessment, http://ec.europa.eu/energy/efficiency/Ecodesign/doc/legislation/sec_2009_114_impact_assesment_en.pdf

Table 3.16 – Simple set top boxes - 2005 baseline and projected impact until 2020

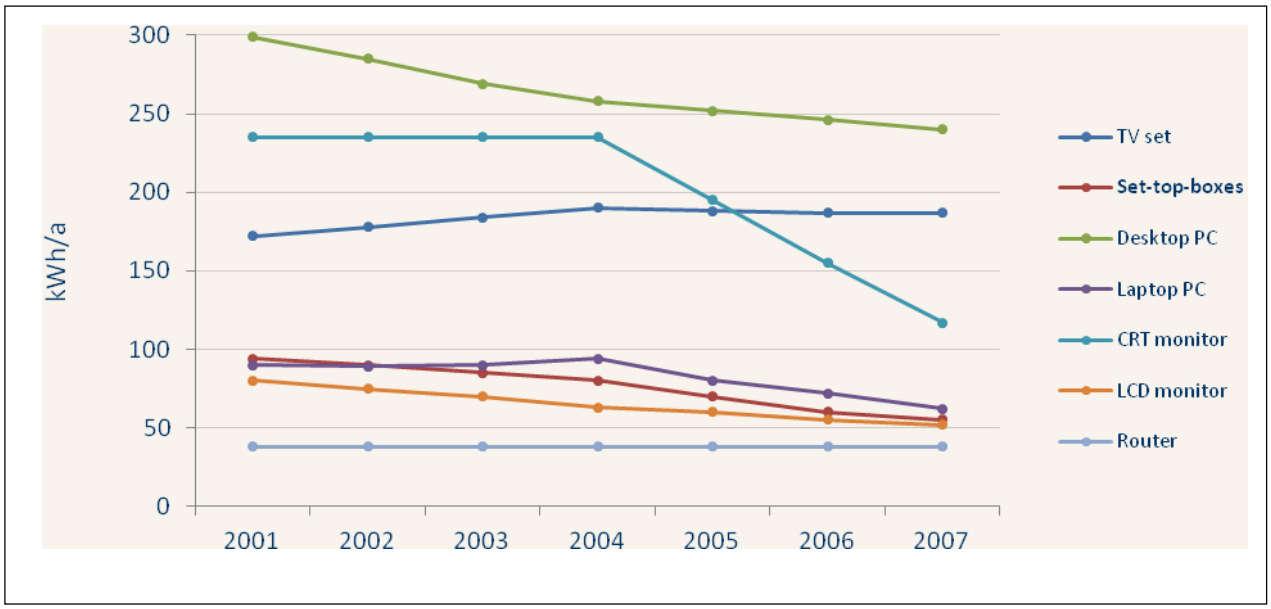
	2005	2010			2014			2020
	Baseline	BAU	Policy	Annual savings	BAU	Policy	Annual savings	Accumulated savings
Number of products (mln.)		90			178			
Energy Consumption (TWh)	6	6	5.5	0.5	14	5	9	47
Electricity Costs (bln. €)							1.4	7.2
CO_2 emissions (Mt)							4	17

Source: Impact Assessment, European Commission

Effects of the Directive

Unfortunately, very limited data were found to allow an assessment of the effects of the Implementing Measure in the case of SSTBs. There were only certain indirect indications that allow for some limited conclusions. Fraunhofer ISI has collected information on the development of total electricity consumption in EU 27, Norway and Croatia, in different operation modes (active, standby, off-mode).[67] The study shows that total consumption for set top boxes has decreased steadily since 2001. However, the data series does not extend beyond 2007 and it is not possible to evaluate energy efficiency or identify any impact of the Ecodesign requirements.

Chart 3.15 - Total electricity consumption by type of appliance 2001-2007



Source: Fraunhofer ISI 2009, Note: Data covers set top boxes in general and not only simple set top boxes.

The Joint Research Centre (JRC) report on Electricity Consumption and Efficiency Trends in the European Union contains data for the power consumption of the new set top boxes sold in 2008 within the EU.[68] However, it is based only on data from companies that have signed the Voluntary Code of Conduct and are

[67] http://www.odyssee-indicators.org/publications/PDF/ICT_households_report.pdf
[68] http://ie.jrc.ec.europa.eu/publications/scientific_publications/2009/EnEff_Report_2009.pdf

probably not representative of the whole market. It indicates a decrease in power consumption of up to 25 % in on mode, in comparison to 2001, for the on-mode of set top boxes, while stand-by consumption levels were almost the same as in 2001.

The UK Department for Environment, Food and Rural Affairs' (DEFRA) Market Transformation Programme has calculated the expected impacts of energy efficiency policies, primarily the Ecodesign Directive, on set top boxes in the UK in standby and on mode. The calculations show that on power electricity consumption for SSTBs has decreased largely as a result of the Ecodesign directive[69]. Basic SSTB energy consumption has on average fallen from around 9W in 2005 to 6W in 2009. Thus, energy consumption was approaching the 5W Tier-1 on mode requirements to come into force in February 2010 but additional improvements were needed. For SSTB with a personal video recorder, energy consumption has on average fallen from around 19W to 13W in 2009. For this type of SSTB, the maximum energy consumption in on mode will be 11W (5 W plus an additional 6 W allowed for hard disk) from 2012.

Furthermore, standby power from SSTBs has decreased and due to the 1 and 0.5 watt standby power consumption target formulated in the Ecodesign Directive for SSTBs, the projected consumption will remain low.

It should be noted that the standard set by the European legislation is expected to act as the de facto standard for the Australian and New Zealand voluntary code of conduct for the performance of set top box providers. The major carriers of pay television services have made explicit reference to the European standards, which are estimated to deliver energy savings of 1.124 TWh, avoid the emission of 948 Kt of CO2 emissions, and save households AUSD 168 million in lower energy bills.[70]

Conclusions

The Ecodesign options available for policy makers in the case of SSTBs were very limited due to the specificity of the market for SSTBs which is expected to peak between 2012 and 2016. Thus, a quick introduction of requirements was considered an important priority in order to avoid individual, non-harmonized action by individual Member States. From that perspective, the Implementing Measure can be considered a success.

Beyond that, the limited data available on market developments do not allow for any conclusions concerning the extent that the requirements have been met. There is some evidence of reductions on energy consumption but they are not adequate to support solid conclusions at this stage.

[69] http://efficient-products.defra.gov.uk/spm/download/document/id/825
[70] http://www.energyrating.gov.au/library/pubs/201103-achievements.pdf

6. Domestic lighting (general lighting equipment)

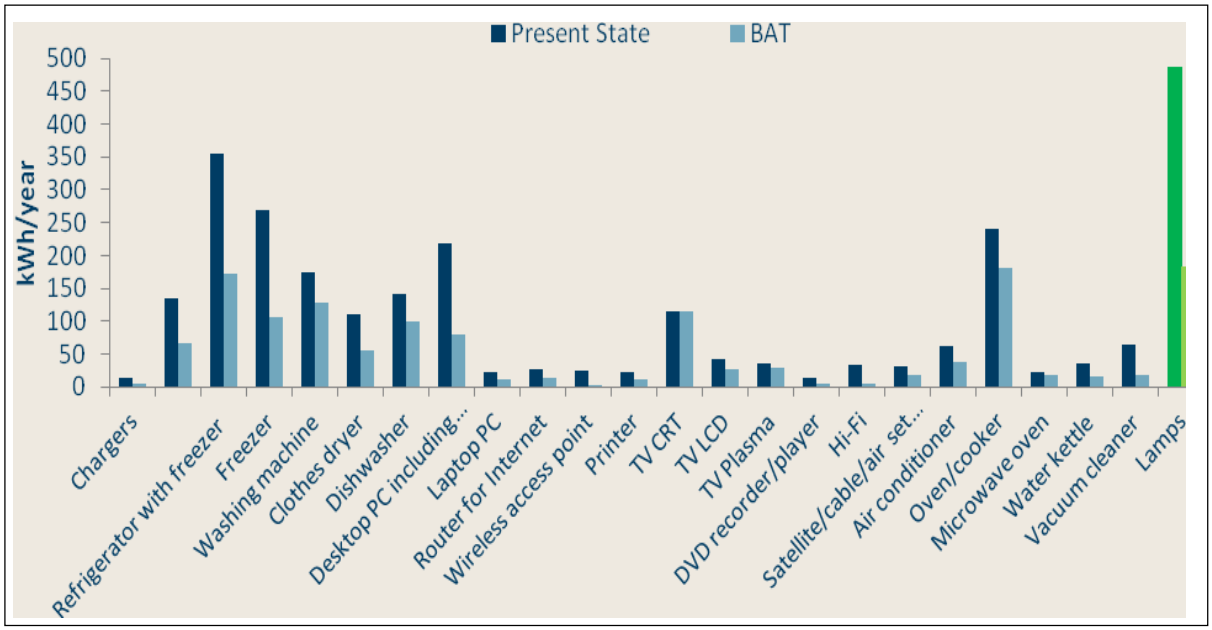
Introduction

In 2007 lighting represented 10.5 % of residential electricity consumption in EU-27. It is the 3rd main electricity consumer after heating and cold appliances.[71]

Domestic lighting includes mainly traditional incandescent lamps (GLS), halogen lamps and compact fluorescent lamps. In 2007 incandescent lamps represented around 50% of residential lighting consumption and halogen lamps around 30%.[71] Compact Fluorescent Lamps (CFLs) represent one of the most efficient solutions available for improving energy efficiency in residential lighting. The CFLs stock in the residential sector was already growing before the Ecodesign requirements came into force due to decreasing prices, improved quality and information and promotion campaigns. Thus, there was a 340 % increase in the consumption of CFLs from 2003 to 2007. Despite improved quality, CFLs do not always provide the same lighting quality and functionality as GLS or halogen lamps.

In many instances however, the energy consumption in non-directional lamps can be reduced while providing the same functionality and reducing the life-cycle costs for the end-user[72]. The electricity savings potential for lighting in a typical European household is significant in both absolute terms and in comparison to other product groups. Besides energy consumption and emission of CO_2, another issue related to lighting is the emission of mercury. Mercury poses a risk to the consumer and the environment. Compact fluorescent lamps (CFLs) contain mercury while incandescent lamps do not. However, the use of the inefficient incandescent lamps indirectly results in the release of mercury as a byproduct of the burning of coal for the production of electricity. Thus, it is estimated that the banning of incandescent lamps can lead to a reduction of nearly 75% of the mercury currently emitted by 2020 in comparison to the business-as-usual scenario.

Chart 3.16 - Comparison of current regulations versus best available technology



Source: ECEEE 2009 Summer Study

[71] Hirl, JRC, presentation at EEDAL conference.
[72] Impact assessment

Timeline

Domestic lighting was considered for eco-design measures in the 2005 Ecodesign Directive. The preparatory study was initiated in July 2007 and published in October 2009. The first proposal for domestic lighting regulation was discussed in 2008 at the consultation forum and the measure was adopted in March 2009.

Table 3.17 - Timeline for developing the Implementing Measure

Preparatory Study		First proposal for regulation discussed at Consultation Forum	Impact assessment published	Implementing measure adopted
First stakeholder meeting	Study published			
July 2007	October 2009	March 2008	18/3/2009	18/3/2009

Source: ECEEE and European Commission DG Energy

The requirements are being introduced in six stages from 2009 to 2016. The stages are summarized in the table below which illustrates how the less efficient lamps are gradually phased out. The grey cells indicate that the technology in question is still available at the given time while white cells indicate that the technology has been phased out according to the provisions given in the "Requirement" column.

Table 3.18 - Detailed plan for phasing out less efficient lamps as a consequence of Ecodesign requirements

	Non-clear lamps				Clear lamps							
Date	Requi-rement	Incan-descent	All Hallogen	CFL / LED	Requi-rement	Incandescent/conventional halogen				Halo-gen C	Halo-gen B	LED [1]
						≥100W	≥75W	≥60W	<60W			
Sept. 2009 [1]	A[2]				C for≥100W[3]		≥ E[3]	≥ E[3]	≥ E[3]			
Sept. 2010	A[2]				C for≥75W[3]			≥ E[3]	≥ E[3]			
Sept. 2011	A[2]				C for≥60W[3]				≥ E[3]			
Sept. 2012	A[2]				C for all							
Sept. 2013	Second level of functionality requirements [1]											
Review 2014	Review											
Sept. 2016	A[2]				B / C [4]					[4]		

Source: http://europa.eu/rapid/pressReleasesAction.do?reference=MEMO/09/113 ;
Notes: 1 - First level of functionality requirements introduced. LEDs are exempted from all functionality requirements. 2 - Refers to lamp energy label class. Correction factors apply to certain lamps, allowing them to be B-class. 3 - Minimum requirement for all lamps: E class. F and G lamps phased out. 4 - Only special cap halogen lamps are allowed to be class C.

Mandatory Labelling of light bulbs has existed in the EU since 1 July 1999 (with exclusions until 31 December 2000) requiring lighting products within the EU to carry compulsory energy A-G labels.

Baseline

The requirements set out in the Implementing Measure for domestic lighting sets a number of standards for maximum power use. As a result of these requirements inefficient lamps (incandescent bulbs and conventional halogen bulbs) have started being phased out since September 2009.

In the impact assessment it is estimated that the total energy consumption from 4.3 billion lighting points equipped with incandescent lamps, halogens or CFLs account for 112TWh in the EU at an annual cost of €15.3 billion in 2005. The impact assessment estimated the energy consumption from domestic lighting to increase to 135TWh by 2020 on the assumption that the number of lamps in the domestic sector is expected to increase by 20% due to economic growth. By phasing out current high energy consuming lamp types and increasing the use of more effective alternatives, the impact assessment suggests that the energy consumption could be reduced from 135TWh in 2007to 48 TWh in 2020 and lead to annual energy savings of 87 TWh and accumulated energy savings of 399 TWh until 2020. As an indirect consequence of this effect mercury emissions will also be reduced by 2.3 tons.

Table 3.19 - Domestic lighting - 2007 baseline and projected impact until 2020

	2007	2010			2020			
	Baseline	**BAU**	**Policy**	**Annual savings**	**BAU**	**Policy**	**Annual savings**	**Accumulated savings**
Number of products (mln.)	Several hundred							
Energy Consumption (TWh)	112	112	112	0	135	48	87	339
Electricity Costs (bln. €)	15.3							54
CO_2 emissions (Mt)	45							160
Mercury emissions (Mt)	2,9						2,3	

Source: Impact assessment, European commission

One of the main effects of the requirements introduced by the Regulation is the reduction in the life cycle costs for consumers. The purchasing costs of the equipment are expected to rise. However, this rise in costs is not estimated to have serious implications on households' consumption patterns as the prices will still be relatively low and are expected to decrease further over time[73]. More importantly, the costs are expected to be more than offset by the savings in operating costs.[74] [75]

[73] Impact Assessment, Incandescent bulbs cost 60 cent whereas the price for new alternatives will be in the areas between € 2-10, and expected to lower over time

[74] Impact assessment pg. 39

[75] Due to the ineffectiveness of incandescent lamps they generate a certain amount of heating that will contribute to heating buildings in the winter. Changing to more efficient alternatives will reduce this heat and extra heating may have to be generated from other heating sources. At the same time, inefficient lamps increase the need for cooling and air-conditioning in the summer. These additional effects should be considered when calculating exact costs and CO_2 emissions.

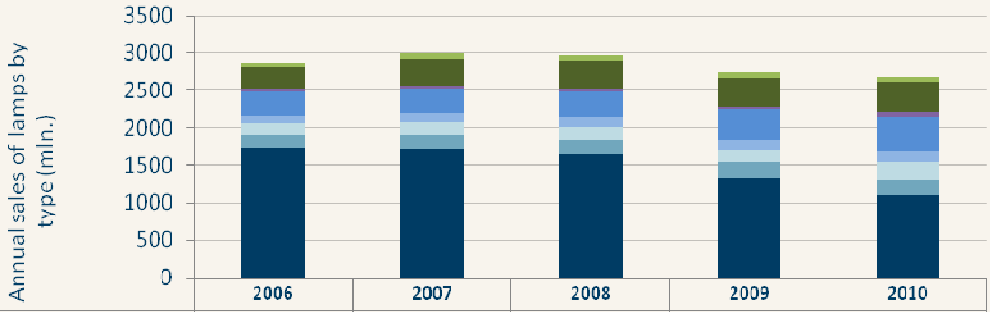
There are however indications that the shift to more efficient lamps was slow before the Ecodesign requirements came into force. A study by REMODECE in 200876 suggested that 40% of consumers never or rarely choose energy efficient CFLs when replacing non-functional lamps. The main reason stated was the high purchasing price of the energy efficient CFLs. At this stage, the cost ratio between inefficient and efficient light sources is around 1/10 (€0.5 compared to €4.5-5.77) However, there are already indications that the price of CFLs is decreasing. According to an Italian study, the average price in 2009 of CFLs was €4.94 which decreased to €4.72 in 2010 and €4.35 in 2011, a 12% drop in price over 3 years. If this trend continues, the price of CFLs could be around half of the 2009 price by 2017-2018.

Effects of the Directive

According to an analysis carried out by "4E Mapping and Benchmarking" there is evidence that the regulatory framework intended to remove less efficient lamps from the market has proven to be successful. It has been found that the average efficiency of lamps put on the market rose by up to 50% in the period from 2008 to 2010[78].

At the European level, the share of incandescent lamp sales was reduced from 66% in 2008 to 52% in 2010, a greater decline than the two preceding years (4%). The incandescent sales have gradually been replaced by CFL and halogen sales. The analysis concluded that there are indications of a positive market effect from the Directive in relation to the withdrawal of incandescent lamps leading to an improved average efficiency of lamps sold.

Chart 3.17 – Annual sales of lamps by type – EU 2006-2010



	2006	2007	2008	2009	2010
Dedicated LED Lamps					
Retrofit LED Lamps					
MV* Linear Flourescent Tubes (T12)	62	75	78	83	81
MV* Linear Flourescent Tubes (T8)	289	353	367	387	398
MV* Linear Flourescent Tubes (T5)	35	42	44	46	59
MV* Self-Ballasted CFLs	317	330	343	391	464
MV* Pin Based CFLs	109	120	125	131	143
Low Voltage (12V) Halogens	144	157	167	183	230
MV* Halgogens (double ended)					
MV* Halgogens (single ended)	170	185	196	215	204
MV* Incandescents	1747	1731	1649	1319	1108

Source: 4E mapping project.

[76] http://www.isr.uc.pt/~remodece/downloads/REMODECE_PublishableReport_Nov2008_FINAL.pdf

[77] According to data submitted by the Federation of National Manufacturers Associations for Luminaires and Electrotechnical Components for Luminaires in the European Union (CELMA).

[78] It is assumed that all products placed on the market are complying with the implementing measure. Market surveillance is addressed further in section 3.4.

Data for the annual sales of lamps for the UK illustrates the long term market development better than data for the entire EU. From 1998 to 2007 there was only a slow annual fall in the sales of incandescent light bulbs but this accelerated from 2007 onwards. The share of all UK lamp sales that were incandescent fell from 65% in 2008 to 20% in 2010. The fact that the change started to happen already from 2007 to 2008 is most likely due to a voluntary agreement between the UK Government and major UK retailers to incrementally remove inefficient lighting (the majority of incandescent lamps) between 2007 and 2010[79]. Interviews with stakeholders from industry has confirmed that there was still significant demand for the non-clear and clear 100-60W incandescent light bulbs in the EU up until the requirements came into force and that a significant market change therefore happened around the time of the requirements coming into force.

It should be noted that in Austria a consumer backlash resulted in a doubling of incandescent lamp sales in the year prior to regulations taking effect.[80] Such market reactions should be expected to postpone but not reduce the ultimate impact of the Directive since replacement lamps will enter the installed stock at a later date. [81] However, this was not a general phenomenon. In the UK a survey by the UK Lighting Industry Federation and Lighting Association showed that stockpiling of incandescent lamps had not taken place. They surveyed 1000 homes in November 2010 and identified the number, wattage and type of lamps in each home. The survey showed that the number of spare tungsten light bulbs kept in homes had halved in 2010 compared to 2007, indicating that householders had not kept stockpiles of phased out lamps. The number of spare CFLs and halogen retrofit lamps increased sharply over the same period.[82]

The switch away from traditional incandescent lamps in the EU has increased demand for energy efficient halogen lamps which in many ways is the closest alternative to incandescent light bulbs but not as efficient as CFLs lamps (energy savings are 10-30% if incandescent light bulbs are replaced with halogen technologies and around 80% with compact fluorescent lamps and LED). A larger than expected switch to halogens lamp will therefore reduce the effect of a switch away from incandescent lamps. However, in the preparatory study a fast increase in the use of of halogen lamps was anticipated and halogen lamps were expected to reach approximately 400 lamps sold in 2010.[83] Data from the 4E benchmarking project estimate sales in 2010 to be 434 million. Thus around 8% higher than expected. The major shift has been to CFLs which has seen annual sales rise with approximately 65% from 2006 – 2010.

In terms of LED penetration, global data for the residential sector show that LED market share was estimated at around 6% in 2010. As its current price is far higher than that of other technologies, current LED market share is limited in this very price-sensitive segment compared to for example architectural lighting. However, LED lighting is expected to take off in the coming years, which is expected to result in a market share of 70% for 2020.[84] The ban of incandescent light bulbs is mentioned as the prime reason for the growth of LED. Since the sharp growth in market share was not expected in the preparatory study and LED is even more energy efficient than CFLs this development, if realized, will improve energy efficiency even further than forecasted.

The experience in other countries[85] suggests that the use of regulatory tools to remove less efficient lamps from the market have generally been successful and Korea and Australia, who have implemented the

[79] http://mappingandbenchmarking.iea-4e.org/shared_files/187/download
[80] 4E Mapping and Benchmarking: http://mappingandbenchmarking.iea-4e.org/matrix
[81] http://mappingandbenchmarking.iea-4e.org/matrix
[82] http://www.lif.co.uk/ and http://www.lightingassociation.com/contact-us/
[83] http://www.eup4light.net/assets/pdffiles/Final_part1_2/EuP_Domestic_Project_report_V10.pdf
[84] http://img.ledsmagazine.com/pdf/LightingtheWay.pdf
[85] http://mappingandbenchmarking.iea-4e.org/shared_files/190/download

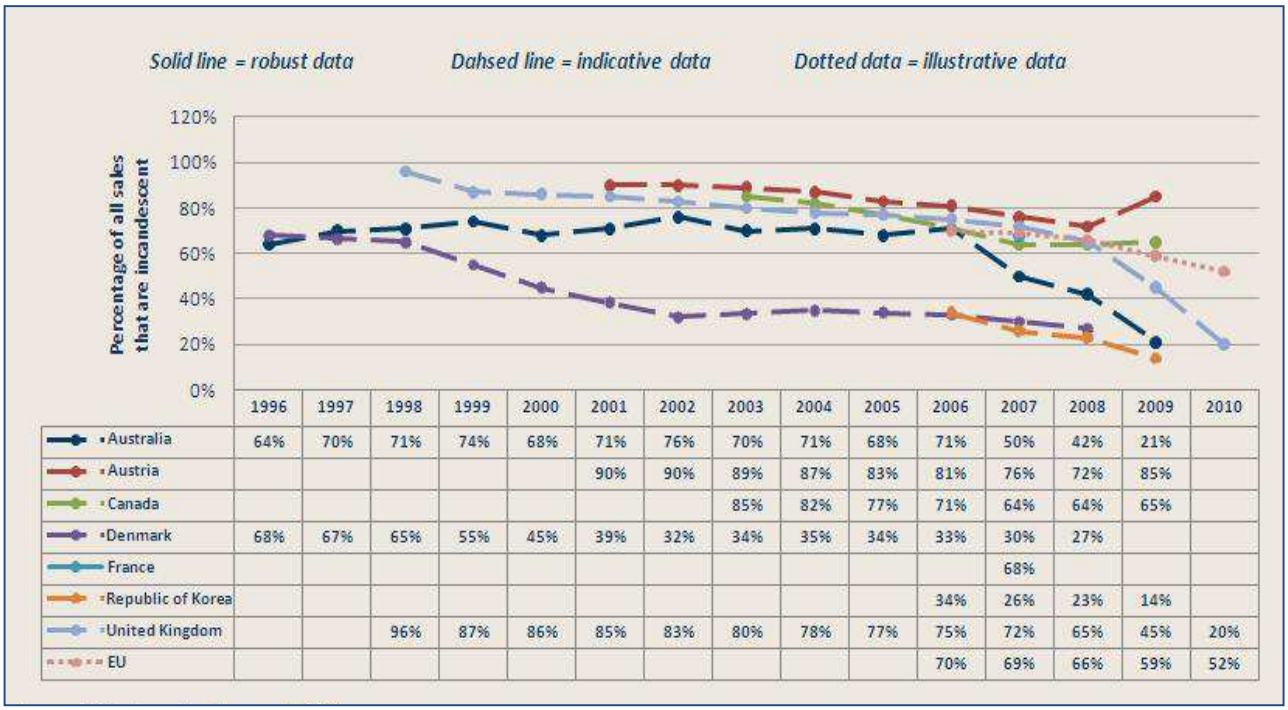
strictest regulation earliest, have seen the most significant increase in efficiency.[86] In Australia and South Korea, the average efficiency of new lamps rose by up to 50% in 3 years and in 2009incandescent lamps had a lower market share than the EU. Data for the EU are only indicative, however, and not as robust as for Australia and Korea.

The performance of the Republic of Korea in managing its lighting market has been remarkable. For South Korea the development has partly been driven by promotional schemes and subsidies but the country is also the first country to have imposed efficiency performance requirements on incandescent lamps (since 2003) and in December 2008 the South Korean government decided to phase out incandescent lamps (except for special purposes) by the end of 2013. Also, requirements are revised on a regular basis. Thus, the experience from South Korea indicates that regular and well signposted regulatory revision of the lighting market is highly successful.

Australia started phasing out inefficient lamps already in November 2008 and the requirements will be fully in force in 2012. The introduction of the requirements had a significant effect. In 2009 21% of the lamps sold were incandescent, down from 71% in 2006.

Compared with the overall data from the EU, this is a much faster change in the level of sales and this is in line with the earlier observation of a significant demand for incandescent lamps up to 2010.[87]

Chart 3.18 - Market share of domestic lamp sales that are incandescent in different countries



	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Australia	64%	70%	71%	74%	68%	71%	76%	70%	71%	68%	71%	50%	42%	21%	
Austria						90%	90%	89%	87%	83%	81%	76%	72%	85%	
Canada								85%	82%	77%	71%	64%	64%	65%	
Denmark	68%	67%	65%	55%	45%	39%	32%	34%	35%	34%	33%	30%	27%		
France												68%			
Republic of Korea											34%	26%	23%	14%	
United Kingdom			96%	87%	86%	85%	83%	80%	78%	77%	75%	72%	65%	45%	20%
EU											70%	69%	66%	59%	52%

Source: 4E Benchmarking Document,2010

Even though Europe currently seems to lag behind Korea and Australia, it is possible that Europe could catch up in the coming years since it has established the fastest roadmap for banning incandescent light bulbs.[88] The Ecodesign Requirements have also influenced energy efficiency outside the EU. At the time of

[86] http://mappingandbenchmarking.iea-4e.org/shared_files/193/download
[87] http://www.iea.org/papers/2010/phase_out.pdf
[88] http://img.ledsmagazine.com/pdf/LightingtheWay.pdf

writing, 46 countries have adopted legislation to improve energy efficiency of lighting. A number of these countries have been inspired by the Ecodesign Requirements.[89]

Data also suggests that a significant delay in the date that regulations come into force after the initial announcement can result in a market effect at odds with the intention of the policy action when the cost of the product is low and its size is small (it is difficult to imagine consumers stockpiling higher value larger goods such as washing machines or TVs in the same way). Another possible result is that the longer lifecycles of more efficient lighting will lead to a fall of the sales for lamps upon implementation of new measures. The evidence from the UK leads to an estimated 75% reduction in the sales of lamps.

From a different perspective, the Coolproducts for a Cool Planet study commissioned by environmental NGOs concludes that the Ecodesign measures on clear lamps for 2012 are not set at the most cost effective level. [90] According to the study, a typical household[91] equipped mostly with products that conform to the 2012 standards will consume as much as 285 kWh/year. While this is better than the standard case by 25% it is still far from the most cost-effective option which would be 185kWh/year[92]. Thus the energy savings expected to be achieved are less than the potential ones under the the most cost-effective scenario . However, the cost-effective scenario used as a benchmark in the study does not take into consideration other criteria used in the development of the Implementing Measures such as the costs for industry or specific consumer interests.

As far as the issue of mercury emissions is concerned, the ban of incandescent lamps is expected to have a beneficial effect on mercury emissions due to reduced energy consumption from lighting. However, no data have been made available to allow for an estimate of the effect on mercury emissions to this point.

Conclusions

The requirements for domestic lighting are taking effect in six stages running from 2009 to 2016. At the time of writing, only the first and second phases have been completed. The available data from the EU and a few Member States indicate that the phasing out of incandescent lamps has, along with subsidies and relevant EU-wide awareness campaigns, accelerated the movement to more energy efficient light bulbs that was happening only slowly through the use of energy labelling, marketing, and educational campaigns that took place before the requirements came into force.

However, in contrast to other appliances, where market transformation happened gradually, in the case of lights bulbs the consumers were still buying incandescent light bulbs up until the point that they were removed from the market. Market transformation happened rapidly after the requirements came into force.

Evidence from Australia and Korea, where stricter requirements were introduced earlier than in the EU, provides substantive evidence to suggest that regulatory frameworks to remove less efficient lamps from the market are proving successful. Thus, the EU can expect an increased effect in the coming years as more requirements come into force. Despite a switch to halogens which seems slightly stronger than expected there are currently no major indications that the policy targets will not be met.

[89] According to information obtained from interview with Philips.
[90] http://www.coolproducts.eu/resources/documents/EnergySaving-in-Practice.pdf
[91] In the case of domestic lighting the typical household was assumed to have 21 lighting points.
[92] The most cost-effective case is, according to the study, a house with 21 top efficient compact fluorescent lamps of various types.

7. Tertiary Lighting

Introduction

'Tertiary sector lighting' is the common term used for the following product groups addressed by the requirements in the Implementing Measure:

- Fluorescent lighting products,
- High intensity discharge lighting products,
- Public street lighting products,
- Office lighting products[93]

Two separate preparatory studies covering "public street lighting products" and "office lighting products" were carried out. After completion of the studies it was decided to integrate the work on public street lighting and high-intensity discharge lighting products and on fluorescent and office lighting products into a single piece of Regulation on "tertiary" sector lighting products.

The final electricity consumption in the tertiary sector of the EU-27 rose by 75.5% over the period from 1990 to 2007. In 2007, office lightening was the largest electricity consumer in the tertiary sector with an estimated electricity end-use of 164 TWh. Although the electricity consumption of a single product is usually small, the large quantity of lighting products in the tertiary sector leads to significant overall electricity consumption. Office lighting accounted for more than 40% of the total electricity used in non-residential buildings corresponding to 21.6% of the overall tertiary sector electricity consumption. According to the preparatory study street lighting represents 4.7% of the overall tertiary sector consumption, around 36 TWh/year. [94]

In 2009, The European GreenLight Programme stated that proven technology, products and services could reduce the lighting energy use by 30-50%, earning internal rates of return above 20%.[95] Correspondingly, the preparatory study concluded that existing technical solutions provided great improvement potential with respect to:

- Reducing the electricity consumption in tertiary sector lighting products, compared to the market average, while providing the same functionality;
- Reducing the lifecycle cost for the end users.

Several market barriers have hindered the achievement of the cost-effective potential of energy efficient lighting. Energy efficient lighting is usually higher in purchase price but lower in the overall lifecycle cost. Due to budgeting concerns, consumers of tertiary lighting are often more concerned by the purchase of tertiary lighting than the overall running cost over the product's lifecycle.[96] On the other hand there is an increasing role of architect and lighting designers and other experts in the selection of lighting in office and

[93] http://ec.europa.eu/energy/efficiency/ecodesign/doc/legislation/sec_2009_324_impact_assesment_en.pdf. The exact definition is that tertiary lighting refers to fluorescent lamps without integrated ballast, high intensity discharge lamps, and ballasts and luminaires able to operate such lamps.
[94] Bertoldi, Paolo & Atanasiu, Bogdan 2009: Electricity Consumption and Efficiency Trends in European Union, Joint Research Centre Institute for Energy, European Commission, EUR 24005 EN
[95] The European GreenLight Programme Catalog 2005-2009.
[96] Industrial/commercial buildings are generally built by construction companies with the sole purpose to be lent or sold, i.e. the costs for operating the building, including the electricity costs for lighting, are not paid by the investor. Thus, there are classical principal-agents problems that hinder an energy-efficient market.

public spaces. Light quality considerations play a role and halogen lamps are in many cases considered preferable in Europe due to the warm light they produce[97].

Timeline

Requirements for tertiary lighting were considered for Ecodesign measures in the 2005 Ecodesign Directive. The preparatory study was published in October 2007 and the first proposal for regulation of tertiary lighting was discussed at the consultation forum in October 2007. The European Commission adopted the Regulations EC No. 245/2009 for tertiary lighting products on 18 March 2009.

Table 3.20 - Timeline for setting eco-design requirements

Preparatory Study		First proposal for regulation discussed at Consultation Forum	Impact assessment published	Implementing measure adopted
First stakeholder meeting	Study published			
April 2006	July 2007	June and December 2007	18/3/2009	18/3/2009

Source: ECEEE and European Commission DG Energy

The requirements for the energy efficiency of tertiary lightning are being introduced in three stages - 1, 3 and 8 years after the adoption of the Implementing Measure in March 2009. There are also two additional intermediate stages, 18 months and 6 years after the requirements were entered into force. The requirements do not ban particular technologies but the limits set are expected to lead to certain types of lamps being phased out. Thus T8 halo-phosphate lamps were essentially phased out from 2010 and linear T12 and T10 halo-phosphate lamps will be phased out from 2012. The exact requirements are multifaceted and therefore difficult to summarise, but the main consequences of the requirements are listed below.

Table 3.21 - Tertiary lighting: Implementing Measure requirements

Date	Target
April 2010	T8 linear, U shaped and T9 circular halo-phosphate lamps as well as T4 linear lamps are no longer to be put on the EU 27 market.
October 2010 (intermediate stage)	Technical information must be provided on websites and in documentation for luminaires > 2,000 lm.
April 2012	Phase-out of the T12 and T10 type halophosphate lamps. New luminaires must be compatible with ballast complying with the third stage ballasts (with a few exceptions). Phase out of the least efficient high-pressure sodium lamps and metal halide lamps.
April 2015 (intermediate stage)	High Pressure Mercury Lamps and High Pressure Sodium-Plug-in/Retrofit lamps are no longer to be put on the EU 27 market
April 2017	Phase out of Metal Halide lamps, not meeting minimum requirements ≤ 405 W All fluorescent lamps must be designed to work with an electronic ballast. Low performing MH E27/E40/PGZ12 lamps and CFLs with 2 pin caps and integral starter not to be put on market. Magnetic ballasts will most likely not be able to meet the requirements and will be phased out.

Source: European Commission and CELMA

The first stages mainly address office lighting (where linear fluorescent lights dominate) and the second and third stages mainly address street lighting (mainly high intensity discharge lamps (HID) such as mercury vapour, metal halide, high-pressure sodium, and low-pressure sodium lamps). For street lighting, a long

[97] http://img.ledsmagazine.com/pdf/LightingtheWay.pdf

transition phase was deemed necessary because most street lighting is owned by the public sector which due to budget constrains often cannot pay high upfront costs even though total life cycle costs might be lower than for alternatives with lower upfront costs but larger total life cycle costs. The transition period should allow owners of street light to adjust their budgets.

Baseline

The Ecodesign Implementing Measure imposes minimum requirements on lamps, ballasts and luminaires, resulting in minimum efficiency and quality requirements on the relevant lighting products. The annual electricity consumption relating to tertiary lighting in the EU has been estimated to have been 200 TWh in 2005 corresponding to emissions of 79,9Mt of CO2[98]. The baseline for the study as set out in the preparatory study is summarised below.

According to the preparatory study, the quantity of lighting in the tertiary sector was expected to grow by 4.0% per annum due to infrastructure developments and a greater demand for lighting in existing infrastructures. Based on these estimates the impact assessment estimated that the Ecodesign Directive will lead to electricity savings of around 38 TWh/year. These savings correspond to € 5.2 billion[99] and 15.3 Mt CO_2 emissions and accumulated savings of 193 TWh and 77.3 Mt of CO_2 by 2020.

Table 3.22 -Tertiary lighting - 2005 baseline and projected impact until 2020

	2005	2010			2020			
	Baseline	BAU	Policy	Annual savings	BAU	Policy	Annual savings	Accumulated savings
Number of products (bln.)	1.6				2,3			
Energy Consumption (TWh)	200				260.3	217.9	38.1	193
Electricity Costs (bln. €)	27.2						5,2	26
CO_2 emissions (Mt)	79.9						15,3	77,3
Mercury Content (tns)	12,6				18,6	4,6	14	

Source: Impact Assessment, European Commission

Mercury content of lamps is another significant environmental aspect to consider. In 2005, the total mercury content of the lamps installed in the tertiary sector lighting amounted to approximately 12.6 tons. It is estimated that the Regulation will reduce the mercury content of lamps emitted in the air by 14 tons resulting in a total mercury content of 4.6 tons compared to a business-as-usual scenario of 18.6 tons. In addition to the expected impact in Europe the Regulation is expected to have a positive environmental impact outside of Europe because approximately 20 % of EU production is exported[100].

[98] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:076:0017:0044:EN:PDF
[99] Average electricity price in 2005 in EU-25: 0.08 Cent/kWh for public street lighting, 13.6 Cent/kWh for other end uses. Because of this difference, the actual cost savings could be slightly lower in all sub-options.
[100] The effect is anticipated but since exports are not placed on the EU marked products do not need to comply with Ecodesign requirements and manufacturers could produce less efficient products for export.

Analysis of findings

As a result of the Ecodesign Directive it is estimated that about 1 billion lighting products will have been replaced by 2015, consisting of 100 million street lamps for street lighting and industry and 900 million neon lamps.[101]

Effects of the Directive

The preparatory study has data for different types of lamp up to 2004.[102] In 2004, linear fluorescent lamps (LFLs) represented a market share of 16% of the total lamp sales and compact fluorescent lamps (CFLs) 6%.

A report prior to the introduction of the Implementing Measure[103] (2008) identified a huge savings potential by utilising available technologies. The total energy consumption of street and road lighting was expected to be reduced by 60% when applying available technology. By replacing the luminaires only, between 40-50% in energy reductions were expected.

A recent market report by McKinsey and Company also points out that the global lighting market is currently undergoing radical change. A move towards greater efficiency for office and outdoor lighting is taking place and it is expected to accelerate in the coming years.[104]

For office lighting Linear Fluorescent Lamps (LFL) currently has a large share of the global market (76%). Only in high-end office buildings are warmer light sources the dominant technology. Compact LFL make up 26 % and LEDs only around 2%.

Table 3.23 – Current and estimated future market share by lamp type for the office lighting market (% of total)

Incandescent		Halogen		HID[105]		Linear Fluorescent		Compact Fluorescent		LED	
2010	2020	2010	2020	2010	2020	2010	2020	2010	2020	2010	2020
1	0	3	1	2	1	76	41	15	4	2	52

Source: McKinsey Global Lighting Market Model; McKinsey Global Lighting Professionals & Consumer Survey.

LFL is forecasted to maintain a high market share by 2020 though it is expected to drop to 41 %. LED which today only has a 2% market share is expected to become the market leader with 52 % of the market. This is despite the fact that LED faces often principal-agent conflicts because the decision makers are generally not the beneficiaries of LED's low energy consumption.

At the time of writing the preparatory study, LFL and CFL lamps were also the dominant technologies. However it is not possible to compare the 2010 data to the 2005 baseline because the data presented here are global and because the preparatory study does not have exact data for office lighting but uses general data for the general lighting marked as basis for making predictions.

The dominant type of LFC is the T5 which is highly energy efficient and which has gained market shares the past 10 years and today accounts for approximately 70% of new installations in Western Europe.[106] It has not been possible to find detailed data which shows the switch away from inefficient office lighting phased out from 2010 and towards more energy efficient LFCs and LEDS. However, interviews have confirmed that this has taken place and that the Ecodesign requirements have contributed to improving energy efficiency

[101] http://www.ekobaseglobal.com/index.php?option=com_content&view=article&id=57
[102] Tertiary lighting products preparatory study: http://www.eup4light.net/assets/pdffiles/Final/VITOEuPOfficeLightingFinal.pdf
[103] http://www.e-streetlight.com/Documents/Homepage/0_3%20Guide_For%20EE%20Street%20Lighting.pdf
[104] http://img.ledsmagazine.com/pdf/LightingtheWay.pdf
[105] HID mainly consists of mercury vapor, metal halide, high-pressure sodium, and low-pressure sodium lamps.
[106] http://www.lighting.philips.co.uk/subsites/oem/lightspec/LightSpec_issue_3.pdf

by phasing out inefficient lighting which would otherwise have stayed on the market. Also, studies have found that the old halophosphate fluorescent lamps sales were still considerable before being phased out.[107]

The current major light sources in the outdoor segment are metal halide (HID) and fluorescent lamps. HID is mainly used for wide-area lighting and fluorescent for narrow-area lighting. The major technology shifts in outdoor lighting are away from HID and towards LED lighting (70 % market share expected in 2020).

Table 3.24 – Current and estimated future market share by lamp type – outdoor lighting

Incandescent		Halogen		Metal Halide		Linear Fluorescent		Compact Fluorescent		LED	
2010	2020	2010	2020	2010	2020	2010	2020	2010	2020	2010	2020
0	0	0	0	81	27	15	4	0	0	5	70

Source: McKinsey Global Lighting Market Model; McKinsey Global Lighting Professionals & Consumer Survey

Current LED market share in outdoor lighting is estimated at around 5%. It is expected to be close to 40% in 2016, rising to around 70% in 2020. Until recently, LED lighting was rarely used in street lighting because of the high price but technology is advancing while the prices are decreasing. Government initiatives are key to the adoption of more energy efficient lighting since governments are the chief owners of most outdoor lighting and are therefore the prime decision makers on LED installations. Like for office lighting it is not possible to compare the obtained data to the 2005 baseline presented in the preparatory study.

Interviews have confirmed that a shift towards more energy efficient street lighting is happening. Since street lighting is owned by professionals and not private consumers, the capacity to calculate life cycle costs is much larger. In addition, the life cycle cost plays a much larger role in making purchasing decisions than for private consumers, as the total costs of street lighting is often very large. Therefore, a switch towards more efficient street lighting also started 5 years earlier than for the private consumer market.

Since the main requirements for street lighting will not come into effect until 2015 and 2017, the current change is mainly driven by lower life cycle costs. However, since budget adjustments to meet the 2015 and 2017 requirements are made gradually, change is already happening in order to be able to meet the requirements. It has not been possible to find data for 2005-2010 which shows the move towards more energy efficient street lighting but it has been confirmed by anecdotal evidence from interviews with industry stakeholders.

It has not been possible to find data to evaluate if the predicted reduction of mercury has been reached.

Conclusions

The Ecodesign requirements within the tertiary lighting market only started coming into force in April 2010 and will not be fully implemented until 2017. For office lighting the main requirements have taken effect but for street lighting the main requirements do not come into force until 2015.

Energy efficiency of tertiary lighting has clearly improved since 2005 but part of the improvement would have happened in the absence of Ecodesign requirements. In contrast to private consumers, owners of tertiary lighting pay greater attention and have greater capacity to estimate life cycle costs. Thus, they are more willing to pay the extra upfront cost if life cycle costs are lower and are quicker to adopt new cost-effective types of lighting.

[107] Bertoldi and Atanasiu, 2011, An In-Depth Analysis of the Electricity End-Use Consumption and Energy Efficiency Trends in the Tertiary Sector of the European Union.

But the Ecodesign requirements have also contributed to improving energy efficiency. Incandescent, linear fluorescent and inefficient high intensity discharge lamps are being phased out more quickly than they otherwise would be. In their place, more energy efficient lighting is gaining market share – including LED – and this drives improvements in energy efficiency.

8. External power supplies

Introduction

External power supplies (EPS) is a cross-cutting issue, covering many product groups characterised by rapid market evolution. The preparatory study under lot 7 also covered battery chargers (BCs) but the consultants concluded that the potential for improving the environmental impact of BCs is minor and as a result they were left out of the Implementing Measure. The conclusion was that the possible measures for improving the use phase energy consumption of BCs are not cost-effective and that their contribution to reductions of energy consumption over the life cycle is less than 5%.

There are several environmental concerns connected to EPS. The first is the active average efficiency of EPS in the use-phase. The second is the electricity waste due to conversion losses and no-load power consumption. A third is the electronic scrap and associated pollution generated by the multiplication of non-standardised EPS and battery charges. The impact assessment report showed significant cost effective improvement potential of the electricity consumption of EPS related both to the no-load electricity consumption and the use electricity consumption. The preparatory study concluded that the improvement potential was possible on the basis of existing technical solutions that could reduce the overall environmental impact of EPS, while providing the same functionality and reducing the life cycle cost. However, cost effective improvement potentials of EPS are often not realized due to market barriers. The market barriers are primary related to the fact that EPS are an accessory usually sold together with the primary load product. The impact assessment report identified three primary factors that lead to market barriers: Cost increments, lack of awareness, and un-harmonised EPS connectors.

The electronic market is very sensitive and even small additional costs can affect the competitive positions of the market actors. Moreover, consumers are often not aware of the electricity consumption of EPS and usually focus on the primary load product and not the EPS. This results in a lack of incentives for the manufacturers of the primary load products to demand for their products. Furthermore, the non-harmonised EPS connectors lead to a very short lifetime of EPS.

Timeline

Battery chargers and external power supplies were identified for eco-design measures in the 2005 Ecodesign Directive. The preparatory study was initiated in 2006 and published in January 2007. In February 2008 the first proposal was discussed at the consultation forum and the measure was implemented in April 2009.

Table 3.25 - Timeline for setting eco-design requirements for external power supplies

Preparatory Study		First proposal for regulation discussed at Consultation Forum	Impact assessment published	Implementing measure adopted
First stakeholder meeting	Study published			
March 2006	January 2007	February 2008	6/4/2009	6/4/2009

Source: ECEEE and European Commission DG Energy

The Ecodesign requirements came into force in two stages, one year (10/2009) and two years (10/2010) after entry into force of the Regulation. The schedule is shown in the table below. The two stages are harmonised with the EU Code of Conduct for power supplies and the current US Energy Star requirements.

Table 3.26 - External power supplies specific requirements

Date	Target
After one year (October 2009)	The no-load condition power consumption shall not exceed 0.50 W. The average active efficiency shall be not less than: • 0,500 · PO, for PO < 1,0 W • 0,090 · ln (PO) + 0,500, for 1,0 W ≤ PO ≤ 51,0 W • 0,850, for PO > 51,0 W
After two years (October 2010)	The no-load condition power consumption shall not exceed the following limits: • PO ≤ 51,0 W | 0,50 W | 0,30 W | 0,30 W • PO > 51,0 W | 0,50 W | 0,50 W | n/a The average active efficiency shall be not less than the following limits: • PO ≤ 1,0 W | 0,480 · PO + 0,140 | 0,497 · PO + 0,067 • 1,0 W < PO ≤ 51,0 W | 0,063 · ln(PO) + 0,622 | 0,075 · ln(PO) + 0,561 • PO > 51,0 W | 0,870 | 0,860

Source: Implementing Measure, European Commission

Several voluntary initiatives prior to the Ecodesign requirements address the no-load and active average efficiency issues. These include the Commission's Code of Conduct for EPS[108], the Energy Star programme[109] for office equipment and the Eco-label. However, according to the Impact Assessment, these programmes address only a limited subset of primary load products operated by EPS, and/or only a limited amount number of manufacturers take part in them[110]. A status report from the European Commission found that the European Code of Conduct would increase the electricity efficiency of EPS in the standby mode, if it was widely adopted. Starting from 2010 the Code of Conduct could reduce the standby consumption by 5 TWH/year[111].

Several Member States have raised awareness of the standby and off mode electricity consumption of primary load products operated by EPS. However, it is questionable whether awareness-raising is sufficient to solve the problems leading to the market failure. As already described, there are market barriers to a more widespread use of advanced EPS, such as low cost increments[112], lack of awareness and, non-harmonised EPS connectors. Furthermore, legislative initiatives at a Member State level will not ensure a fully harmonised European market. The Ecodesign Directive aims to at harmonise the legislative framework in the EU and set uniform and stringent requirements.

[108] Code of Conduct: http://www.phihong.com/assets/pdf/Code_of_Conduct__EPS_Ver4__March_09.pdf
[109] EnergyStar Requirements: http://www.energystar.gov/ia/partners/prod_development/revisions/downloads/eps_spec_v2.pdf
[110] Battery chargers and external power supplies Impact Assessment: http://ec.europa.eu/energy/efficiency/Ecodesign/doc/legislation/2009_fia.pdf
[111] Bertoldi, Paolo & Atanasiu, Bogdan 2009: Electricity Consumption and Efficiency Trends in European Union, Joint Research Centre Institute, European Commission, EUR 24005
[112] This cost increment is small in absolute terms (from EUR 3-20), but it can be a fairly high percentage premium, and even small cost factors can have a substantial impact on the net profit, in particular in the highly competitive markets for electronics products. The costs are distributed across many products and users, with the aggregate usage being significant.

Baseline

The Implementing Measure aims to improve the environmental impact of EPS by setting maximum levels for their no-load power consumption and average efficiency in the use-phase. The no-load power consumption of EPS accounts for a significant electricity waste since the EPS often remains connected to the main power source after the mobile primary load product is disconnected. The preparatory study showed that the Ecodesign requirements could be achieved with already available technology.

In 2005, the preparatory study estimated that the annual electricity consumption resulting from losses for power conversion and 'no-load use amounted to 17 TWh, corresponding to 6.8 Mt of annual CO2 emissions. In the absence of measures this consumption is predicted to increase to 31 TWh in 2020, with a corresponding increase in CO_2 emissions.

Table 3.27- External power supplies - 2005 baseline and projected impact until 2020

	2005	2009			2020			
	Baseline	BAU	Policy	Annual savings	BAU	Policy	Annual savings	Accumulated savings
Number of products (mln.)	2000							
Energy Consumption (TWh)	17	17,3	-	-	31	22	9	-
Electricity Costs (bln. €)	-						1	
CO_2 emissions (Mt)	6.8						3,6	

Source: Impact assessment, European Commission

The Regulation is expected to increase the market penetration of technologies that improve the lifecycle environmental impact of EPS, leading to estimated electricity savings of 9 TWh/year by 2020, respectively, compared to the situation without taking any measures. The electricity savings correspond to 3.6 million tons of CO_2 emissions. The saving potential is estimated taking into account the expected increase in annual sales. According to the Impact Assessment, the annual sales and the EPS in use in the EU are expected to almost double. This implies use phase electricity consumption cost savings of € 1 billion by 2020.

The primary environmental aspect is the electricity consumption of EPS in the use phase, i.e. the losses associated to with the conversion of mains power to power suitable for a particular primary load described by the "average active efficiency", the no-load power consumption and the production of electronic waste. Moreover, it is expected that the Regulation will have positive spill-over effects due to the lower material content/weight of technologies that reduce EPS electricity consumption in the use phase. The expected additional impacts of the Ecodesign Directive thus include a reduction of waste by approximately 180,000 tonnes per year.

Effects of the Directive

External power supplies are a cross-cutting issue, covering many product groups characterised by rapid market evolution. They are often complementary to other products that are introduced to the market. No updated data on the effect of the Directive are publicly available, mainly because of the cross- cutting nature of EPS and the recent application of the Directive.

Energy efficiency of EPSs can be achieved relatively easily by switching to better quality transformers. Lately, electronic switch-mode transformers have gained market share, which has contributed to improving

energy efficiency since there are both lower energy losses and lower production costs compared to traditional power supplies.[113]

The US introduced standards for EPS in 2007, which have been effective from July 2008. No more than half a watt in no load mode is allowed, which is the same as the Ecodesign requirements allow from 2009. In active mode efficiency requirements vary by output. Stricter standards will be effective from July 2013.[113] Canada is expected to adopt MEPS, harmonised with the US.

Australia started working on MEPS in 2004 which were introduced in December 2008. To meet MEPS, a power supply must meet or exceed the requirements for average efficiency, and meet or be lower than the no load thresholds.[113]

Conclusions

The Ecodesign requirements for external power supplies have recently entered into force but the impact of the Directive is currently not clear. Sufficient data have not been identified to highlight any changes in the energy efficiency of external power supplies before and after the Ecodesign requirements have entered into force. Other countries have established MEPS earlier than the EU and the Ecodesign requirements are at the same level as the requirements initially implemented in the US.

9. Electric motors 1–150 kW

Introduction

It has been estimated that electrical motors consume 30% of all electrical energy in the EU and the systems in which the motors operate account for about 70 % of the electricity consumed by the industry in 2005.[114] Electrical motors are therefore the product group which has by far the highest electricity consumption of the product groups currently covered by Ecodesign Requirements.

An electric motor is defined as a product that converts electric energy into mechanic energy[115]. In this study, low voltage motors with a power range between 1-150 kW are considered[116]. Electric motors are the most important type of electric load in industries within the EU, where motors are used in production processes. The industrial installations with motors account for about 70% of the electricity consumed by the industry. There is a total potential for cost-effective improvement of energy efficiency of these motor systems by about 20%[117]. The impacts in efficiency and life-cycle costs are almost entirely captured in the use-phase[118] as most materials used in motors are recycled during the end-phase.

One important element of the Regulation is the focus on the Variable Speed Drive (VSD). Currently 90% of all motors are running at full speed no matter how much output is needed[119]. Mechanical brakes slow down the motor where the full output is not needed. This process is very inefficient as much energy is wasted. By employing VSD technology, motors run with varying speeds depending on the power needs and

[113] IEA, 2010, Transforming Global Markets for Clean Energy Products.

[114] www.eceee.org/Eco_design/products/electric_motors/FinalReport_motors

[115] Preparatory study

[116] However, to take into account standard power sizes a lower bound of 0.75 kW and an upper bound of 200 kW was considered

[117] Commission Regulation (EC) No 640/2009, implementing Directive 2005/32/EC with regard to eco-design requirements for electric motors Text with EEA relevance http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:191:0026:01:EN:HTML

[118] Impact AssessmentIA

[119] http://cleantechnica.com/2011/06/16/electric-motors-consume-45-of-global-electricity-europe-responding-electric-motor-efficiency-infographic/

need for energy thereby using only as much electricity as needed. It has been estimated that such a system could save 1,718 TWh globally[120] thereby representing a significant improvement potential.

Timeline

Electric motors were considered for Ecodesign measures in the 2005 Ecodesign Directive. The preparatory study was initiated in June 2006 and the study was published in early 2008. The first proposal for regulation of electric motors was discussed in May 2008 and the measure was implemented in July 2009.

Table 3.27 - Timeline for setting eco-design requirements

Preparatory Study		First proposal for regulation discussed at Consultation Forum	Impact assessment published	Implementing measure adopted
First stakeholder meeting	Study published			
June 2006	February 2008	May 2008	22/7/2009	22/7/2009

Source: ECEEE and European Commission DG Energy

The requirements laid out in the Ecodesign Regulation will be phased in over three stages. The first stage took effect in June 2011. With no delay the second and third stages will come into effect in the beginning of 2015 and 2017 respectively. This time frame should allow manufactures to adapt their production to the new requirements.

Table 3.28 – Implementing measure requirements for electric motors

Stage	Date	Target
Stage 1	June 2011	Motors shall not be less efficient than the IE2 efficiency level
Stage 2	January 2015	Motors with a rated output of 7.5-375 kW shall not be less efficient than the IE3 efficiency level, or meet the IE2 efficiency level and be equipped with a variable speed drive.
Stage 3	January 2017	All motors with a rated output of 0.75-375 kW shall not be less efficient than the IE3 efficiency level, or meet the IE2 efficiency level, and be equipped with a variable speed drive.

Source: European Commission

Prior to the initiation of the Ecodesign Regulation, various voluntary initiatives had been introduced in order to set environmental requirements for motors. One of them is the CEMEP/EU agreement. This is a voluntary agreement developed in 1998 between the European Committee of Manufacturers of Electrical Machines and Power Electronics (CEMEP) and the European Commission. The agreement was signed by 36 motor manufacturers representing 80% of the total production of standard motors within the EU.

An aim of the agreement was to reduce the sales of low efficiency motors by 50%. This target was reached and surpassed since the sales of low efficiency motors declined from 68% to 45% in the period 1998-2005. However, the market penetration of the most efficient motors has not increased significantly, largely due to its higher price. Whereas producers managed to produce medium efficiency motors at prices comparable to those of low efficiency motors, the price of high efficiency motors is currently 20-30% higher than the medium efficiency segment.

The European Commission has also promoted the Motor Challenge Programme, which was established in 2003. The aim of the programme is to encourage motor manufactures to improve the energy efficiency of

[120] http://cleantechnica.com/2011/06/16/electric-motors-consume-45-of-global-electricity-europe-responding-electric-motor-efficiency-infographic/

their products. Participating companies will be aided in developing a plan to reduce the energy consumption while ensuring continuing high quality and reliability. In return they will receive public recognition for contributing towards reaching the objectives of EU's energy and environmental policies[121]. By 2009, 93 companies from 16 Member States participated in the programme, accounting for estimated savings of 0.185 TWh/year[122].

In the North American market, mandatory requirements for motors have been in place since 1997 and have led to a market transformation from low efficiency to higher efficiency motors. The challenge for EU legislation is to capture more benefits by promoting the use of variable speed drive. Technical solutions already exist on the market but the penetration of the high efficiency motors and variable speed drives have remained relatively low.

Baseline

Baseline studies have shown that motors should be a priority for energy-efficiency improvements due to the savings potential from implementing existing optimisation methods.[123]

The preparatory study shows that electric motors are placed on the EU market in large quantities, with the use-phase energy consumption being the most significant environmental aspect of all life-cycle phases.

In 2010 approximately 110 million electrical motors existed in Europe and the number is expected to reach 127 million by 2020.[124] The annual electricity consumption in 2010 from about 110 million motors amounted in 2010 to 1119 TWh corresponding to 523 Mt of CO_2 emissions at the cost of €97.2 billion. Without the Implementing Measures the energy consumption is predicted to increase to 1252 TWh in 2020.[125]

Table 3.29 – Electric motors - 2005 baseline and projected impact until 2020

	2005	2010			2020			
	Baseline	BAU	Policy	Annual savings	BAU	Policy	Annual savings	Accumulated savings
Number of products (mln.)	110*				127			
Energy Consumption (TWh)	1119*	1119	1119	0	1252	1117	135	657
Electricity Costs (bln. €)	97.2*	97,2			108,3			57
CO_2 emissions (Mt)	475*	523			574		63	301

Source: Impact Assessment, European Commission

Once fully implemented, the Regulation is expected to increase the market penetration of technologies that improve the environmental impact of electric motors, leading to estimated life-cycle energy savings of 5500 PJ and electricity savings of 135 TWh by 2020, compared to the situation if no measures had been

121 http://re.jrc.ec.europa.eu/energyefficiency/motorchallenge/index.htm
122 http://re.jrc.ec.europa.eu/energyefficiency/motorchallenge/index.htm - REPORT
123 The European Copper Institute (ECI). 2004. "Energy Efficient Motor Driven Systems can save Europe 200 billion kWh of electricity consumption and 100 million tonne of greenhouse gas emissions a year" http://www.eurocopper.org/doc/uploaded/File/Moteurs%20Press%20Kit%20April%2004%20EN%20finale1.pdf
124 Grundfos: http://www.resourceefficiency.aau.dk/UploadImages/Ecodesign_Nov-2010_2.pdf
125 Electric Motors Implementing Measure, http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32009R0640:EN:NOT

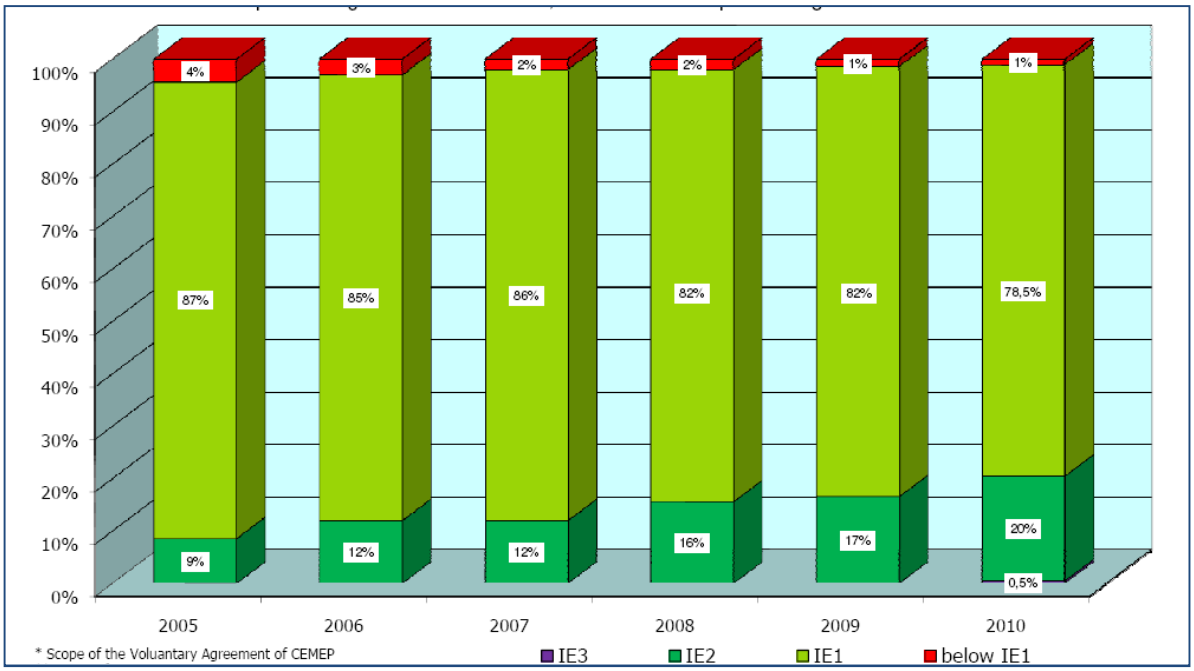
taken. This amounts to an annual reduction of 63 million tonnes of CO_2 emissions[126]. The energy savings of 135 TWh is equivalent to the entire consumption of Germany[127] and accumulated electricity savings is expected to reach 657 TWh by 2020.

Effects of the Directive

Motors have a long life-cycle of around 12-20 years. This means that the expected energy savings from the stock of product will take longer to materialise but that they are also likely to continue and even increase after 2020 since the more efficient products that will be sold after the requirements are introduced will be in use well beyond 2020.

From 1998 to 2010, Europe has seen a gradual shift towards more energy efficient motors. The market is dominated by IE1 motors while the sale of more efficient IE2 motors are increasing but remain at a relatively low market share (20% in 2010).

Chart 3.19 - Market share of efficiency classes in Europe under the CEMEP voluntary agreement



Source: CEMEP

In June 2011 IE1 motors were phased out. Given a market share of 78 % in 2010 and that the switch to more efficient motors has been happening slowly this is very ambitious.

Clearly, the introduction of the IE2 requirement whould be expected to lead to substantial changes that would not have taken place otherwise. However, an important part (as much as one third) of the manufacturers have been unaware of the forthcoming requirements. According to one industry expert *"...from feedback at exhibitions and from telephone calls and visits, as much as one-third of the EU's OEMs are still either wholly or partially unaware that new general-purpose AC motors installed from June must meet a minimum efficiency of IE2"* [128].

[126] Grundfos. 2010. Workshop on Ecodesign and Resource Efficiency, A Case on Electrical Motors http://www.resourceefficiency.aau.dk/UploadImages/Ecodesign_Nov-2010_2.pdf
[127] http://www.coolproducts.eu/product_electric_motors_3163.aspx
[128] http://www.machinebuilding.net/ta/t0207.htm

While the development has been positive it has been slower than what has been seen in the US and Canada. IE2 motors already had a market share of around 65 % in the US in 2001. In the EU it was around 4% in 2001. The share of the most efficient motor class (IE3) reached 27% in the US in 2006 and 39% in Canada in 2007.

In the United States, market penetration of energy-efficient motors has been increasing particularly since 1997 when MEPS were enforced (the Energy Policy Act of 1992, Epact).[129] The market introduction of the most efficient class IE3 has since 2006 been supported by a federal procurement programme under the Federal Energy Management Program. In December 2010, the US's Energy Independence Security Act (EISA) came into force mandating minimum efficiency levels of EI3.[130] Similar requirements will not come into force in the EU until 2015 and 2017. Canada has taken many of the same initiatives and introduced MEPS similar to those introduced in the United States.[131]

Conclusions

Voluntary agreements between the industry and the EU were implemented prior to the development of the Ecodesign Directive and they have pushed manufacturers towards marketing relatively more efficient motors. A change in the market towards more efficient alternatives is currently taking place and it seems unlikely that the IE1 motors which dominated the market in 2007 would have been phased out without the push of Ecodesign requirements. Thus, the requirements have had a significant direct effect on the market. Still, it is doubtful whether the set targets will be met. At the same time though, the requirements seem to be rather relaxed in comparison to those in the US and Canada where IE3 requirements were introduced in 2010 and where these motors already have a significant market share (39% in Canada in 2007).

10. Domestic washing machines

Introduction

Domestic appliances such as washing machines take up a large share of the residential energy consumption. In 2007, the EU-27 domestic washing machine stock was estimated to be around 172.85 million units - the sales for washing machines were at around 13.7 million units per year.

The electricity consumption of domestic washing machines was already in transition before the Ecodesign Implementing Measure was adopted, as a result of a consumer move towards more efficient washing machines. The market of domestic washing machines is characterised by a high level of substitution and the penetration of more efficient washing machines had already reduced the energy consumption by 24% from over the period 1997 - 2005.

However, as approximately 90% of washing machines at the time were in the highest energy class A (according the 97/17/EC labelling) consumers were left with uncertainty about the more efficient appliances in the energy group. Thus, the preparatory study found that the existing regulation and labelling scheme could not improve the industry any further as the regulation did not enhance technological development but rather clustered the products in the (currently) highest efficiency class. This regulatory failure resulted in a strong market demand for a revision of the Labelling Directive and the adoption of Ecodesign requirements.

Timeline

[129] http://www.motorsystems.org/files/otherfiles/0000/0068/motor_policy_guide_aug2011.pdf

[130] http://www.motorsystems.org/files/otherfiles/0000/0080/brunner_global_progress_12092011.pdf

[131] www.iea.org/papers/2011/EE_for_ElectricSystems.pdf

Domestic washing machines were considered for the eco-design measures in the initial 2005 Ecodesign Directive. The preparatory study was initiated in 2006 and published in December 2007. In December 2008 the first proposal for regulation was discussed at the Consultation Forum and the implemented measure was adopted in November 2010.

Table 3.30 - Timeline for setting eco-design requirements

Preparatory Study		First proposal for regulation discussed at Consultation Forum	Impact assessment published	Implementing measure adopted
First stakeholder meeting	Study published			
September 2006	December 2007	December 2008	10/11/2010	10/11/2010

Source: ECEEE and European Commission DG Energy

The Implementing Measure contains both generic and specific eco-design requirements. The main elements are summarised below. The first phase of the requirements came into effect on December 2011 while the second phase will be introduced in December 2013.

Table 3.31 - Domestic washing machines: Implementing Measure requirements

Date	Target
December 2011	• Limits for water consumption, standby and off modes. • Instruction manuals for energy use and water consumption. • Updated energy efficiency index to reflect the increasing use of 60° and 40° programmes and part load. • The Energy Efficiency Index (EEI) shall be less than 68 for all washing machines (Minimum class A according to the new energy classes) • A cold wash (20°) option
December 2013	• The Energy Efficiency Index (EEI) shall be less than 59 (for washing machines with a rated capacity equal to or higher than 4 kg) (minimum A+) • Further tightening of limits on water consumption

Source: European Commission

Baseline

Electrical energy is mainly used for heating up the water in the washing machine to the desired temperature, for driving the drum motor and for the other electronic devices, including the user interface. In addition, after the end of the programme, electricity is used by many machines (to a very small extent) to keep some safety functions alive, like water protection sensor systems or remote control systems.

According to the preparatory study for wet appliances, the estimated energy consumption of the washing machine stock in 2005 was around 51 TWh/year, with 295 kWh average annual energy consumption per appliance and 90% penetration rate in the EU-27 households. The total sale of domestic washing machines in the EU-27 was close to 14 million in 2005. The total trade represents a value of € 6.12 billion with water consumption of 2.2 billion m^3/year.[132]

[132] Impact assessment report:
http://ec.europa.eu/governance/impact/ia_carried_out/docs/ia_2010/sec_2010_1354_en.pdf

Table 3.32 - Washing Machines - 2005 baseline and projected impact until 2020

	2005	2020			
	Baseline	BAU	Policy	Annual savings	Accumulated savings
Number of products (mln.)	173	202			
Energy Consumption (TWh)	35	37.7	36.2	1.5	6
Electricity Costs (bln. €)	-	12,3	12,4	0,.1	1
CO_2 emissions (Mt)	18.2	20	19	1	3
Water consumption (mln m3)	2213	2051	1968	83	380

Source: Impact Assessment, European Commission

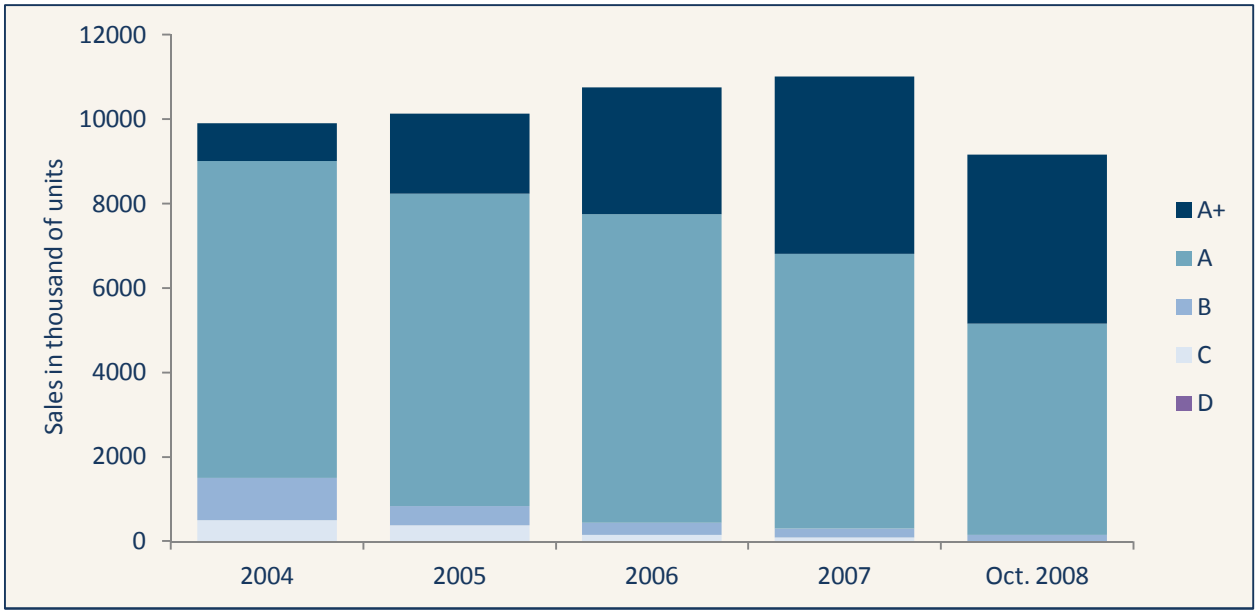
According to the impact assessment expected sales were assumed to be steady after 2005, achieving a penetration rate of 95% in 2015. The installed base is some 167 million appliances and this is estimated to increase to 202 million by 2025 for the EU-27.[133] The Ecodesign requirements are harmonised with the EU labelling scheme. 2011 is a transition phase between the old label EU Directive 92/75/EC and the new label EU No 1061/2010 which will apply from 20 December 2011. During 2010 the old and the new EU energy labels coexist.[134]

Effects of the Directive

There has been limited publicly available data regarding the amounts of energy used for laundry washing in Europe. As noted earlier, the market for domestic washing machines was already responsive to environmental concerns before the implementation of the Ecodesign Directive and was dominated by energy class A products. Already in 2004 products of at least class A made up almost 90 % of the total market and in 2005 it was up to around 95 %[135]. Thus, the majority of products fulfilled Tier-1 requirements long before these came into force towards the end of 2011. On the basis of an agreement with manufactures through CECED (European Committee of Domestic Equipment Manufacturers) an A+ class was created with increasing market share during the period 2004 – 2008.

[133] The impact assessment report: http://ec.europa.eu/governance/impact/ia_carried_out/docs/ia_2010/sec_2010_1354_en.pdf
[134] www.come-on-labels.eu%2Fdownload-library%2Fproduct-criteria-paper-on-washing-machines&ei=DKvCTtLqHYn_4QTJ0YT-DA&usg=AFQjCNH-V8Yd-PMmlmh55U3XduOD4vkH3Q
[135] Data from France, Germany, Italy, Denmark, Portugal, Netherlands and UK

Chart 3.20 – Sales of washing machines by energy class – Fr, D, It, NL, UK, Pt and DK



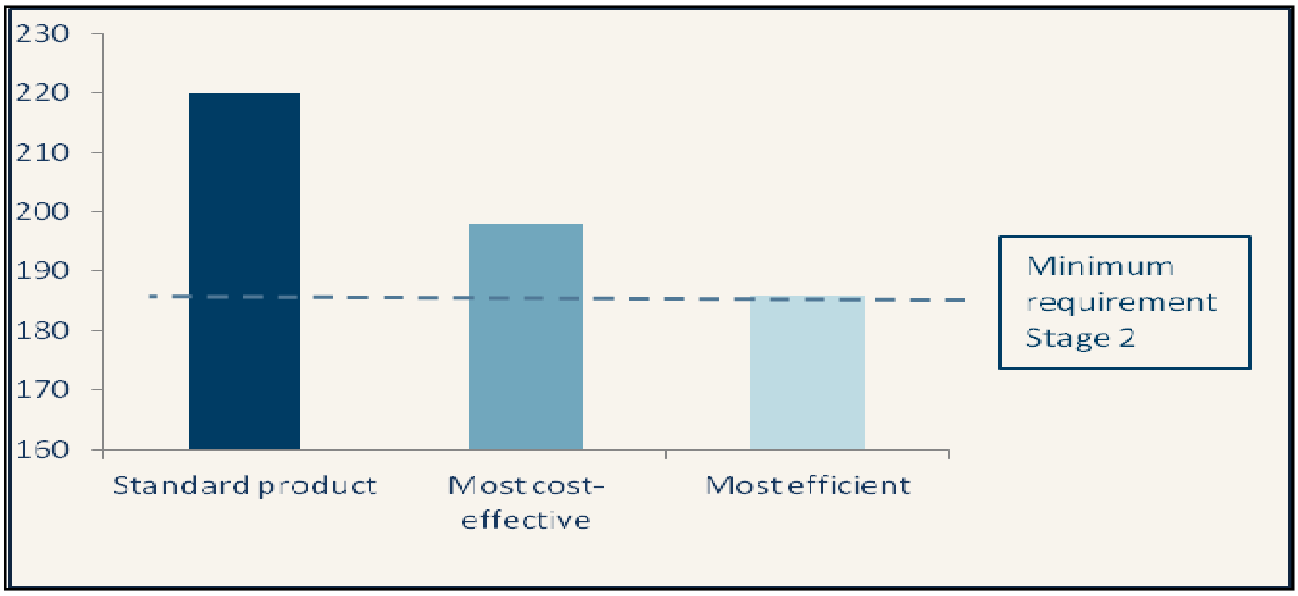
Source: Attalli/Bush for DEFRA.

Data from the 4E mapping and benchmarking study indicates that this has not been the case. Data from 2000-2009 show that energy efficiency increased significantly more during the period 2000-2005 than in the following period 2006-2009.[136]

The Coolproduct study confirmed the assumption that a European household can make substantial energy savings by choosing the most efficient products on the market. According to the study the first stage of minimum requirements for washing machines (which entered into force in December 2011) is estimated to correspond approximately to a yearly consumption of 210 kWh (for a 5.36 kg machine), close to the 2006 standard case and is expected to have very limited market impact. The 2nd stage (in December 2013) is about 15% more ambitious, close to the most efficient product on the market in 2006, and will ban class A models. Since class A models had a large market share in 2008 this seems more likely to push less energy efficient models out of the market. If the development illustrated in chart 3.18 continues class A+ models or better will have a market share around 80% in 2013.

[136] http://proceedings.eceee.org/visabstrakt.php?doc=2-512

Chart 3.21 - Indicative level of ambition of the 2nd stage of Ecodesign requirement for washing machines



Source: Coolproducts for a Cool Planet (2010).

Earlier studies found that the former labelling scheme had a huge impact on the sales of energy efficient washing machines. Thus, it is reasonable to assert that the Ecodesign Directive and revision of the energy label will provide incentives to further improvement. This is supported by the fact that the efficiency of washing machines has continued to increase and that models with higher efficiency than the current leading A+++ are already available on the market.[137]

It has not been possible to find any data to assess the effect on water consumption.

Conclusions

The energy efficiency of domestic washing machines has improved significantly during the last decade. Energy class A has become the dominant class and the labelling scheme had to be revised. The new labels entered into force in 2011 and products which are more efficient than the new A+++ label are already available.

At this stage it is not possible to attribute market changes to the Ecodesign Directive, since the developments in the market started long before the Directive was implemented and the first set of requirements which came into force in December 2011 do not appear to be ambitious. However, tier-2 requirements are considered to be more ambitious and can be considered as, at a minimum, having a positive role in maintaining the trends towards higher levels of efficiency. This seems to be in conjunction with the new labelling scheme introduced.

11. Domestic Dishwashers

Introduction

According to the preparatory study data sales of dishwashers in recent years have been increasing at a rate of around 10% in Western Europe and 50% in Eastern Europe. In the EU-27 around 69,000 units are installed annually within the residential sector in EU-27. Still, market penetration of dishwashers continues to be lower than for other white appliances at around 50-60%.

[137] http://www.topten.info/uploads/File/039_Barbara_Josephy_final_Washing.pdf

Considering the life-cycle of dishwashers, the preparatory study concluded that the environmental impact is largest during the use-phase. Furthermore it has been shown in the preparatory study that 38% of the total annual consumer expenditure comes from electricity consumption.

Timeline

Domestic dishwashers were considered for Ecodesign Requirements in the 2005 Ecodesign directive. The preparatory study was initiated in 2006 and finished in December 2007. A year later in December 2008 the first proposal for domestic dishwashers was discussed in the consultation forum. The further process was stalled several times but the Implementing Measure was adopted in November 2010.

Table 3.33 - Timeline for setting eco-design requirements

Preparatory Study		First proposal for regulation discussed at Consultation Forum	Impact assessment published	Implementing measure adopted
First stakeholder meeting	Study published			
September 2006	December 2007	December 2008	10/11/2010	10/11/2010

Source: ECEEE and European Commission DG Energy

The measures consist of both generic and specific requirements. Stage 1 came into force on 1 December 2011 introducing minimum specific requirements. In the second and third stages generic eco-design requirements will be introduced while in stages four and five, further specific eco-design requirements will apply.

Table 3.34 – Implementing measure requirements

Stage	Date	Target
Stage 1	1 December 2011	(a) *EEI* be less than 71(equal to A or better under new label for all household dishwashers, except household dishwashers with a rated capacity of 10 place settings and a width equal to or less than 45 cm); (b) *EEI* less than 80 (equal to B or better under new label for household dishwashers with a rated capacity of 10 place settings and a width equal to or less than 45 cm, (c) for all household dishwashers, the Cleaning Efficiency Index (*I C*) shall be greater than 1.12
Stage 2	1 December 2012	For the calculation of the energy consumption and other parameters for household dishwashers, the cycle which cleans normally soiled tableware (hereafter standard cleaning cycle) should be used. This cycle should be clearly identifiable on the programme selection device of the household dishwasher or the household dishwasher display, if any, or both, and named 'standard programme' and should be set as the default cycle for household dishwashers equipped with automatic programme selection or any function for automatically selecting a cleaning programme or maintaining the selection of a programme.
Stage 3	1 June 2012	The booklet of instructions provided by the manufacturer shall provide: (a) the standard cleaning cycle referred to as 'standard programme' and should specify that it is suitable to clean normally soiled tableware and that it is the most efficient programme in terms of its combined energy and water consumption for that type of tableware; (b) the power consumption of the off-mode and of the left-on mode; (c) indicative information on the programme time, energy and water consumption for the main cleaning programmes.
Stage 4	1 December 2013	(a) for all household dishwashers, except household dishwashers with a rated capacity of 10 place settings and a width equal to or less than 45 cm, the Energy Efficiency Index (EEI) shall be less than 71; (b) for household dishwashers with a rated capacity of 10 place settings and a width equal

Stage	Date	Target
		to or less than 45 cm, the Energy Efficiency Index (EEI) shall be less than 80; (c) for household dishwashers with a rated capacity equal to or higher than 8 place settings, the Drying Efficiency Index (I D) shall be greater than 1,08; (d) for household dishwashers with a rated capacity equal to or less than 7 place settings, the Drying Efficiency Index (I D) shall be greater than 0,86.
Stage 5	1 December 2016	For household dishwashers with a rated capacity of 8 and 9 place settings and household dishwashers with a rated capacity of 10 place settings and a width equal to or less than 45 cm, the Energy Efficiency Index (EEI) shall be less than 63. (equal to energy class A+ or better).

Source: Implementing Measure

In 1999, the industry organisation for dishwasher manufacturers, the European Committee of Domestic Equipment Manufacturers, agreed on a Voluntary Commitment. The commitment, in which it was decided to remove all of the least efficient dishwashers from the market by 2004, appears to have been successful in enhancing the energy efficiency of dishwashers.

The Energy Label for automatic dishwashers, also introduced in 1999, focused on setting energy requirements, has prompted improvements in energy efficiency in the range of 37-44% depending on the type of machine[138]. These savings have been reinforced by other voluntary commitments by the industry. Since most dishwashers had reached class A, a revised labelling system introducing class A+, A++ an A+++ was adopted on September 2010 and applying from December 2011.

Baseline

According to the preparatory study the number of installed dishwashers in the residential sector within the EU27 totalled 70 million and it is estimated to increase to reach 115 million units by 2020. Total energy consumption for domestic dishwashers in the EU was estimated at 26 TWh amounting to emissions corresponding to 13 Mt of CO_2. By 2020 total energy consumption is expected to increase to 33.7 TWh if no measures are taken resulting to CO_2 emission equivalent of 17.5 Mt. The Implementing measures were expected to achieve annual saving in 2020 of 1.7-2.0 TWh leading to accumulated electricity savings of around 9 TWh.

Table 3.35 - Dishwashers - 2005 baseline and projected impact until 2020

	2005	2010			2020			
	Baseline	BAU	Policy	Annual savings	BAU	Policy	Annual savings	Accumulated savings
Number of products (mln.)	70				115			
Energy Consumption (TWh)	26	26	26	0	33.7	31.7	2.0	9
Electricity Costs (bln. €)	6.06				10,2	10,2	0	-1
CO_2 emissions (Mt)	13				17	16,5	0,5	5
Water Consumption (Mt m3)	308				389	325	64	294

Source: Impact Assessment, European Commission

The environmental impact of dishwashers is not only a result of electricity consumption but also of water consumption. According to the Impact Assessment water consumption from dishwasher appliances amounted to 308 m3 in 2005. In a BaU scenario the number is expected to increase to 389 m3 in 2020.

[138] Preparatory study – Task 2

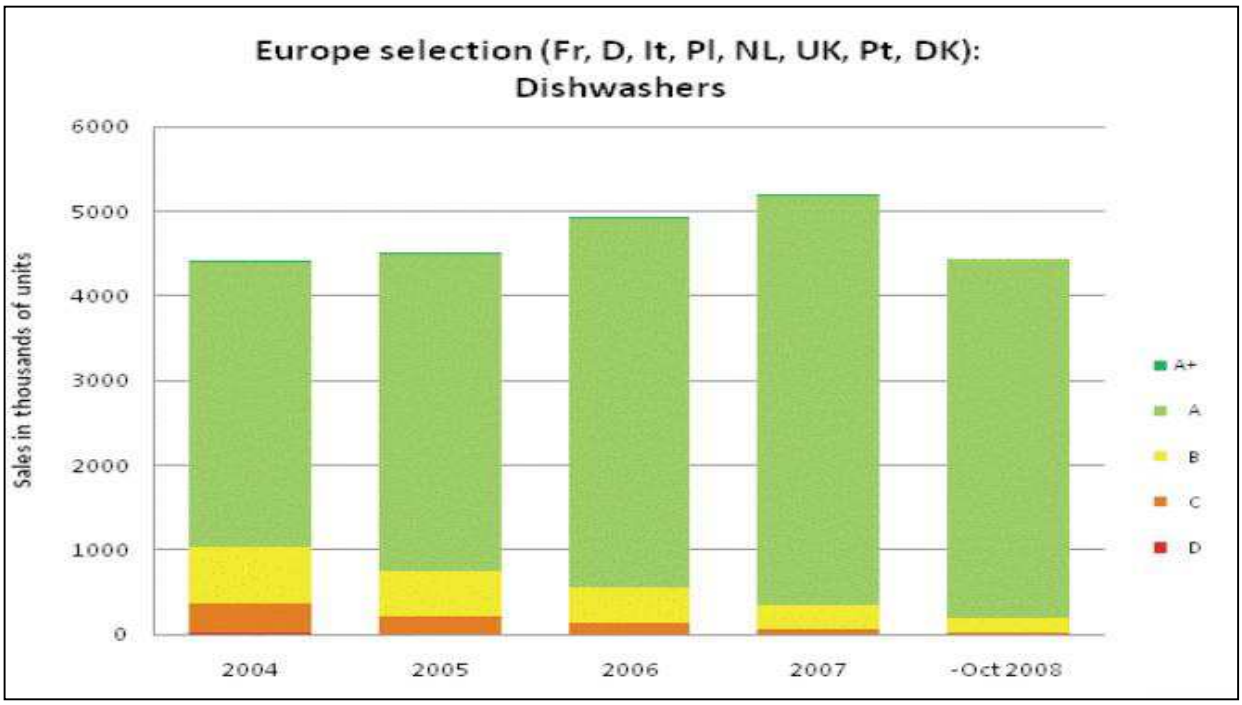
Effects of the Directive

The first requirements only came into effect in December 2011. The main requirement is that all dishwashers below energy class A will be prohibited (according to the revised labelling scheme).[139]

As for washing machines, energy class A by far dominates the total dishwasher market and most models fulfilled the tier-1 requirements long before they came into force. A-class products have held a market share of 80% or more for many years and have surpassed 90% since 2007. The label no longer assists with product differentiation and has therefore been revised as already mentioned. However, publicly available data only covers the old labelling scheme.

Data for the development in the market shares of different energy classes document a small degree of progress in terms of improvements in energy efficiency between 2004 and 2008. To the extent that it is possible to assess the development given the very little product differentiation, the movement towards more energy efficient products seem to have been steady over the period.

Chart 3.22 - Sales of dishwashers according to energy class in selected European countries

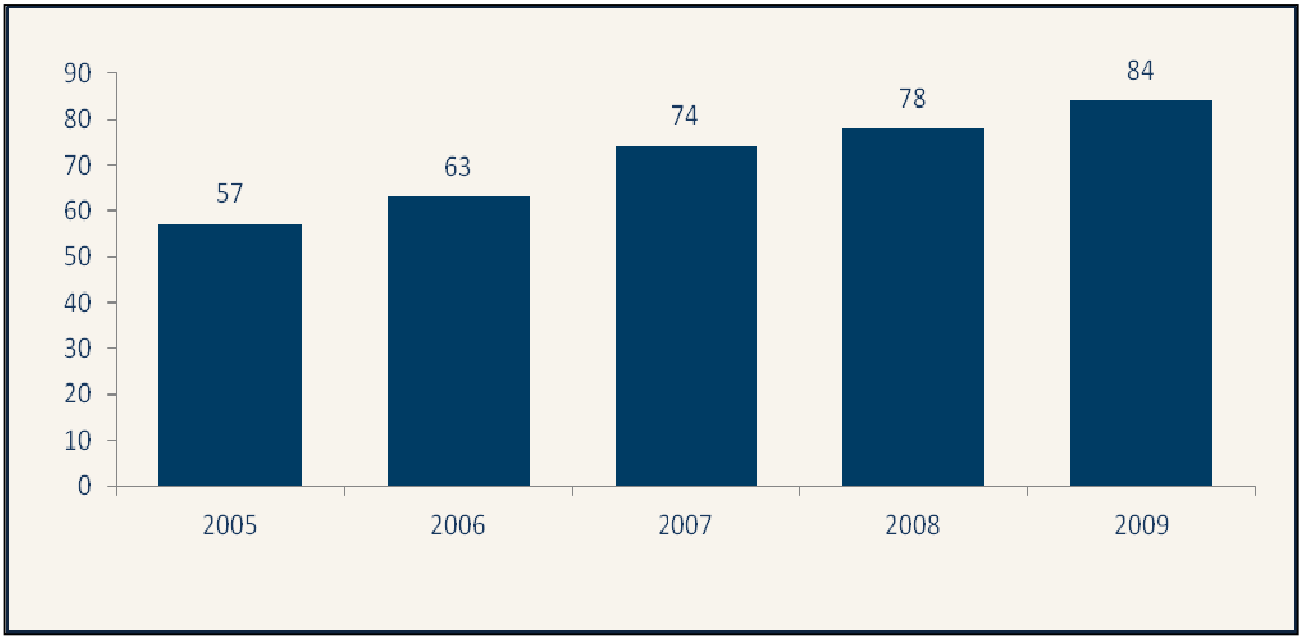


Source: GfK, Attali/Bush for Defra[140]

Thus, a positive development in energy efficiency has taken place as the Implementing Measure was prepared, but it has not been possible to identify a clear link. Furthermore, it is not possible to know if improvements have happened within energy class A products. However, data provided only for the UK, where dishwashers can achieve ratings up to triple A, shows significant positive developments in the period 2005-2009 (see chart below).[141]

[139] With the exception of household dishwashers with a rated capacity of 10 place settings and a width equal to or less than 45 cm where energy class B or better under new label for household dishwashers will be allowed.
[140] Attali, Bush & Michel (2009)
[141] http://www.gfkrt.com/uk/news_events/gfk_rt_uk_news/home_newsletter/single_sites/005163/index.en.html

Chart 3.23 - Value share (%) of triple-A rated appliances in the UK



Source: GfK Retail and technology, 2010

With the new labelling coming into effect in the EU, there will be a similar opportunity to market highly efficient dishwashers to consumers which could provide renewed incentives for the industry to develop more energy efficient dishwashers and to provide consumers with more detailed information about which dishwashers are most energy efficient. At the same time the requirements have been criticised for not being very ambitious (as there are few products left below the A class).[142]

It has not been possible to find any data to assess the effect on water consumption.

Conclusions

The first requirements for domestic dishwashers took effect on December 2011 when dishwashers below the new energy class A was phased out.

Consumers seem to be shifting towards more energy efficient dishwashers but lately the development has been slow and no effect of the Ecodesign Directive or the Implementing Measure can be detected with the limited data currently available. Tier 1 requirements phased out a very limited share of products and it is currently unclear how many products will be phased out due to Tier 2 requirements as no data for the new A+, A++ and A+++ are available. Indications from the UK – as well as evidence from other areas like cold appliances – indicate that the revised labelling scheme and the Ecodesign measure are likely to speed up the transition to more energy efficient dishwashers in the future and increase the effect from the requirements and labelling scheme.

[142] http://www.coolproducts.eu/cool_blog_archive_ecodesign_process_moves_forward_as_washing_machine_dishwasher_requirements_are_adopted_246.aspx

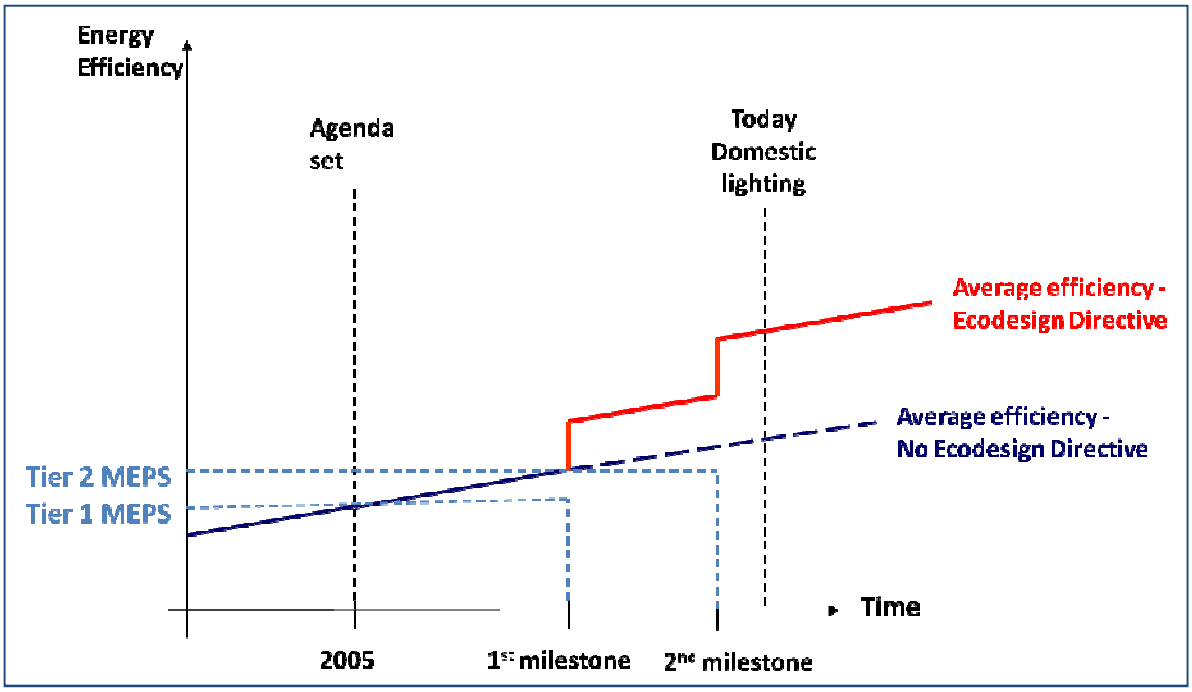
Summing up the experience from the 11 product groups considered

The Ecodesign Directive has been put in place as part of a wider set of policy instruments to encourage greater energy efficiency and other environmental benefits by 2020. At this stage, for many of the products the requirements set in the Implementing Measures have not come into effect yet, while for some only the first stage – mostly not very demanding – requirements are in force.

It is still too early to evaluate the effect of the Directive and the requirements set in the Implementing Measures and for many products there are not sufficient recent data to identify trends that can be linked dirtectly to the Ecodesign measures. Still, available data do show for all products a move towards improved energy efficiency and for some products there are indications, albeit not always strong, of an effect of the Ecodesign Directive.

Domestic lighting stands out as the clearest example of a product group were the Ecodesign requirements led to a large number of products being phased out when the requirements came into force. These would otherwise have stayed on the market. The effect is illustrated in the figure below, showing how the Ecodesign requirements have added to the improvement of energy efficiency which was already taking place. Incandescent light bulbs maintained a relatively high market share up until the requirements came into force and were then removed rather suddenly from the market. This led to a rapid market transformation and an improvement in average energy efficiency around the time the Implementing Measures came into force.

Chart 3.24 – Actual and projected evolution of average energy efficiency level (domestic lighting)

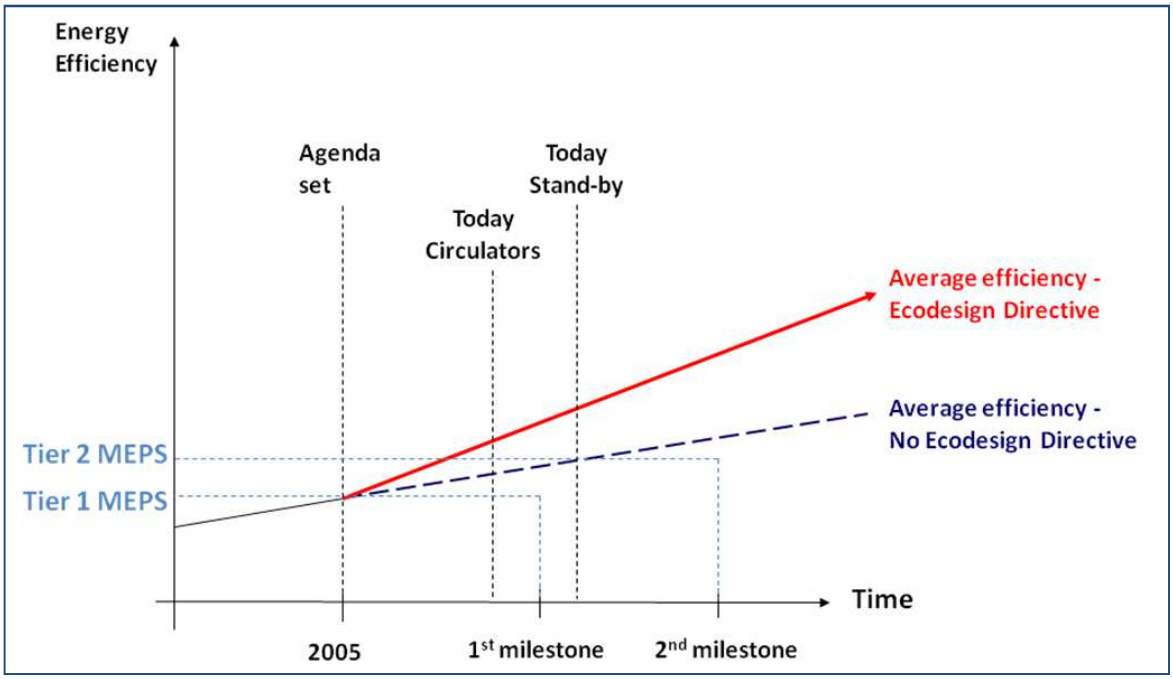


The same seems to be the case for tertiary lighting although evidence to document the direct effect of the Ecodesign requirements is weaker. Data indicate that a similar strong direct effect can be expected for motors and circulators in the coming years as requirements come into force. These product groups are among the ones with the highest potential for energy savings.

In the case of standby and off mode that covers product groups horizontally, the requirements have been effective inces there was previously little focus on standby and off mode energy consumption for some product groups. Global initiatives in this direction have also played a role. However, data on these product groups indicate that energy efficiency has gradually been improved since discussion of standby minimum

efficiency standards started and no sudden phase out of products around the time of the requirements taking effect can be detected. The Ecodesign Directive started having an additional effect on average energy efficiency before the requirements came into force because in anticipation of the requirements, producers increased their efforts to improve the energy efficiency of products and started phasing out inefficient products.

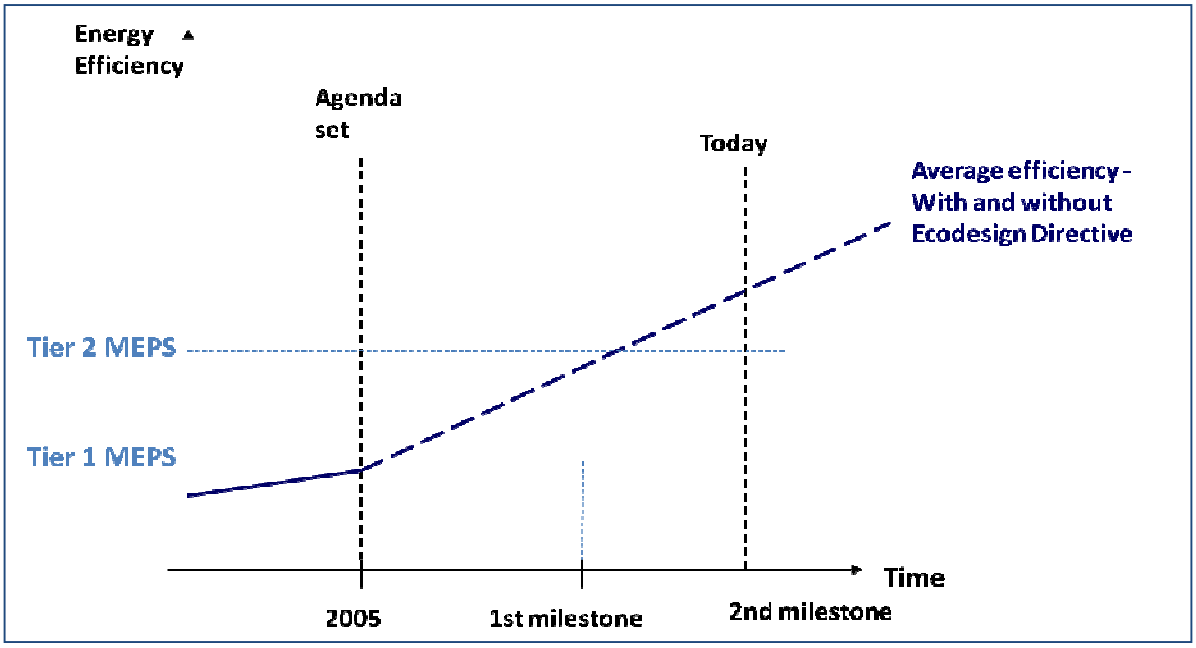
Chart 3.25 – Actual and projected evolution of average energy efficiency level (standby and circulators)



In the case of circulators, products which would most probably have stayed on the market were phased out through the combination of the voluntary agreement already in place and the anticipation effect of the Ecodesign requirements.

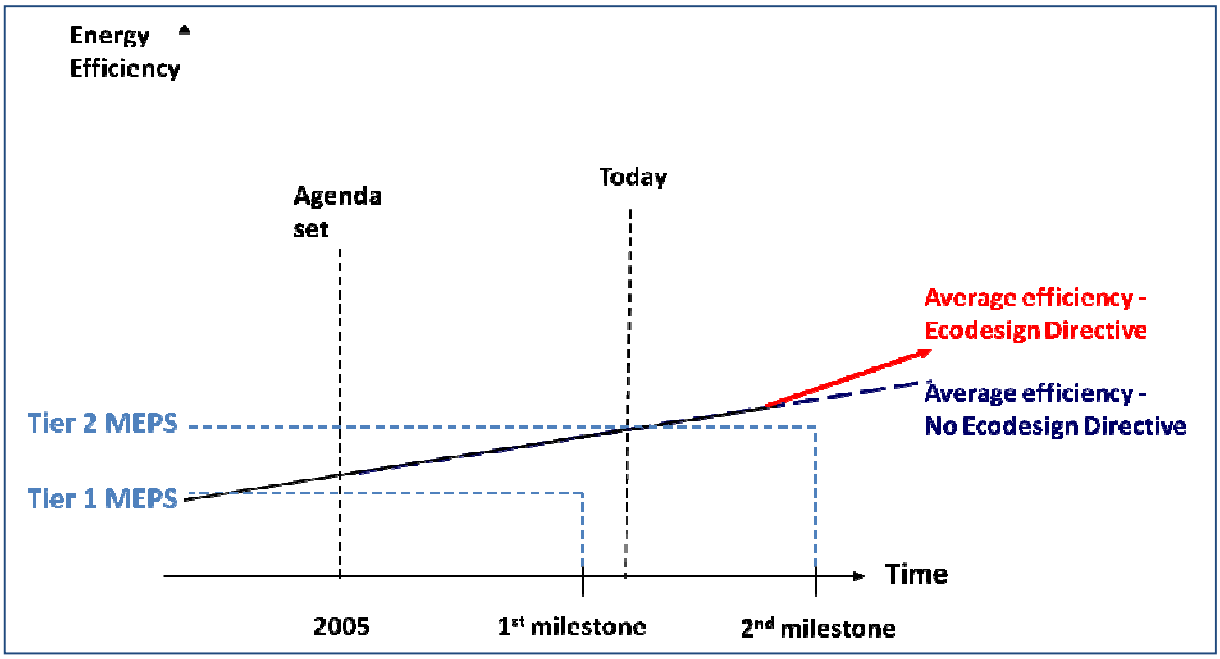
The largest improvements in energy efficiency have been achieved in the case of TV sets but the evidence so far suggests that the role of the Ecodesign requirements has been limited to removing a very small share of inefficient products. Technological developments in this product group have taken place at a much faster pace than what was projected when the Implementing Measure was adopted so that the requirements have become rather irrelevant. The desired result is probably still the same although there is an argument for a missed opportunity for even greater levels of efficiency. Illustrated graphically, the development in average energy efficiency has been more or less the same under the Ecodesign Directive as it would have been in the absence of Ecodesign measures.

Chart 3.26 – Actual and projected evolution of average energy efficiency level (TVs)



Finally, according to the limited sources available in the case of cold appliances, washing machines and dishwashers, the first stage requirements have been fairly easy to meet for the majority of the products in the market. Greater effects can be expected in the future when stricter requirements and revised labelling come into force but no evidence has been made available to verify such trends. The first tier of Ecodesign requirements, therefore, had no additional effect on the ongoing improvement of energy efficiency. But in order to meet the second tier of requirements producers are increasing energy efficiency faster than has been the case. Thus, an additional effect on average energy efficiency can be expected from Ecodesign requirements in the future.

Chart 3.27 – Actual and projected evolution of average energy efficiency level (cold appliances, washing machines and dishwashers)



Analysis of findings

Product group	Change in market	Change attributable to Ecodesign	Additional comments
Standby and off-mode losses of EuPs	Improved energy efficiency	For some of the areas covered	Data show increased energy efficiency in standby and off mode but cannot document a direct link between the IM and energy efficiency improvements due to limited data availability. Industry indicates that the Directive has increased attention to energy loss from standby and off mode for some groups of appliances and has accelerated efforts to increase energy efficiency.
Simple set-top boxes	Improved energy efficiency	Uncertain due to limited data	Very limited data available. After 2007 only data for UK available. UK data show significant improvement in energy efficiency with average energy efficiency in 2008-09 approaching the 2010 tier-1 requirements
Domestic lighting	Improved energy efficiency; move toward higher efficiency lamps	Clear role in removal of incandescent bulbs	Indications of change which can be attributed directly to the IM. Inefficient incandescent lamps that until recently had a significant market share are being phased out. Not evidence on other groups
Tertiary Lighting	Improved energy efficiency gradual move toward higher efficiency lamps	Indications of role in removal of inefficient office lighting. Also some effect on street lighting but effect is mainly expected later due to long transition phase.	Indications of change attributed directly to the IM. Outdated types office lighting that until recently had considerable sales is being phased out. Some effect on street lighting although requirements do not take effect until 2015
External power supplies	No data available to assess effectiveness	Uncertain due to limited data	Very limited data available
Domestic refrigerators and freezers	Improved energy efficiency	Currently seems limited. Effect attributable to IM will increase the coming years	Label A and A+ class products today dominate the market driven by the introduction of Energy Labelling. Improvement of energy efficiency predates the Ecodesign so that a direct effect is not apparent. Tier 2 standards can help maintain trend towards higher levels of performance since they are more demanding.
Electric motors 1–150 kW	Efficiency improvements reported but still slow	Changes would most probably have not taken place without Ecodesign	No recent data available. Shift from fixed speed to variable speed motors will improve energy efficiency. Anecdotal evidence indicates that market is still slow in responding and requirements are expected to have direct effect on energy efficiency.
Televisions	Improved energy efficiency	IM not a driver but possibly supported the continuation of existing trends	Improvement of energy efficiency predates the Ecodesign and tier-1 requirements seems to have had limited effect since most products complied before they came into force and a direct effect is therefore not apparent. Requirements may help maintain trend towards higher levels of performance. Tier 2 standards could also have been more demanding or introduced earlier.
Circulators in buildings	Improved energy efficiency	Indirectly through support for development of voluntary agreement. Direct effect expected in the coming years.	Improvement of energy efficiency predates the IM. First requirement will not take effect until 2013. Discussion of Ecodesign requirements led to a voluntary agreement that pushed energy efficiency. A strong shift from C and D labelled products to A and B labelled products. 2013 requirements expected to increase energy efficiency further.

Product group	Change in market	Change attributable to Ecodesign	Additional comments
Domestic washing machines	Improved energy efficiency	Limited so far. Effect attributable to IM and labelling likely to increase in the coming years	First requirement will not take effect until end of 2011. A shift from less energy efficient product groups to more efficient occurred in the past due to the earlier introduction of Energy Labelling and improvements of energy efficiency predate the IM due to early introduction of Energy Labelling. Tier 2 requirements and new labelling are expected to help maintain movement to higher levels of performance.
Domestic dishwashers	Improved energy efficiency	Currently limited. Effect attributable to IM and labelling likely to increase in coming period	First requirement will not take effect until end of 2011. Improvement of energy efficiency predates the IM and occurred due to earlier introduction of Energy Labelling, and during the preparatory study indicating a possible anticipatory effect. Tier 2 Requirements and new labelling are expected to help maintain trend to higher performance

Table 3.36 - Summary table of evidence of the impact of Ecodesign Directive on individual products

Key factors influencing the effectiveness of Implementing Measures

The 11 products groups presented above provide some lessons on the factors that influence the effectiveness of Implementing Measures, although these lessons will need to be further tested and refined as additional evidence is gathered, since only partial conclusions can be drawn currently and only for some product groups.

The analysis has pointed to the following aspects. These are interlinked in certain respects

- The nature of the product examined and the role of energy efficiency in consumer decisions
- The availability of energy efficient technologies in the market
- The technological developments at the time of the formulation of the Implementing Measures

For most product categories, energy efficient products existed before the Implementing Measures were adopted. However, in many cases energy efficient products had achieved only a very limited market share due to the limited role that energy efficiency plays in consumer decisions. In the case of domestic lighting, private consumers have been reluctant to buy cost effective lighting because of high up-front costs. In such a case, the introduction of minimum requirements has a substantial impact by banning the least efficient models. Such a development is also favourable for most manufacturers as it provides a very effective tool to increase the market share of newer and initially more expensive, products.

In contrast, in the case of tertiary lighting, where consumers are mainly professionals who have the capacity to assess life cycle costs, there are much clearer incentives to use energy efficient lighting products. As a result, cost effective lighting had gained market share in tertiary lighting quicker than in domestic lighting and before Ecodesign requirements came into force. In the case of cold appliances washing machines and dish washers where energy efficiency has higher priority in consumers' decisions, energy efficiency was a significant issue for manufacturers long before the Ecodesign Directive came into force. For such products, energy labelling seems to have been a more important driver of market developments since it supports the differentiation of the more energy efficient products from others on the market and allows higher prices to be charged.

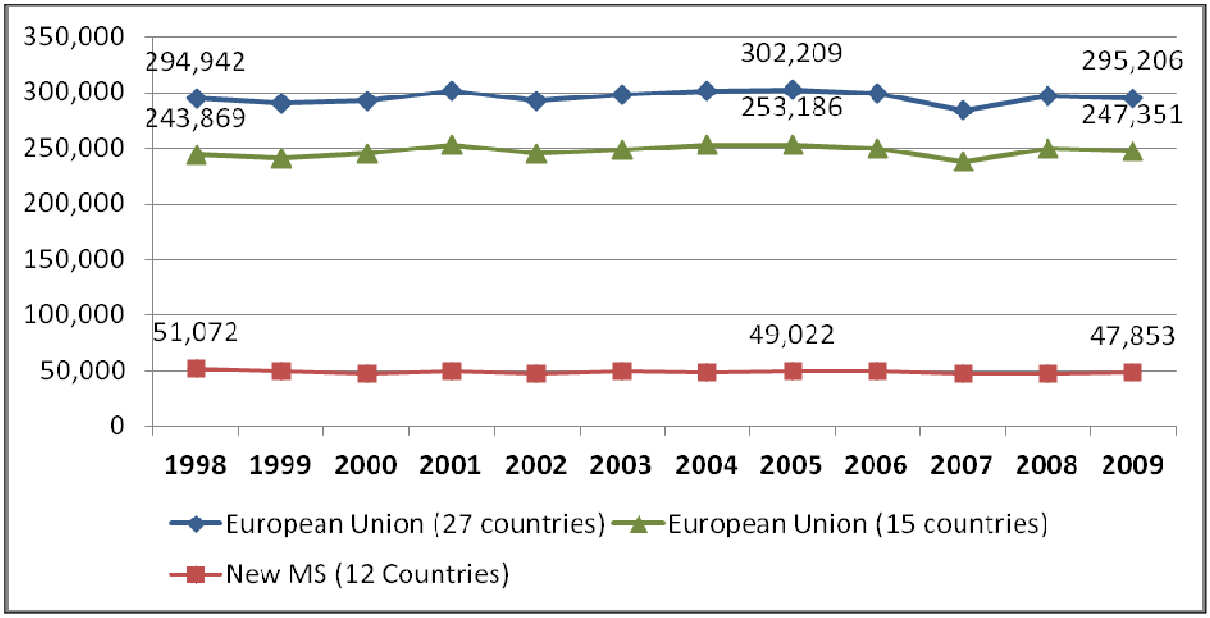
The availability of energy efficient technologies for a specific product clearly makes it easier to switch to more efficient products and is an obvious but significant driver. For example, the market for motors has seen increased energy efficiency in the USA and Canada but not to the same extent in the EU. It has consequently been possible to improve energy efficiency significantly in the EU, just by narrowing the gap with the leading countries.

At the same time though, technological developments at the time of the introduction of specific requirements can have a challenging role in terms of the effectiveness of Ecodesign requirements. In markets characterised by rapid technological change and the introduction of new technologies, it is difficult to set appropriate requirements. Televisions are the most obvious example where improvements in energy efficiency happened faster than expected at the time of the development of the Implementing Measures and made the requirements largely outdated even before they came into force. Rapid technological developments also make it more difficult to set specific standards at an appropriate level and to avoid unintended consequences for producers and consumers.

3.3.3 Assessment of overall effectiveness in reaching 2020 targets

The lack of data generally means that it not possible to make direct statements on the overall effectiveness of the Directive and the contributions of the Directive to reaching the 2020 targets. At this stage it is only possible to make reference to certain forecasts and and assess existing trends. In this there is some encouraging news. Overall, energy consumption levels in households have not significantly changed over the last 12 years while average energy consumption of appliances is decreasing.

Chart 3.28 – Evolution of energy consumption in households in the period 1998-2009 (in thousand tonnes of oil equivalent)



Source: Eurostat

Data from various sources indicate that energy consumption from appliances is decreasing. For instance, GFK retail panel data[143] indicate that this is the case for the average energy consumption of new home appliances (Washing Machines, Dishwashers, Cooling, and Freezers) – which account for more than half of domestic electricity consumption. In a five-year comparison (2005-2010) across 23 EU Member States, the average consumption in Europe has fallen by 7%, despite the fact that there has been an increase in demand for even bigger appliances and advanced features, such as no-frost technology for fridges or larger television screens.

[143] http://www.gfk.sk/imperia/md/content/gfkslovakia/pressrelease/2011/gfk_mda_energy_efficiency_en.pdf

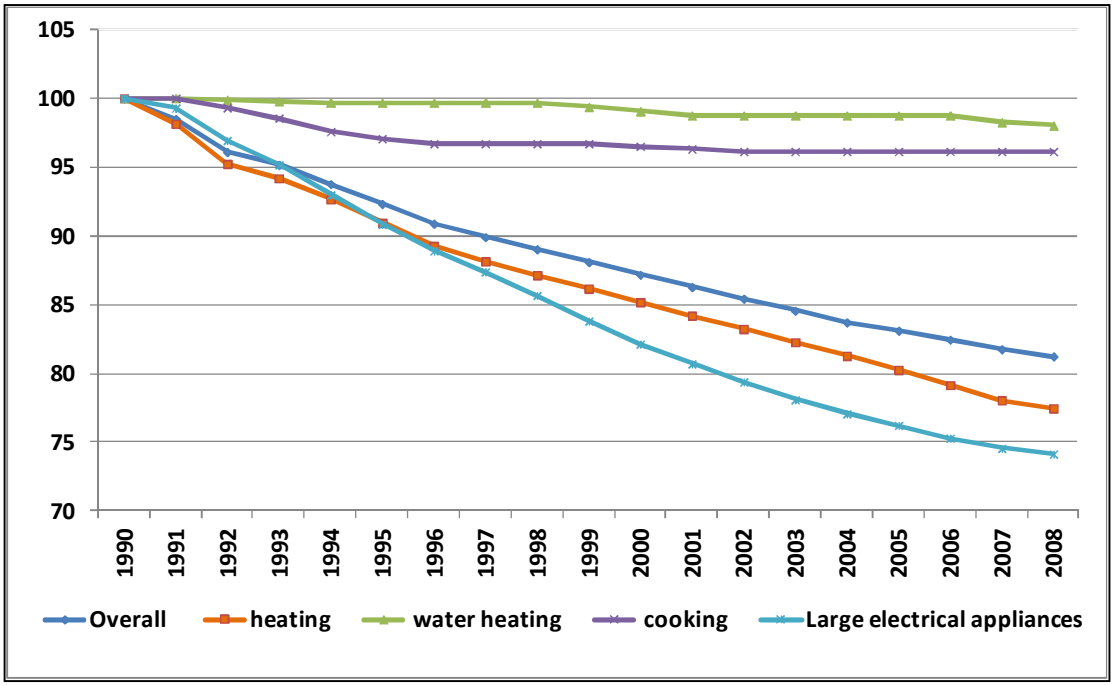
Table 3.37 – Changes in the levels of energy consumption in EU - period 2005 and 2010

	2005/kWh	2010/kWh	Growth_% 2005 → 2010
Average 23c EU	265	246	-7%
Germany	237	215	-9%
Great Britain	265	265	0%
France	261	255	-1%
Italy	282	256	-11%
Estonia	328	268	-18%
Poland	263	242	-8%
Netherlands	241	232	-4%
Belgium	243	236	-3%
Austria	252	225	-15%

Note: Some countries supported the market transformation with bonus systems: Estonia since 2006, Italy since 2007 and Austria since 2009/2010 * Washing machines, Dishwashers, Cooling, Freezers ** AT, BE, DE, DK, ES, FI, FR, GB, GR, IT, NL, PT, SE, BG, CZ, EE, HU, LT, LV, PL, RO, SI, SK ; Source: GFK Retail and Technology and IFA 2011 Industry Power Briefing-Home Appliances, presentation by Anton Eckl

This is also supported by data from the Odysee energy efficiency index. It shows definite improvements in energy efficiency in households for the period 1990-2008 particularly for electrical appliances that are already covered by Implementing Measures. Clearly, the role for the Ecodesign Directive in these developments is principally one of encouraging anticipatory effects and these have already been identified for some of those products analysed.

Chart 3.29 – Evolution of energy efficiency – Odysee efficiency index (1990=100)



Source: Odysee database

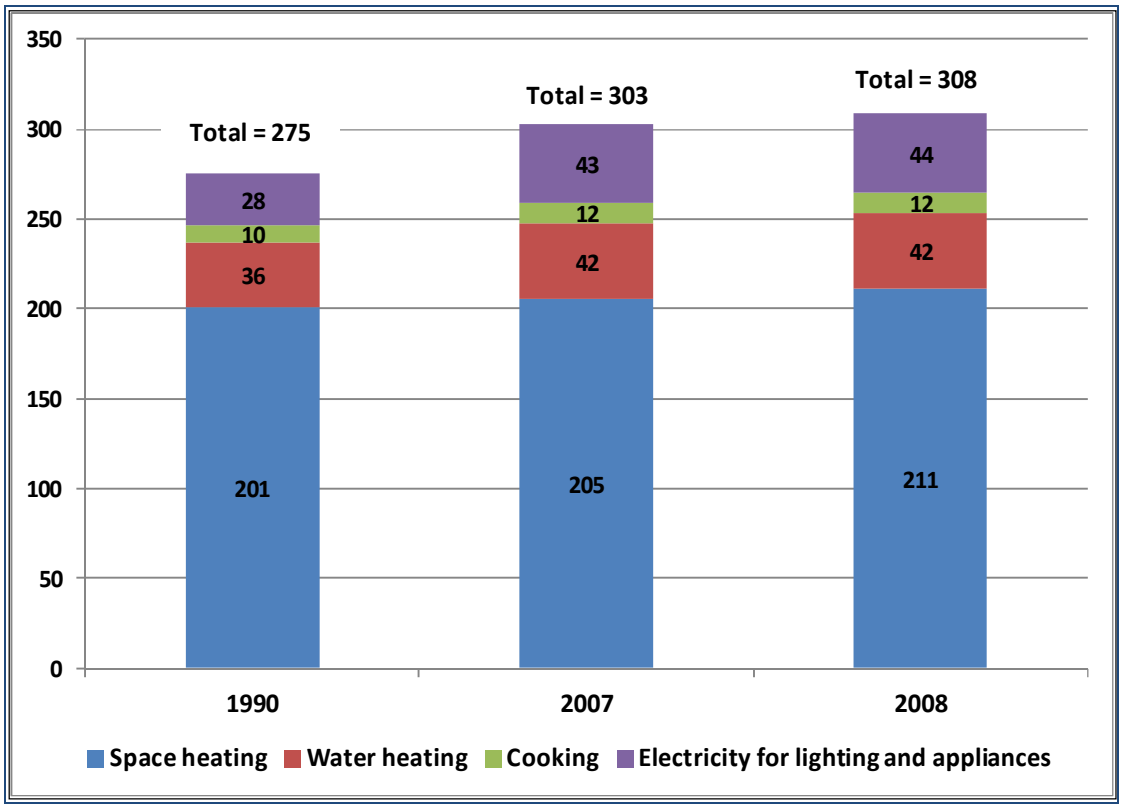
However, despite the general improvement in the efficiency of appliances, overall consumption has remained steady. This is because the number of appliances has increased on a year by year basis in line with a tendency towards larger homes. These trends tend to offset more than 70% of the efficiencies achieved through technological development[144].

What the above chart also suggests is that the greatest improvements have taken place with electrical appliances (refrigerators, freezers, washing machines, dishwashers and TVs) and heating while improvements have been less marked in the relation to cooking and water heating. This is particularly significant, given that there are still no Implementing Measures for products like boilers and water heaters and indicates the potential for important contribution from the implementation of Ecodesign requirements for those appliances.

This point is made even clearer by data on the share of the various end uses in energy consumption in households. The Implementing Measures already in force cover only a small part of the overall energy consumption in households. In 2008, electricity for lighting and appliances represented only 14% of the total. In comparison, space and heating represented 84% of the total consumption. Existing Implementing Measures represent only a small part of the much greater potential of the Ecodesign Directive. The delays in the development of some of the Implementing Measures – as will be analysed in greater detail in section 3.4 – can be seen as an important obstacle to the achievement of the full potential of the Directive.

Chart 3.30 – Share of energy consumption by end uses in total households' consumption (in MToe)

[144] ODYSSEE. Drivers of the change in average annual energy consumption per household. The Odyssee database is available at http://www.odyssee-indicators.org/. The access is restricted to project partners or subscribers



Source: ODYSSEE database

Considering future projections, a forecast for Germany generated by GfK Retail and Technology predicts that the energy consumption of major domestic appliances will be considerably reduced by 2020. On the assumption of a market growth of 0.5% annually and a replacement of appliances when they are ten years old, energy savings of 10% are expected. This would mean that the electricity consumption of major domestic appliances in Germany would be reduced by a quarter between the years 2000 and 2020.

3.3.4 Impacts on markets and industry

The previous section has already made reference to changes in the share of products of different energy efficiency levels and attempted to identify the role of the Ecodesign Implementing Measures. In this section we turn to the role and possible impact of the Ecodesign Directive on industry and the markets for products. More specifically we consider:

- Effects on the production costs and the profit margins for the regulated products.
- The evidence on the impacts on the prices of the regulated products
- The role of the Ecodesign Directive on innovation
- The evidence of any impacts on non-EU importers
- The effects on the market structure
- The overall impacts on the competitiveness of EU industry

For most of the above questions, the data available were rather limited or not recent enough to allow any meaningful conclusions to be made relating to the role and impact of the Ecodesign Directive and the Implementing Measures. Thus, on a number of occasions, we had to rely on qualitative or anecdotal evidence to make judgments on the potential effect of the Ecodesign Directive.

Costs for producers of EuPs

The study has not been able to identify broadly based data to allow a comprehensive and robust analysis of the costs to industry of the implementation of the Ecodesign Directive. Thus it is rather difficult to make any comparisons with the initial estimates provided in the impact assessments of the Implementing Measures. In those studies the general estimation was that changes to product platforms are usually in the range of between €50,000 and €100,000 with additional per-unit costs of between €1 and €10. Furthermore, testing costs for appliances were estimated to be in a range of €500-1500 per product model-family.

Nonetheless, there have been some data and other qualitative inputs provided by manufacturers of EuPs that illustrate the variety of impacts in terms of costs. One producer referred to an increase of production costs of around 20% in the case of electric motors while one of the larger producers of circulators suggested that the total costs to the firm so far have been close to €100million - including necessary production changes for some of the products, product testing facilities and the personnel required to ensure compliance. The total amount was around 10% of the annual turnover of the company although, clearly, most of the elements are one-off costs. The same manufacturer indicated that in the case of circulators the whole industry has invested over €400 million for changes in production, representing according to the data from the relevant preparatory study around 5-10% of the annual turnover of the sector. Focusing on the costs for the testing of products, the information collected through a survey organised by the Finnish Industry Association indicated that, on average, for each firm the one-off costs for setting up the necessary test labs were around €200,000 with an additional €150,000 per annum for the relevant personnel. According to another source, for a large firm producing 20 product families the investment for the test lab was around €500,000 while annual personnel costs in the various departments was €520,000. Unfortunately there was no information on what these costs represented as a proportion of annual turnover or total operating costs. In the case of firms that use external labs to assess conformity the cost per product is, according to information from the impact assessments, around €1000 per product model-family

On the other hand, some manufacturers suggested that for most of the products covered by Implementing Measures Tier 1 requirements were not particularly challenging and did not affect production costs. Investments in production are expected to take place – or be completed - in the coming years prior to the stricter Tier 2 and Tier 3 requirements. In that respect, the use of lead times – as in the case of the use of the less demanding Tier 1 requirements - enable producers to minimise costs by integrating design and manufacturing changes into the normal industrial cycles. The importance of the lead time in minimising the cost to manufacturers is also documented in other countries that have introduced minimum standards.[145] Others – e.g. in the case of TV sets - indicated that the investments in efficient technologies had taken place at an earlier stage independently of the introduction of the Implementing Measures and that these investments are not been driven by the Implementing Measures but by competition and market demand for more energy efficient products.

Considering the long term cost impacts, unit production costs should be expected to decline. This is the conclusion of a recent review of relevant data on behalf of Defra[146]. It suggests that after an initial increase, the learning curve and economies of scale lead to a gradual decline of average unit production costs as market shares and production volume of new, efficient products increase.

[145] International Energy Agency (2007), Experience with energy efficiency regulations for electrical equipment
[146] Final Summary Report Impacts of Innovation on the Regulatory Costs of Energy-using Product Policy, Policy Studies Institute & BIO Intelligence Service - A research report completed for the Department for Environment, Food and Rural Affairs

Besides costs associated with production changes, the implementation of the Implementing Measures also involves administrative and information provision costs. Most impact assessment studies referred to "no significant administrative costs in the order of several thousand Euros per firm". The survey responses again provided rather limited information concerning the specific nature and extent of these costs. One manufacturer suggested that administrative costs (including the human resources dedicated) are very high, if the full range of costs is taken into account, including management time to follow initial developments prior to the Regulation and to make changes across the firm, establishing and maintaining technical files and other documentation, the creation and operation of testing facilities, possible involvement in standardisation activities; and writing eco-design features into supplier terms and conditions. Another producer indicated that administrative costs are negligible and could well have been incurred anyway in responding to global market conditions. Most associations of producers of EuPs also considered that the costs for development and management of the technical and other relevant documentations can be rather significant occupying substantial human resources. In order to set some kind of benchmark for the costs, we asked stakeholders to indicate, if the costs are high in comparison with those incurred with other environmental legislation. The responses of six individual manufacturers are rather balanced (3 say that they are higher and 3 that they are less or the same). This suggests that the experience of firms can vary depending on the product concerned and their own situation.

Specifically concerning SMEs, their representatives consider that the compliance costs can be disproportionate. The most challenging part, according to UEAPME, is that the legislation encourages SMEs to adopt some form of life cycle approach over the longer term and this is a perspective that many of them are not familiar with. We should note however that at this stage no Implementing Measure has introduced generic requirements requiring the development of the Ecological profile of EuPs. Thus such costs should not be directly linked with the Ecodesign Directive. Still, to the extent that it does happen on a voluntary basis, it introduces short terms costs but it can also have the potential for substantial long term benefits.

Overall, it is difficult to draw conclusions in relation to the costs of the Directive and the Implementing Measures to manufacturers of EuPs and to validate or not the estimates in the impact assessments. Judging from the input available, it appears that the administrative cost aspects may be more problematic than the costs of the necessary changes to production that can often be part of firms' ongoing efforts to develop better, more efficient and more environmentally friendly products.

Further to that, some initial studies expected that manufacturers would be able to pass some or all the additional compliance costs on to consumers. The review of the impact assessment studies conducted on behalf of the UK government predicted that the net costs to UK manufacturers for most products examined (circulators, motors, televisions, non-directional lighting, dishwashers, washing machines) would be rather small as they were expected to pass most of the initial costs onto final consumers. Only in the cases of simple set top boxes and power supply units was there a prediction that manufacturers would eventually assume most of the relevant costs. However, it has not been possible to verify the extent to which such predictions have materialised. Furthermore, industry representatives (CECED) claimed that in practice most manufacturers had to absorb any additional costs resulting from the implementation of the Ecodesign Directive primarily due to their weak bargaining position in relation to the retailers of white goods and other electrical appliances.

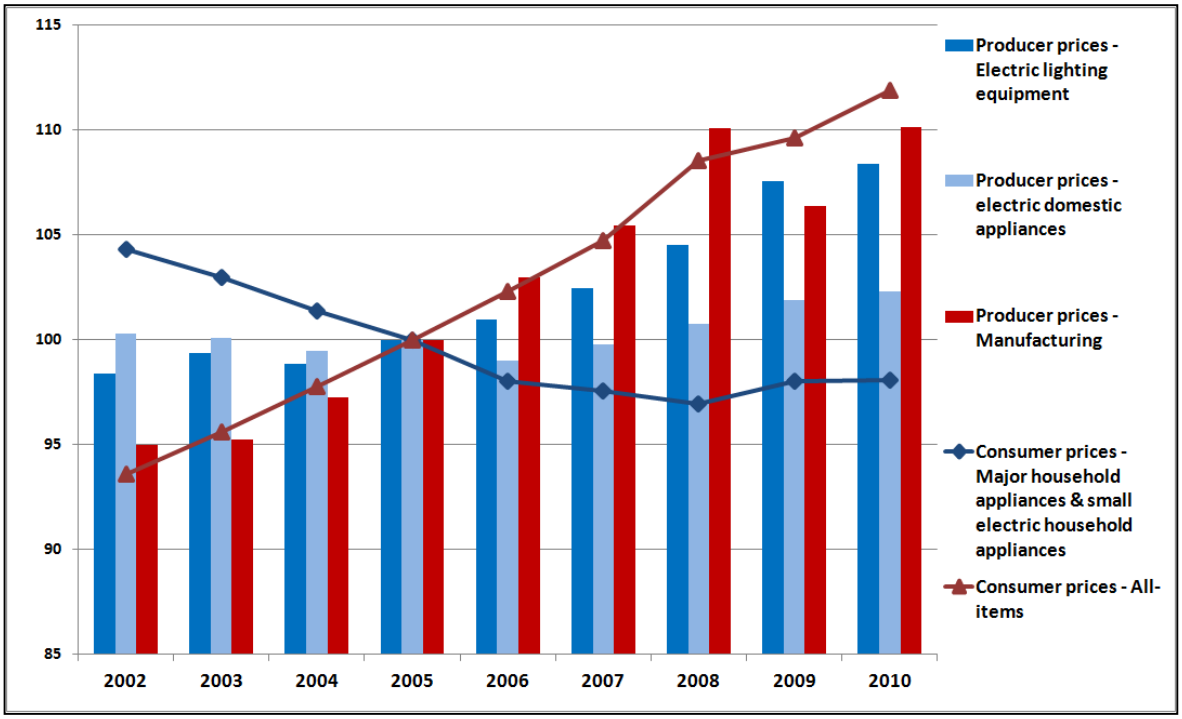
Impact on prices of EuPs

As in the case of costs to producers, market data on prices of EuPs covered by Implementing Measures have been rather limited. The individual responses of industry representatives and individual firms to the survey provided only a few specific examples. In the case of compact fluorescent lamps, there are currently products that cost below €1 in contrast to the assumption of a cost of € 7-10 in the preparatory studies a few years ago.

At a more general level, the data from Eurostat on the evolution of the producer and consumer price indices provide some additional support to the conclusion that Implementing Measures have not had a negative impact on the prices of EuPs. As presented in the chart below there has been a strong downward trend in the price of household appliances (both electric and non-electric) over the period 2002-2010, somewhat in contrast to the evolution of the global prices index.

At the same time, producer prices for electric domestic appliances and lighting equipment have increased at a lower rate than prices for the manufacturing sector in total. The evolution of these price indices is affected by a large number of factors (including energy and material costs) and does not provide conclusive proof that the Directive has not had any negative effect. As already indicated, the input from CECED suggests that it is manufacturers rather than consumers that have to absorb any additional costs resulting from the implementation of the Directive, given their weak position in relation to the retailers of white goods and other electrical appliances. However, it does suggest that, if anything, the adverse effect on the prices of household appliances has been minimal. Furthermore, a similar analysis conducted by the IEA for a number of countries indicated similar developments in other countries (Australia, US and Japan)[147].

Chart 3.31 – Evolution of producer and consumer price indices for selected product groups in EU27 (2005=100)



Source: Eurostat

Additional supportive evidence comes from a study conducted on behalf of Defra[148] that examined data from the UK on cool equipment covered by MEPS. It concluded that, all else being equal, the average price of most energy efficient products at the time that they enter the market has been declining over time. Data from the period 2000-2007 suggest that the average price for fridges in the A category declined substantially over time as those products increased their share in the market from 20% in 2000 to around

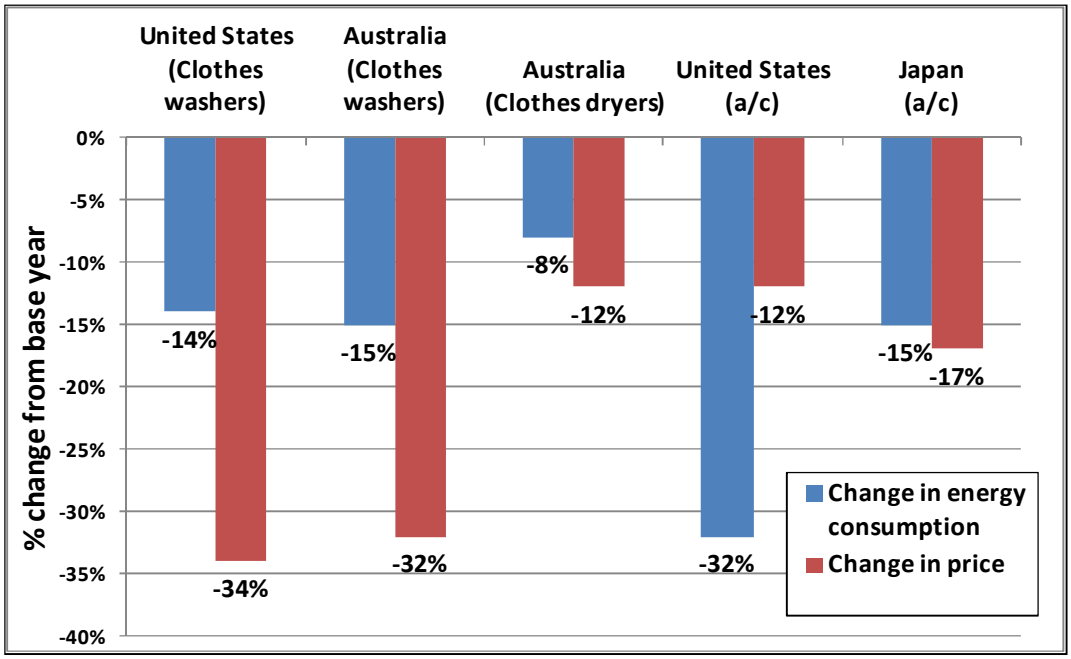
[147] International Energy Agency (2007), Experience with energy efficiency regulations for electrical equipment
[148] Final Summary Report Impacts of Innovation on the Regulatory Costs of Energy-using Product Policy, Policy Studies Institute & BIO Intelligence Service - A research report completed for the Department for Environment, Food and Rural Affairs

60% in 2007. This study also concluded that policy interventions such as MEPS may push up average prices but only in the short term. As time passes, manufacturers adjust their product ranges in response to a shift in demand and new (more efficient) products enter the market. Thus, policy interventions are expected to cause only a short term disruption in a long-term downward trend in prices. However, as the study is based on data from periods prior to the introduction of most of the Implementing Measures it does not provide direct evidence of the current developments in the European market for EuPs.

Such evidence can be found in third countries. In the US, the review of the market data following the introduction of standards for refrigerators at the state (California) and national level in the 1980s and 1990s suggests a decline in the unit value of products (wholesale price) very much in parallel to a high rate of improvement in energy efficiency and an increase in the features of the average appliance. Another study by the Lawrence Berkeley National Labs on behalf of the Department of Energy (DOE) in 2004 concluded that there was no evidence of an impact from standards introduced in the 1990s on the prices of products[149]. Additional studies[150] have found that price predictions in the rulemakings by the DOE for the different products tend to overestimate the impacts of standards from between 20% to 310%, because they did not properly integrate productivity improvements, changes in technology, economies of scale from increased production volumes and lower profit margins. Similar evidence is made available by IEA for other countries (Australia and Japan) that have used mandatory standards[151]. For all products examined a decline in real prices of between 10% and 45% was identified, in parallel to increases in energy efficiency of 10% to 60% over the period when data were available. The results presented in the following chart for clothes washers, dryers and air-conditioners apply also to cold equipment. Furthermore, the same study showed that the forecasted price in the relevant impact assessments of MEPS in Australia tend to be higher than the actual prices.

[149] Neubauer,M. et al (2009), Ka-Boom – The power of appliance standards – Opportunities for New Federal Appliance and Equipment Standards
[150] Larry Dale,Camille Antinori,Michael McNeil,James E. McMahon,K. Sydny Fujita (2009), Retrospective evaluation of appliance price trends, Energy policy, 37: 597-605
[151] International Energy Agency (2007), Experience with energy efficiency regulations for electrical equipment

Chart 3.32 - Summary of efficiency and price trends for clothes washers, clothes dryers and air conditioners (varying timescales)



Source: IEA, 2007

The IEA study concludes that, rather than leading to increases in the prices of appliances, the introduction of mandatory standards most often leads to an increase in market share and a reduction of the prices of the more energy efficient appliances.

Concluding, there is sufficient evidence supporting the view that the introduction of mandatory standards on energy efficiency has not had any negative impact on the prices of products at least at the level of the consumer. Other than an initial increase in the prices of certain products, the price of more efficient products tends to decrease, in contrast to what had been predicted in the initial studies. Direct evidence concerning the EuP Implementing Measures is scarce, but the discussions with stakeholders have not produced any apparent reason that these general conclusions do not apply to the EuPs covered by the Ecodesign Directive.

The analysis also suggests that there are possible weaknesses in the engineering/cost-based approach that is currently followed in the preparatory studies. It should be re-examined in order to take into consideration the impacts of technological advances and learning by doing and of increasing volumes of production as the market shares of the more efficient products increase.

Impact on innovation

The assessment of the impact of the Ecodesign Directive and the Implementing Measures on innovation requires, as a first step, a clarification of their expected role in this direction. On the basis of the provisions of the Directive there is no expectation that it should play a direct role in the development of new technologies. According to Annex II standards set are expected to be based on existing technologies available on the market. At the same time recital 17 states : *'while the best-performing products or technologies available on the market, including on international markets, should be taken as a reference, the level of Ecodesign requirements should be established on the basis of technical, economic and environmental analysis'*. Thus, we conclude that the main objective of the Implementing Measures is to promote the diffusion of existing energy efficient technologies and not the development of new

technologies. Within the context of the SCP/SIP it is the role of the Energy Labelling Directive, the European and the national Eco-labels and the other market-pull tools to promote the adoption of new technologies.

Having said that, the feedback from stakeholders still suggests a positive, even though indirect, role for the Directive in the development of innovation. According to a number of industry representatives, the Directive and the Implementing Measures provide the necessary framework conditions, a clear timetable and legal certainty for the operation of a competitive market and hence a good environment for the development of innovation. On this basis, the introduction of even longer term requirements than is currently the practice is considered to be desirable. Furthermore, while not representative, 9 of the 12 individual manufacturers/importers that responded to the CSES survey considered that the Directive has had a positive role in the stimulation of innovation.

Turning to the role of the Directive in the promotion and adoption of existing technologies, it seems clear that the requirements set in the first stage (Tier 1) of most Implementing Measures have had a very limited impact in terms of the adoption of existing energy efficient technologies. The focus has been on standard existing technologies and the main result is the elimination of the worst performers from the market. As suggested in the recently developed MEErP methodology, Tier 1 requirements represent '*an intermediate level which would typically reflect only small - application engineering type adjustments to the product and mainly serves to promote capacity building with the stakeholders and the surveillance authorities*'. This lead time provided by the Tier 1 requirements is generally considered to be a positive aspect by industry.

It is Tier 2 requirements, that are a result of the Least Life Cycle Cost assessment, that are linked to significant changes in terms of the adoption of energy efficient technologies The picture on the role of Tier 2 requirements is rather mixed. On the one hand, the information provided by some industry representatives suggests that the Implementing Measures have had a challenging role for some sectors and led to the adoption of existing or new technologies. In the power supplies sector, the Directive has strengthened the tendency towards more energy efficient products. In the case of lighting, the industry representatives suggested that while new technologies – such as LED - were already developed prior to the introduction of the Directive, there is a strong link between the adoption of new types of lighting and the requirements. There is nowadays a clear shift of the lighting industry towards LED-based technology with the number of LED lamps available on the market accelerating. According to one analyst of the lighting market *'...the LED lamp market is going to evolve at a breakneck pace in the coming years. New brands, improvements in the technology, consumer awareness and government regulations are all driving the demand for these lamps'*[152]. Inputs from the circulator industry also suggest that the requirements were quite ambitious and present a challenge to some producers.

In some other cases the requirements have not been ambitious enough and, while more demanding than the existing standard models, they seem to fall short of promoting the most efficient existing technologies. The analysis conducted for the purposes of the Coolproducts campaign concludes that the second phase requirements are set somewhere between the 'standard' and the 'most cost-effective' level corresponding to the least life cycle cost option. The study took place in 2008 and considered products available on the market. It is based on certain assumptions concerning the prices of products and electricity costs that are used to identify the Least Life Cycle Costs and the Best Available Technologies options used for comparison. According to the study, for four appliances for which Implementing Measures are in place, only in the case of washing machines are the Tier 2 requirements set close to the best available technology option. More importantly, in the case of fridges and clear lamps the requirements are well below what they identified as the most cost-effective option. In the case of 32'' TV sets they are a bit more efficient – on an annual consumption base – than the most cost-effective product in the market. [

[152] IMS Research releases monthly LED lamp retail price tracker – global average retail price for 60W incandescent LED lamps at $36 in October, http://www.ledsmagazine.com/press/32752

Table 3.38 - Comparison of expected annual energy consumption of EuPs according to stage 2 requirements set by Implementing Measure against standard, cost-effective and most efficient options identified in the Coolproducts' campaign study (kWh/year)

	Stage 2 requirement	Standard product	Cost- effective product identified on the basis of LLCC criterion according to study experts	Most efficient product on the market as defined by the Coolproducts study experts
Television (32'' LCD)	**175**	240	180	89
Fridge	**260**	324	251	192
Washing machines	**185**	220	198	186
Domestic lighting (only clear lamps)	**285**	378	185	185

Source: Coolproducts

Considering the main reasons for the less demanding standards, the available evidence and the input from stakeholders point to a number of operational limitations in the implementation of the Directive. One problem is the delays in the development of some Implementing Measures. As has been argued by some firms, prolonged development periods can introduce long periods of uncertainty and lead to delays in investment in new technologies, cancelling the general benefits of stability and certainty referred to earlier.

The problem is that the delays in the development of some Implementing Measures and the length of the process from the launching of the preparatory study to the entry into application of legal requirements[153] can lead to a definition of requirements on the basis of outdated data. The fact that the Implementing Measures may enter into force 6 or 7 years after the end of the preparatory study and that the most demanding Tier 2 requirement may be introduced 4 or 5 years later means that the requirements may often fail to relate to recent market trends and technological developments. The case in requirements for televisions is one such example. According to the consultant that conducted the study, at the time LED based displays were still considered to be a niche product, there were no standards available and limited information. However, since then, LED based technology has become widespread making the 2012 requirements rather easy to meet for the great majority of products. From the point of view of adoption of the new technology, it may still be argued that the requirements have played a positive role in promoting the adoption of LED technologies. Having said that, it can also be said that the Tier 2 requirements became irrelevant some time before their entry into force.

Another reason for less demanding requirements, as indicated by a number of NGOs, eco-design experts and some Member State representatives, is the use of the least life cycle cost (LLCC) criterion for setting the requirement levels[154]. According to these stakeholders the use of the Least Life Cycle criterion often leads to the setting of requirements that may be below the performance of the average product in the market. The cases of fridges and clear lamps identified in the Coolproducts study are such examples. An alternative approach based on equal life cycle costs (i.e. no additional costs to consumers over the life cycle) could be used to determine more demanding requirements while not having an impact on the total life cycle cost of the product.

[153] Around 5 years between the start of the preparatory study and the entry into application of Tier-1 requirements, and between 1 and 4 years between the entry into application of Tier-1 requirements and Tier-2 requirements.
[154] Refers to the product configuration in which the overall costs of the product through its whole life cycle are reduced to a minimum, meaning that the additional investment costs are more than outweighed by reduced energy and other costs during the estimated product lifetime.

However, we should note here that the provisions of the Directive (article 15) require that there is no negative effect on both the life cycle costs and the affordability of the product. This means that account must be taken of the purchase price. The analysis provided in the Coolproducts study suggested that for some of the product categories considered the prices of the most cost effective model were already significantly higher (20% for fridges and 200% for lamps). The use of an equal life cycle costs approach could possibly result on even higher purchase price that would make them unaffordable for certain parts of the population. This is clearly not desirable from both a political and a social perspective. Having said that, as already indicated, there is significant evidence that prices of energy efficient products tend to fall over time as a result of the learning curve and economies of scale. Still, it is uncertain whether these developments will take place before or after the introduction of the more demanding Tier-2 requirements.

From a rather different angle, a few firms considered that the efficiency requirements may inhibit the development of additional functions as the requirements do not always take into account the possible additional energy needs. However, no concrete evidence was provided to substantiate the assertion that the requirements have created constraints in the introduction of new functions. Furthermore, the consultation process and the long lead times until the entry of Tier 2 requirements into force should, at least in most cases, allow manufacturers to address any such constraints.

The identification of advanced benchmarks in the Implementing Measures was another tool expected to promote the adoption of new technologies by providing information on best performing products already in the market and providing businesses with a long-term perspective of future minimum requirements. Furthermore, benchmarks were expected to contribute indirectly, through their use in defining high performing energy labelling categories, in setting public procurement or for defining financial incentives. However, the evidence available indicates that they have had a very limited role up to this point. Most industry stakeholders did not consider that advanced benchmarks have made any contribution, stating that they are rarely taken into consideration. The best available technologies indicated are usually well known in the market but may not be accessible due to intellectual property constraints or high investment costs. Furthermore, on the basis of the survey responses, only the Swedish authorities make use of advanced benchmarks in setting public procurement requirements.

The absence of a dynamic approach to the Ecodesign Implementing Measures is also an issue raised by a number of stakeholders. In principle the review process provides the mechanism for addressing and correcting problems relating to outdated data, unambitious requirements and missed opportunities. However, some stakeholders question whether the review process can serve this objective pointing, primarily, to the high resource inputs required from the Commission resources and stakeholders. Specific suggestions to increase the dynamic character of the Implementing Measures have also been made including:

- The introduction of more ambitious tiers of requirements within implementing measures linking their entry into force with market developments, i.e. entering into force after a percentage defined in the implementing measure of devices put on the market reaches a certain efficiency level.
- Using the advanced benchmarks as medium term target standards by presetting the new minimum efficiency standards to be determined for the next revision of a regulation.

From an evaluation point of view there is no experience at this stage to assess the effectiveness of the review process and the capacity to ensure the dynamic element of the Ecodesign requirements. We do recognise the potential issue arising from the limited resource inputs. However, as analysed in sections 3.4.6, the cost-effectiveness of the Ecodesign requirements justifies the allocation of more resources. We should also point out that the linkage of requirements with market developments cannot be implemented at this stage. The analysis has already pointed to the absence of relevant and up-to-date date on market developments as a key problem in assessing the effectiveness of the Implementing Measures. Thus, prior steps ensuring the availability of reliable data need to be taken before such a measure is considered. The

issue of data availability is a broader one affecting a range of implementation aspects and it is further discussed in section 3.4.3. In contrast, we do not see any obstacles or problems in the adoption of longer term requirements, possibly making use of the advanced benchmarks that, as already indicated, have not had a clear role so far and consequently have remained rather irrelevant[155].

Overall, the evidence suggests that, directly or indirectly, the Ecodesign Directive and the Implementing Measures do have a role in the adoption of energy efficient existing technologies – its prime objective, but also, in some cases, the development of new technologies. At the same time, the length of the decision-making process and the resulting reliance on outdated data for the development of the requirements can mean that the regulatory requirements do not properly reflect market trends and technological developments and this may lead to missed opportunities in terms of promoting more energy efficient technologies.

Impact on importers

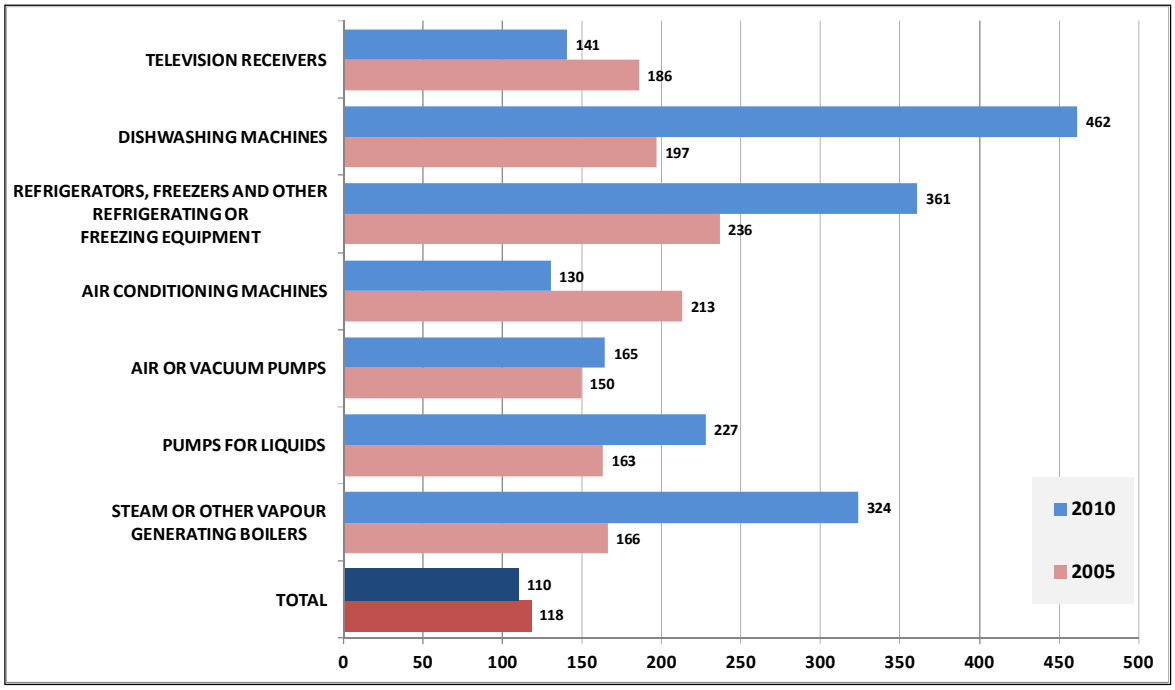
Our research has not produced evidence of adverse effects on importers of EuPs and the input from stakeholders is that there have been no significant changes for importers. The only concerns raised were about the difficulty in following the requirements and procedures of the Directive. Still, these are not seen as different from those applying to European firms, especially SMEs.

The review of the minutes of a number of WTO Technical Barriers to Trade Committee meetings, indicate that the main concern of the representatives of some non-EU countries – mainly China - is the adoption of more stringent requirements than those adopted internationally (e.g. the adoption of 0.5W for stand-by in contrast to the one watt plan promoted by the IEA) or that required measurement and test methods often deviated from the international measurement methods. In relation to the former, representatives of China in the WTO suggested that the more demanding standards created special difficulties for developing countries.

Examining trade data from Eurostat and the WTO we do not see evidence of a relative reduction – in comparison to the general trade patterns – in the level of imports from non-EU countries for almost all categories of products already covered by an Implementing Measure. As indicated in the following chart, the data for the period 2000-2010 show an increase in the level of imports for almost all products and at rates greater than the total increase in the volume of trade. Import levels for 2010 were clearly affected by the financial crisis. At a country level, there is great variation depending on product category but, in general, the data suggest significant increases from China, in particular, and India and less so from the US, Japan or South Korea (Eurostat trade date).

[155] Another proposal made was for the adoption of a process similar to that applying in the case of ISO50001 standard that concerns energy management in organisations that requires continual improvement. This requires that an energy declaration must be made by the organisation involved including a time frame and target. After that time the certification runs out unless the next stage of improvements are made. The evaluation team does not feel that it can make a proper assessment of such a proposal. However, we need to point out that there may be important enforceability issues and additional burden on market surveillance, an area which is already undersourced.

Chart 3.33 – Evolution of the volume of imports (in kgs) to the EU for selected energy using products (2000=100)



Source: Eurostat

Impact on market structure

The introduction of Implementing Measures for Ecodesign requirements could in theory influence the market structure by shifting market power from companies with established positions.

A key issue is the impact on the number of suppliers, and thus the level of competition in the specific markets, and the possible barriers to entry to the market. What we have already concluded in the analysis above is that SMEs may face rather higher costs - in relative terms. Larger firms are in general able to spread the compliance costs over a larger number of units of production compared with SMEs and in that respect the Implementing Measures– as is common for a number of regulations – may have an asymmetric impact. Similarly, the Implementing Measures may raise the threshold for entry to the market by increasing fixed costs for establishing a business. Unfortunately, data from Eurostat in terms of new firm creation and turnover of firms of different size are not recent enough to allow us to assess whether any changes have occurred.

What should be noted though is that for most of the white goods but also for TV sets and circulators[156] the markets were already dominated by a small number of large EU or non-EU firms[157]. The case is rather different in the relation to electric motors characterised by a larger number of small size producers despite recent consolidation trends[158]. What we observe, as indicated earlier, is that the prices of appliances have, in general, been reduced. Even if not conclusive, this is an indication that the forces of competition do operate in the relevant markets.

[156] http://ec.europa.eu/energy/demand/legislation/doc/consultation_forum/2008_05_27/annex_2_circulators_en.pdf
[157] http://www.ecowet-domestic.org/index.php?option=com_docman&task=doc_view&gid=28
http://www.displaysearch.com/cps/rde/xchg/displaysearch/hs.xsl/061208_pr1.asp
[158] http://www.eceee.org/Eco_design/products/electric_motors/ExplanatoryNotes_motors

Furthermore, given the EU-wide application of the Implementing Measures, we do not expect any direct adverse effects on manufacturers in specific countries in the EU and the same applies in relation to non-EU manufacturers that have to comply with the same requirements. Having said that, we should note the position of the representatives of Norwegian industry and the government who state that the Primary Energy Factor value of 2.5 for electricity used in a number of preparatory studies is incorrect and places electric appliances at a disadvantage in comparison to natural gas based appliances. This is said to disregard the use of hydro electric power in Norway and more generally, the increasing role of renewable resources in the production of electricity. At the same time, to the extent that this approach penalises the use of renewable it could be considered to be in conflict with the long term goal of decarbonisation set in the Energy Roadmap 2050[159] where the increasing use of renewables is identified as a key aspect.

In relation to the possible impacts of the Ecodesign Directive and the Implementing Measures along the supply chain, we have not received any input indicating that it has affected in any material way the balance of power among the various actors that include equipment suppliers, producers of components and final product manufacturers. The Directive applies to the final product manufacturers that are responsible for compliance with the requirements which, as in the past, are the ones that most often set the design specifications for the specific products. The Ecodesign requirements could potentially strengthen the position of equipment or component suppliers or owners of certain technologies where the use of their technology assists compliance with the Ecodesign requirements. Our attention has not been drawn to any such cases. In general, there is widespread availability by suppliers of the relevant hardware and software, suggesting that there is unlikely to be a shortage of required parts and that individual suppliers will not be able to impose significantly increased prices due to higher demand[160].

Finally, we have been unable to identify any direct evidence on the balance of power between manufacturers, installers, distributors and retailers arising from the implementation of the Directive. However, equally, we have not seen any reason to suppose that these relationships have been significantly altered.

Impact on the competitiveness of the European industry

There is again rather limited information to assess the impact of the Directive and the Implementing Measures on the competitiveness of the European industry. Given the early stages in the implementation process and the relatively relaxed Tier 1 requirements, direct impacts are rather limited at this stage. Furthermore, parameters such as access to finance, level of market demand, access to necessary skills or costs of energy and resources can have a much greater impact than legislation that is explicitly required not to cause any significant impact on manufactures (article 15). This aspect is of course, considered in the preparatory studies and in the subsequent development of the Implementing Measures. Indeed, recent reports on the competitiveness of the electrical and electronic sector refer to lower productivity and value-added levels in comparison to the US and Japan and R&D expenditure as the main determinants of performance[161]. To the extent that the Directive and the Implementing Measures contribute to the adoption of energy efficient technologies, the Directive can have a supportive role against firms that are not subject to such requirements. In contrast, in the case of electric motors, the Ecodesign requirements are less demanding than the corresponding U.S. standards. According to one sector expert[162], US producers are expected to gain market share by offering more efficient products. However, for many other product categories with few global players, the Ecodesign requirements should not be expected to have such an impact. The costs of compliance with the Implementing Measures could possibly affect the profit margins

[159] http://ec.europa.eu/energy/energy2020/roadmap/doc/com_2011_8852_en.pdf
[160] Information provided on Impact Assessment for the UK government on stand-by, http://www.ialibrary.bis.gov.uk/
[161] http://ec.europa.eu/enterprise/sectors/electrical/files/electrareport_annex1_en.pdf
[162] http://www.machinebuilding.net/ta/t0207.htm

of firms as compared with non EU competitors. However, according to most impact assessments conducted so far, such costs have not been expected to be substantial and, with the possible exception of circulators, the limited information provided does not indicate that this has been the case. Reduced unit costs resulting from learning effects and increases in production volumes allow manufacturers to maintain, on average, similar profit margins, even in a situation of falling overall prices for appliances [163].

For both positive and negative aspects, one needs to consider that similar, if not more demanding, requirements have been introduced in most other regions of the world and in all important markets (e.g. US, Japan, China, Australia, Canada), at least as far as energy efficiency requirements are concerned. Non-EU manufactures selling in non-EU markets face similar administrative and other compliance costs as well as incentives for the adoption of new technologies.

Concluding, while it difficult to reach specific conclusions on the impact of the Ecodesign Directive on the competitiveness of European industry, there is no indication of a particularly negative impact of the Directive. If anything, the Directive provides a positive basis for innovation and adoption of new energy efficient technologies that are important for maintaining competitiveness in the long term. The Directive has yet to be fully tested in terms of the possible impact on competitiveness from the adoption of measures related to other environmental aspects. This is an area where similar legislation in other countries is largely absent and where the impact – positive or negative – may be more significant.

Looking beyond the EuP sector, energy use is an important input for almost all industrial and service sectors and energy savings are a key factor for the competitiveness of EU businesses. Legal measures on energy efficiency are adopted or are under discussion in most regions of the world. It is thus crucial that the EU legal framework supports the access to similar or even better energy efficient technologies. Irrespective of its possible weaknesses, the presence of minimum standards, in combination with Energy Labelling, represents a key tool in this direction. Furthermore, if the conclusions from a recent study on the role of minimum efficiency requirements in the United States apply in the EU, the establishment of standards can have an important role in job creation through the investment of part of the savings made[164].

3.3.5 Global impacts of the Ecodesign Directive

The assessment of the broader global impacts of the Ecodesign Directive concerns three main aspects:

- the effect of the Directive on third countries including any possible effects on the performance of the products traded in third countries
- the impact on the introduction of relevant regulations in third countries
- possible impacts on the global harmonisation of standards

In relation to the first point, on a theoretical basis there is indeed the potential for positive externalities in areas where no specific or less stringent standards apply. In this direction, feedback from a small number of manufacturers is that they are attempting to 'impose' European standards (i.e. requirements) on other markets, where they can. However, in general, it has not been possible to identify clear evidence of a direct impact of the Ecodesign Directive on the actual performance of products traded in other countries. What is probably more relevant is the indirect effect through the influence of the Ecodesign Directive on the legislation in other countries. It is important here to distinguish between regulations focusing exclusively or primarily on energy efficiency - which have also been the main issue addressed in the Implementing Measures - and the more general approach also adopted by the Ecodesign Directive

[163] DEFRA study, impact of innovation
[164] Gold,R et al. (2011),Appliance and equipment efficiency standards- A moneymaker and job creator

concerning the a life cycle dimension that means that the overall ecological profile of a product should be considered,looking into a broad range of environmental aspects.

In relation to the second issue, it should be noted that minimum standards were already in place in the US, Australia, Korea and Japan even earlier than the introduction of the Ecodesign Directive[165]. In some other countries the requirements set have had a direct influence. Canada and Switzerland are examples where recently introduced regulation is very closely related to the requirements set for stand-by products. The voluntary agreement on set-top boxes under development in Australia explicitly refers to the European standards as the default global standards and has set the Ecodesign Directive as the baseline standard. There is also a stated intention that Australian requirements should follow the EU requirements (1 watt and 0.5watt) on stand-by. The UNEP 'En-lighten' initiative[166] to ban incandescent light bulbs worldwide has benefited from the EU experience with the participation of the European Commission and other EU public and private organisations as members of the relevant task forces. The extensions of the Top Ten Europe programme (supported by the European Commission through the Intelligent Energy Europe Programme) to other regions (China and the US) promotes more energy efficient appliances through information to consumers but also provides advice and sharing of experience to policy makers.

At the same time, at an international level there are several initiatives aiming to increase exchanges between regions on the setting of standards. These include the international Super-efficient Equipment and Appliance Deployment (SEAD) initiative[167] that promotes the adoption of the most energy efficient standards across the major economies of the world, coordination activities within the context of International Energy Agency for the promotion of the 1 Watt requirements on stand-by or the Agreement for a Co-operating Programme on Efficient Electrical End-Use Equipment (4E)[168] with the participation of a number of EU Member States.

All these initiatives offer opportunities to promote the EU Ecodesign policy framework and operate as a basis for mutual learning among policy makers, in a policy area where most countries are already quite active. According to the IEA 4E programme there is evidence of a convergence of the minimum efficiency requirements of products in several regions and this should over time lead to a convergence of the performance of products. The implementation of the EU Ecodesign Directive is clearly reinforcing this trend and in some cases it serves as an example or a benchmark indicating an indirect effect in the performance of products in third countries.

Looking beyond the issues of energy efficiency, the information made available by stakeholders and the research conducted by CSES did not identify any comparable scheme following the Ecodesign Directive's consideration of a broader range of environmental aspects on the basis of a life cycle approach. We do not have information of any efforts to promote this approach which in any case has yet to be tested. At this stage, most relevant initiatives covering other environmental aspects concern the development of relevant labels and in most cases operate on a voluntary basis. In that respect, the Ecodesign approach does represent a frontrunner. However, since most Implementing Measures have focussed mainly on energy efficiency so far, there is no possible learning impact.

Finally, on the third point, the globalisation of standards, there are indeed significant developments towards harmonisation that tend to be more and more agreed at an international level through the International Electrotechnical Commission. Initiatives such as CLASP[169] and IEA 4E[170] have as one of their

[165] EPTA, PE International and NTUA(2007), Study for preparing the first Working Plan of the Ecodesign Directive
[166] http://www.enlighten-initiative.org/Home/tabid/4915/Default.aspx
[167] http://www.cleanenergyministerial.org/SEAD/index.html
[168] http://www.iea-4e.org/
[169] Collaborative Labelling and Appliance Standards Program, http://www.clasponline.org/index.php
[170] 4E - Efficient Electrical End-Use Equipment, http://www.iea-4e.org/

prime objectives the promotion of a more consistent approach to standards internationally although this is still work in progress. A recent study by CLASP[171] in April 2011 concluded that for some products including refrigerators, clothes washers and dryers, water heating appliances, space heating appliances the degree of harmonisation of test procedures was relatively low while it is much higher in the case of electric motors, external power supplies, air conditioners and light bulbs. New IEC standards were expected by CLASP to have a positive role for most of the products. A number of firms and industry associations also pointed out that the coordination between the development of standards under IEC – as the international body for electrical appliances – and the relevant European bodies is not always effective and there is scope for improvement.

Overall, we can conclude that the Ecodesign Directive has an important role within a global context where policies concerning the energy efficiency of appliances are common. In relation to the requirements set in the Implementing Measures there is a gradual move towards the more demanding standards in all regions supported by the initiatives described. In relation to the broader coverage of environmental aspects, it has not been possible to identify countries where the overall Ecodesign Directive Framework has been adopted. Still, given that very limited actual use has been made of this so far by the EU, it is not possible to speak of a leading role.

Conclusions on the effects of the Ecodesign Directive on industry and markets

The investigations in this area have been hampered by problems of data availability, especially in relation to the costs for industry arising from the Ecodesign Directive and its impacts on market prices. Nonetheless, partial evidence does allow some conclusions to be drawn on a range of matters relating to the impacts of the Directive on industry and markets, both within the EU and on a global scale. The following summarises these conclusions:

- The Implementing Measures already in force cover only a small part of the overall energy consumption in households. In 2008, electricity for lighting and appliances represented only 14% of the total. In comparison, space and heating represented 84% of the total consumption. The Directive consequently has considerable remaining potential.
- The greatest improvements in energy efficiency have taken place with electrical appliances (refrigerators, freezers, washing machines, dishwashers and TVs) and heating while improvements have been less marked in the relation to cooking and water heating. This is significant, in that there are still not Implementing Measures for these products.
- Estimates provided by stakeholders of the costs incurred in complying with the Implementing Measures vary considerably, ranging from major impacts to almost negligible ones. An issue is the extent to which development costs can be attributed to the Directive, when they might have been incurred in responding to market pressures.
- An important factor in minimising the impact of costs to manufacturers is the lead times allowed before the introduction of the most stringent requirements. This means that compliance costs can be assimilated in normal development costs.
- Unit production costs for products covered by current Implementing Measures should be expected to decline after an initial increase, as market shares and the production volume of new, efficient products also rise.

[171] CLASP and Navigant Consultants, Opportunities for Success and CO_2 Savings from Appliance Energy Efficiency Harmonization, http://www.clasponline.org/clasp.online.resource.php?disdoc=781#opportunities

- Feedback suggests that administrative and information provision costs can also be high and pose a particular problem for SMEs.
- The available data on the evolution of producer and consumer price indices provide some support to the conclusion that Implementing Measures have not had a significantly negative impact on the prices of EuPs, in a situation where the prices of household appliances are generally falling
- A similar situation is found outside the EU. This situation contrasts interestingly with preliminary studies that have tended in all regions to anticipate a greater impact on product prices.
- The Directive does not set out to promote the development of new technologies, but rather to promote the diffusion of existing energy efficient technologies. Furthermore, particularly because of delays between preparatory studies and the adoption of Implementing Measures, Tier 2 requirements can fall short of promoting the most efficient existing technologies, notably in the case of TV sets.
- The use of the Least Life Cycle criterion in combination with the significant time lapse for the entry of the requirements into force may also on occasions lead to requirements that are less demanding than performance levels that are common in the market at the time of application.
- So far, the identification of advanced benchmarks in the Implementing Measures has had a very limited effect either through use in public procurement or as an indication to the market of likely future developments.
- Industry stakeholders nonetheless suggest a positive role for the Directive in the development of innovation, by providing the necessary framework conditions, a clear timetable and legal certainty for the operation of a competitive market and hence a good environment for the development of innovation.
- Investigations have not found evidence of adverse effects on importers of EuPs. Data for the period 2000-2010 show an increase in the level of imports for almost all products covered by an Implementing Measure and at rates greater than the total increase in the volume of trade.
- While it is difficult to reach specific conclusions on the effects of the Ecodesign Directive on the competitiveness of European industry, there is no reason to suppose a negative overall impact. If anything, the Directive provides a positive basis for innovation and adoption of new efficient technologies that are important for maintaining competitiveness in the long term.
- The Ecodesign Directive has an important role within a global context where policies concerning the energy efficiency of appliances are common. Examples of other countries following an EU lead are cited

The following table provides possible points of action arising from conclusions on the impacts of the Directive on markets and industry.

Possible actions arising from the conclusions on the Impacts of the Directive on markets and industry
• The restricted availability of data on the market performance of products covered by the Ecodesign Directive and equally on their environmental impacts again suggests that an effort to develop data frameworks and to collect the appropriate information is an important task for the future monitoring of the Directive and related legislation. • In future Implementing Measures, more account should be taken of developments in the market, so that they can be reflected better in the requirements. This will require more extensive preparatory studies and improvements in the collection of data.

- The engineering/cost-based approach that is currently followed in the preparatory studies should be re-examined in order to take into consideration the possible impact of expected technological advances and learning by doing and of increasing volumes of production on production costs as the market shares of the more efficient products increase.
- The use of the Least Life Cycle criterion should be kept under review and consideration given to the use of 'equal life cycle costs (i.e. no additional costs to consumers over the life cycle) on occasions when there is not an excessive initial impact on prices and when use of least life cycle would otherwise lead to the setting of requirements that are below the performance of the average product in the market .
- Preparatory studies and impact assessments need to take into account the observation that in international studies estimates have not sufficiently anticipated falling prices in the markets for domestic appliances.Consideration should be given to setting even longer term (Tier 3) requirements, as a way of assisting long term planning by industry. This would contribute both to the promotion of innovation and to helping to minimise the costs of production, by allowing changes to be anticipated.
- Similarly, the Commission should give further thought to enhancing the profile and application of advanced benchmarks, going beyond the current proposals in relation to their role in Green Public Procurement. They could possibly be linked with longer terms Tier 3 requirements and operate or be used as major points of reference in the review process.
- The co-ordination of European bodies with the IEC –the international body for electrical appliances - in the development of international standards should be kept more closely under review and, where necessary, improvements promoted.