"Omnibus" Review Study on

Cold Appliances, Washing Machines, Dishwashers, Washer-Driers, Lighting, Set-top Boxes and Pumps

FINAL REPORT

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Executive Summary

This study is an exploratory analysis to provide a prioritisation and indication of extensiveness of review activities related to measures that currently exist for eight product groups: Domestic Washing Machines, Domestic Dishwashers, Domestic Washer-Driers, Domestic Cold Appliances, Lighting products (non-directional, tertiary and 'special purpose'), Set-top Boxes. For water pumps only a review of tolerances was required.

The analysis focused on possible energy savings as basis for prioritisation, but - following the request of the European Commission made during the kick-off meeting - also considers resource efficiency aspects insofar feasible within the constraints of the study. The conclusion of this exploratory study is that for all product groups considered (except pumps) a revision of existing regulations (or introduction of new regulations) is the preferred policy option.

The analysis shows that these product groups are expected to (continue to) meet eligibility criteria for the introduction of ecodesign and/or energy labelling measures, with simple set top boxes as sole exemption as its market and environmental significance is in rapid decline (sales are expected to be marginal by 2020).

Important non-energy aspects were addressed in the analysis for the following products groups: Washing machines, washer-driers and dishwashers (water consumption and status of method development), cold appliances (status of method development), lighting products (material aspects) and simple set-top boxes (resource efficiency aspects). A full (quantified) assessment of possible revised measures (on energy or resource efficiency) and their impacts on consumers, industry or other stakeholders is outside the scope of this exploratory assessment, as such an assessment should be covered by the proposed follow-up activities.

The study identified the following product groups as "High priority", requiring extensive / comprehensive further study:

- Lighting products, as the energy savings potential is the largest (non-directional: 18 TWh/year in 2030, tertiary: 18 TWh/year in 2030) and a horizontal approach (combining several existing measures) should be considered. The missed energy savings from 'misuse' of special purpose lamps for general lighting varies between 0.3 to 1.3 TWh/year, depending on the alternative that consumers would have bought instead (halogen or CFL).
- Domestic cold appliances, as the saving potential is also large (at least 5 TWh/year in 2030), and an assessment of correction factors, number of product categories and the effect of a revised test standard is required. The study should also include an assessment of possible ecodesign requirements for wine storage appliances;
- Domestic washing machines, also due to their savings potential (3 TWh/year in 2030) and the need to better understand the interaction between a.o. washing temperature, cycle duration, label information, and actual load behaviour by users.

Of "medium priority", requiring either a modest study enabling a possible fast track approach, or a more elaborate study in case the fast track approach is not feasible, are:

- Domestic dishwashers as no urgent issues requiring immediate action have been identified, although the introduction of a new test standard should be closely followed and some inconsistencies in regulatory texts and standards can be solved. The savings potential is assessed at 1.4 TWh/year in 2030;
- Domestic washer-driers as although the out-dated energy label is up for urgent review, no other direct problems have been identified. Alignment of requirements with other laundry

appliances should be considered. The saving potential for domestic washer-driers could not be assessed in this exploratory study.

Of "low priority", requiring no further study, or a study of explorative nature, are:

- Simple set top boxes, as the significance of the product group will be reduced within a decade, and the energy savings potential is modest (0.2-0.3 TWh/year in 2030). The resource efficiency related savings potential is estimated to be relatively significant compared to the direct energy but in absolute terms the impact is limited as sales diminish.

Note that all saving potentials presented have to be analysed further as regards life cycle costs and possible negative impacts on manufacturers, consumers, functionality, etc..

The prioritisation is based on several aspects that need to be considered when reviewing the existing measures and which would require limited or extensive follow-up study. The list below mentions the most prominent aspects that a future review should address:

Domestic dishwashers: Although a change in the test standard might incur changes on energy efficiency values, drying and cleaning performance, no immediate or urgent issues have been identified. The energy class A+++ is not densely populated. A modest review provides an opportunity to reconsider the calculation method for the EEI and to remove inconsistencies between the ecodesign and labelling regulations. A more extensive review should address issues for better alignment of the measurement and calculation method to real life use and the possibility for resource efficiency requirements.

Domestic washing machines: The A+++ energy labelling class is filling up faster than expected. A comprehensive study should look into the possible causes of this phenomenon, such as the increase of washing cycle duration and decrease of actual wash temperatures for the 'standard 60ºC cotton cycle'. Furthermore the review could assess the appropriateness of introducing rinsing (and possible spin drying) requirements and whether the energy label information should be amended to include wash cycle duration and/or washing performance (ao.). Also important is to have a better understanding of actual (real-life) loading behaviour by consumers and how this relates to the trend in increasing washing machine capacity. The feasibility of resource efficiency requirements should also be addressed in this follow-up study.

Domestic washer-driers: A review provides an opportunity to terminate the out-dated energy label Directive and introduce updated energy labels, if needed combined with ecodesign requirements. This update should be aligned, or combined, with activities related to washing machines. Depending on which option is taken, the calculation of energy efficiency should be re-assessed as 'washing' appears to be a more prominent activity than 'drying'. The feasibility of resource efficiency requirements should also be addressed in this follow-up study.

Domestic cold appliances: A revised international test standard is about to be published, which is expected to change the current EEIs. The effects of this should be considered. The review also provides an opportunity to reconsider the various correction factors (for climate class etc.) as urgently requested by stakeholders, and a proper consideration of ecodesign requirements for wine storage appliances. The feasibility of resource efficiency requirements should also be addressed in this follow-up study.

Non-directional light sources: The exploratory analysis shows that there are considerable uncertainties when and how a revision of the existing regulation should be implemented in order to minimise possible negative impacts in terms of functionality, affordability and industry's competitiveness. The possibility of a holistic approach whereby the regulations for all lighting products (including 245/2009 and 1194/2012) are treated in a single piece of legislation should be considered. The above will require a comprehensive follow-up study in which resource-efficiency requirements should be considered as well.

Tertiary lighting: The energy savings claimed above can partly be met through replacement of out-dated ballasts, partly by improvements of minimum lamp efficacy. Impacts on temperature sensitivity and life time should be assessed. The LED lamp type should be included in the scope of tertiary lighting products. The possibility of a holistic approach whereby the regulations for all lighting products (including 245/2009 and 1194/2012) are treated in a single piece of legislation should be considered. The above will require a comprehensive follow-up study in which resource-efficiency requirements should be considered as well.

Special purpose lamps: The exploratory study mentions several options to deal with the misuse of incandescent types, but also signals that in general a more comprehensive study on the definition of special purpose lamps and other exceptions is needed in order to make the next step in efficiency improvement without causing significant negative impacts. This would also need to fit in a holistic approach for lighting products.

Simple set top boxes: The analysis shows a rapid decay of significance of this product group, but also that a revision could be used to align scope and definitions with related measures and initiatives and to reap (limited) energy savings. The analysis has also assessed the possible effects of measures regarding resource efficiency, showing larger indirect energy savings than by increasing energy efficiency alone. This analysis however should be further scrutinised as the assessment is based on a simplified analysis and background study. Therefore the options are to either leave the existing regulation as is (no change) or to have a further study into resource efficiency measures as a first 'test case'.

Water pumps: The assignment for this product group was limited to investigating the aspect of test tolerances, i.e. the allowed deviation between measured and declared values. The exploratory study did not result in information that the existing regulation needs to be revised on this point.

Contents

1. Introduction

1.1 General information

This is the Interim Report for services under contract reference ENER Lot 2 №EN ER/C3/2012-418-Lot2/03 in the context of the multiple framework contract №ENER/C3/2012-418-Lot 2.

This service contract requires a study related to the review of the following Commission Directive and Regulations, including all amendments of these:

Table 1-1 Subject of the review study

	Product group	Measure	Reference
1	Washer dryers	Energy labelling	Commission Directive 96/60/EC
2	Simple set-top boxes	Ecodesign	Commission Regulation (EC) No 107/2009
3	Non-directional lamps	Ecodesign	Commission Regulation (EC) No 244/2009 [1)]
4	Lamps without ballast & ballasts	Ecodesign	Commission Regulation (EC) No 245/2009 [2)]
5	Household cold appliances	Ecodesign	Commission Regulation (EC) No 643/2009
		Energy labelling	Commission Regulation (EC) No 1060/2010
6	Household washing machines	Ecodesign	Commission Regulation (EC) No 1015/2010
		Energy labelling	Commission Regulation (EC) No 1061/2010
7	Household dishwashers	Ecodesign	Commission Regulation (EC) No 1016/2010
		Energy labelling	Commission Regulation (EC) No 1059/2010
8	Water pumps	Ecodesign	Commission Regulation (EU) No 547/2012

1) Including Commission Regulation 859/2009, Non-directional lamps, Amendment UV radiation.
2) Including Commission Regulation 347/2010, Lamps without ballast & ballasts, Amendment UV radiation.

1.2 Tasks

This review study provides supplementary analysis to help the preparation of the review of abovementioned measures.

Specific activities

The specific activities to be performed during this review study have been outlined in the Request for Services as follows:

- analyse and use existing key documents (e.g. CLASP-analysis) as basis for the review study of the above mentioned Regulations, and, if appropriate, relevant legislation in third countries;
- if necessary, collect and evaluate relevant market data;
- identify new products and technologies that have relevance in the context of the regulations and assess whether the scope of the regulations is still appropriate;
- conclude on further improvement potential;

- assess other aspects that might require an adaptation of the regulations;
- in addition, for Commission Regulation (EC) No 244/2009: assess the evolution of sales of special purpose lamps since the introduction of this regulation, especially in the context of possible misuse for general lighting purposes, and, if such misuse happens, prepare a recommendation on how to stop this;
- for Commission Regulation (EU) No 547/2012: the scope is to only review the tolerances used in the methodology for calculating the energy efficiency;

During the kick-off meeting with DG ENER and DG ENV the consideration of 'non-energy aspects', such as resource efficiency (reusability, recyclability, etc.) was added to the tasks, although this was not specified in the Terms of Reference.

Information sources

The information used for the analysis is based on publicly available material and/or material received from the Commission or stakeholders. As regards the sales of special purpose lamps the contractors will actively search for data of the evolution of special purpose lamps sales by consulting stakeholders such as industry associations, manufacturers, importers, resellers, Member State authorities, etc.

Deliverables

The study results in an Interim report which is discussed with stakeholders[1]. After receiving their comments and integrating them into the study, the report is finalised.

1.3 Aim

This study is preliminary and intended to provide the Commission with sufficient information to decide on subsequent activities as regards timing and resources to be allocated to review activities (for example a decision for further, more thorough analysis on specific or generic items, or withdrawal of the product group from the work program or other decisions).

1.4 Team

Lead contractor for the study is VHK and parts of the required tasks and deliverables are attributed to consortium partners Viegand & Maagøe (hereafter "VMAS"), VITO and Wuppertal Institut. The study subjects have been attributed as follows:

Table 1-2 Consortium partners and subjects

Subject	Partner
Overall co-ordination	VHK
Washer dryers	VHK
Simple set-top boxes	VMAS
Non-directional lamps and special	VHK

[1] The stakeholder meeting took place on 18th november 2013.

purpose lamps	
Tertiary Lighting	VITO
Household Refrigerators	VHK
Household washing machines	VHK
Household dishwashers	VHK
Water pumps	Wuppertal Institut

1.5 Report structure

The study covers seven product groups for which ecodesign and energy label regulations or directives shall be reviewed. This report is divided into chapters for the different product groups. Where a product group is to be evaluated for both the energy label and the ecodesign regulation this is combined in a single chapter.

The structure of the chapters is derived from the Methodology for Ecodesign of Energy-related products (MEErP). The only exceptions being the study regarding lighting products in which special consideration is given to special purpose lamps and the study regarding pumps in which only the tolerances needed reviewing.

Table 1-3. Overview of study structure

Product group	Report section	Consortium partner	Contents
Household dishwashers	2	VHK	Scope Market Users Technical
Household washing machines	3		
Washer dryers	4		
Household Refrigerators "Cold appliances"	5		
Simple set-top boxes	9	VMAS	
Non-directional lamps & Tertiary lighting	6, 7 & 8	VHK + VITO	For NDLS and tertiary lighting: as above + special consideration for special purpose lamps
Water pumps	10	Wuppertal	Review of tolerances only

2. Dishwashers

Main author & final editing: VHK, Karin Brakkee & Martijn van Elburg

2.1 Legislation & standards

2.1.1 Revision

Regulation 1016/2010 on ecodesign of domestic dishwashers calls for a review "in light of technological progress" and more specifically an assessment of verification tolerances, ecodesign requirements for water consumption and the potential for hot water inlet. The review deadline is 1 December 2014.

Delegated regulation 1059/2010 on energy labelling of domestic dishwashers calls for a review in light of technological progress and an assessment of verification tolerances. The review deadline is 20 December 2014.

Household dishwashers are covered by ecodesign regulation 1016/2010[2] and the delegated regulation for energy labelling 1059/2010[3]. These regulations came into force in 2010 and 2011. The regulations both stated that they should be revised no more than four years after their entry into force.

2.1.2 Legislation

Energy label Regulation 1059/2010

Before 2010 the Energy classes of dishwashers were regulated by Directive 97/17/EC and distributed according to Table 2-1. The classes related to an energy efficiency index (E), which is the ratio of the declared energy use per cycle (to be measured according to the standard method described in EN50242) divided by the reference energy use per cycle "E_R" (kWh/cycle) to be calculated as in Equation 2.1 and Equation 2.2.

$$E_R = 0{,}025 \times ps + 1{,}35 \qquad \text{for } ps \geq 10 \qquad \text{Equation 2.1}$$

$$E_R = 0{,}09 \times ps + 0{,}45 \qquad \text{for } ps \leq 9 \qquad \text{Equation 2.2}$$

In which *ps* is the number of standard place settings.

In 2011 a new label system was introduced described in regulation 1059/2010. No longer is the energy efficiency only related to the energy of one single cycle, but the energy efficiency index is now based on the total yearly energy use including standby related to SAEc, the Standard Annual Energy consumption of a dishwasher, calculated by:

$$SAE_c = 7{,}0 \times ps + 378 \qquad \text{(for } ps \geq 10 \text{ and width of } > 50 \text{ cm)} \qquad \text{Equation 2.3}$$

$$SAE_c = 25{,}2 \times ps + 126 \qquad \text{(for } ps \leq 9 \text{ and } 9 < ps \leq 11 \text{ and width} \leq 50 \text{ cm)} \qquad \text{Equation 2.4}$$

Note that in regulation 1016/2010 for ecodesign the last condition is formulated as *ps≤ 9 and ps >9 width ≤ 50 cm.*

[2] COMMISSION REGULATION (EU) No 1016/2010 of 10 November 2010 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for household dishwashers (OJ L293, 11.11.2010)

[3] COMMISSION DELEGATED REGULATION (EU) No 1059/2010 of 28 September 2010 supplementing Directive 2010/30/EU of the European Parliament and of the Council with regard to energy labelling of household dishwashers(OJ L314, 30.11.2010)

Note that a 12 ps machine with a width of less than 50 cm is currently not covered by the above formulas. Although these machines may not exist at the moment, this can pose a possible loophole to put machines on the market without a label. As they are not excluded in the ecodesign regulation, they still have to fulfil the minimum requirements.

The AEc (Annual Energy consumption) for appliances without power management is calculated as:

$$AE_c = E_t \times 280 + \frac{P_o \times \frac{525600-(T_t \times 280)}{2} + P_l \times \frac{525600-(T_t \times 280)}{2}}{60 \times 1000} \qquad \text{Equation 2.5}$$

Where:

- E_t (kWh) is the energy use per cycle, rounded to three decimal places.
- P_o (W) is the power consumption in off mode, rounded to two decimal places.
- P_l (W) is the power consumption in left-on mode, rounded to two decimal places.
- T_t (min.) is the program time for the standard cycle, rounded to the nearest minute.
- 280 is annual cycles (roughly 5.4 per week)

Table 2-1 Energy classes in energy efficiency index from the regulation after 2010

Class	EEI (%) after 2010
A+++	EEI<50
A++	50≤EEI<56
A+	56≤EEI<63
A	63≤EEI<71
B	71≤EEI<80
C	80≤EEI<90
D	EEI≥90
E	-
F	-
G	-

Ecodesign 1016/2010

The ecodesign regulation for dishwashers 1016/2010 was adopted in 2010. No Ecodesign regulation for dishwashers existed before 2010. The revision clause stated that no longer than 4 years after the implementation it should be reviewed in the light of technological progress. The first requirements apply from 1 December 2011.

The generic requirements specify the cycle to be used for declaring energy consumption and other parameters ("shall be ... named 'standard programme' ") and require certain information to be provided in the booklet of instructions..

The specific requirements set out in the regulation will come into force on specific dates.

From December 2011:

- The Energy efficiency index of all dishwashers, accept for the ones with a rated capacity of 10 place settings and a width of maximum 45 cm shall be less than 71 (is energy efficiency label A).

- Those exempted should have an energy efficiency index of less than 80.
- The cleaning efficiency shall be greater than 1.12 (comparable with cleaning efficiency class A as defined by the energy label regulation for dishwashers).

From December 2013:

- The Energy efficiency index of all machines with a rated capacity of 11 settings or more and machines with a capacity of 10 settings and a width higher than 45 cm, shall be less than 63 (is energy efficiency label A+).
- The drying efficiency shall be greater than 1.08, comparable with drying efficiency class A (from December 2013) for machines with a rated capacity of 8 or more.
- The drying efficiency shall be greater than 0.86, comparable with drying efficiency class A (from December 2013) for machines with a rated capacity of 7 or less.

From December 2016:

- The Energy efficiency index of all machines with a rated capacity of 8 or 9 settings and machines with a capacity of 10 settings and a width less than 45 cm, shall be less than 63 (is energy efficiency label A+).

Table 2-2 Overview of the requirements, which classes are phased out

Class	EEI	Tier I Dec 2011	Tier II Dec 2013	Tier III Dec 2016
A+++	EEI<50			
A++	50≤EEI<56			
A+	56≤EEI<63			
A	63≤EEI<71		Allowed for ps=10 and width<45cm Allowed for ps≤10	Only allowed for ps≤7
B	71≤EEI<80	Allowed for ps=10 9 and width<45cm	Banned for all machines	
C	80≤EEI<90	Banned for all machines		
D	EEI≥90			

Note that this regulation covers machines with all possible place settings and widths, whereas 1059/2010 has no labelling requirements for machines with ps ≥ 12 and width ≤ 50 cm.

Another inconsistency is that the specific ecodesign requirements in Annex I are categorised according a width of 45cm, while the calculation method of the EEI in Annex II is based on a threshold width of 50cm.

Related EU Legislation

The Standby/off mode Regulation

Commission Regulation 1275/2008 applies to domestic dishwashers and requires as maximum power for low power modes of 2 W in standby mode and 1 W in off mode. After 7 January 2013 this decreases to 1W and 0.5 W respectively. More details can be found in Annex A.

This means that standby and off mode of dishwashers are to be regulated through 1275/2008, but as many dishwashers have a safety feature that prevents water leakage but which consumes energy. In the regulations 1016/2010 and 1059/2010 not standby but left-on mode is defined.

Definitions used for off-mode and left-on related to dishwashers are:

left-on mode: the lowest power consumption mode that may persist for an indefinite time after completion of the programme and unloading of the household dishwasher without any further intervention by the end-user

off-mode: a condition where the household dishwasher is switched off using appliance controls or switches accessible to and intended for operation by the end-user during normal use to attain the lowest power consumption that may persist for an indefinite time while the household dishwasher is connected to a power source and used in accordance with the supplier's instructions. Where there is no control or switch, off-mode is the condition reached after the household dishwasher reverts to steady-state power consumption on its own

Using Equation 2.5, assuming a cycle time of three hours, a maximum yearly energy consumption of 6 kWh per year maximum from 2013.

The test method for low power modes is described by standard EN 50564:2011. EN50242:2008/A11:2012 annex O contains the specific low-power-mode measurement methodology for dishwashers.

The EU Ecolabel

The voluntary Ecolabel (regulation 66/2010) is designed to promote products which have a reduced environmental impact compared with other products in the same product group. Commission decision 2001/689/EC[4] established ecological criteria for the award of the eco-label to dishwashers under the old regulation 1980/2000, but this decision expired in 2007. No new criteria for dishwashers have been established under the new regulation

The regulation for energy labelling 1059/2010 still considers the possibility that an EU Ecolabel can be printed on the energy label in accordance with regulation 66/2010.

Non-European legislation and other initiatives

International Policies

Several nations outside the EU have adopted energy requirements and other environmental criteria for dishwashing appliances. These include mandatory and voluntary labels and minimum requirements. A list of policies is included in Annex A.

[4] Commission Decision 2001/689/EC of 28 August 2001 establishing ecological criteria for the award of the Community eco-label to dishwashers

2.1.3 Tolerances

Table 2-3 Verification tolerances for the required parameters of regulation 1016/2010 and 1059/2010

Measured parameter	Verification tolerances
Annual energy consumption	The measured value shall not be greater than the rated value (*) of *AE C* by more than 10 %.
Water consumption	The measured value shall not be greater than the rated value of W_t by more than 10 %.
Cleaning efficiency index	The measured value shall not be less than the rated value of *I C* by more than 10 %.
Drying efficiency index	The measured value shall not be less than the rated value of *I D* by more than 19 %.
Energy consumption	The measured value shall not be greater than the rated value of *E t* by more than 10 %.
Programme time	The measured value shall not be longer than the rated values *Tt* by more than 10 %.
Power consumption in off-mode and left-on mode	The measured value of power consumption *P o* and *P l* of more than 1.00 W shall not be greater than the rated value by more than 10 %. The measured value of power consumption *P o* and *P l* of less than or equal to 1,00 W shall not be greater than the rated value by more than 0,10 W.
Duration of left-on mode	The value measured shall not be longer than the rated value of *T l* by more than 10 %.
Airborne acoustical noise emissions	The measured value shall meet the rated value

The verification tolerances for most of the variables are defined as 10% of the declared value.

This means that for a 12 place setting machine with A+++ label with a declared annual consumption of 231 kWh/year the measured value can be 254 kWh/year.

Assuming a low power mode consumption of 6 kWh yearly this measured value could mean an energy consumption of 0.8 kWh/cycle. Applying verification tolerances this would be 0.88 kWh. The maximum to be declared level for an A++ machine would be 0.9 kWh. This is very small difference. If the new labels of EEI 45, 40 and 36 proposed by CLASP would apply this would result in acceptance of measured values of 0.79, 0.70 and 0.63 kWh while the limits of the classes would be 0.72 0.64 and 0.57kWh. There is no overlap, but the differences are very small.

Verification tolerances cannot be expressed as relative values (%) indefinitely as at some point they may be much smaller than (absolute) measurement uncertainties. In this context it is worthwhile to assess the measurement uncertainty and the allowed verification tolerance for possible future declared values for energy efficiency etc.

In 2003, a round robin test performed by CECED[5] resulted in a standard deviation in reproducibility for energy measurements by 19 laboratories of 5.8%. Addition of product variability will increase the overall variation of results of a random check.

[5] Report on the CECED dishwasher ring test comparing 19 European laboratories performing the European Energy Label - test for dishwashers Version 0.9, University of Bonn, 2003

2.1.4 Standard

Dishwashers are tested according EN 50242:2008[6] which is based on IEC 60436. The energy efficiency index, the drying en cleaning performance and water consumption is measured. The drying and the cleaning performance are established by comparison of results to a reference machine. A revision of the international IEC standard is currently worked on according the Mandate M481 from EC:EN50242:2008 + EN50242:2008/A11:2012 (listed in the OJ of EU under 2013/C169/01) and is expected to be harmonised in 2015. The revisions will include changes to the test load and the way of soiling.

Test Programme

According to the standard EN 50242 the test programme is described as: 'the cycle which cleans normally soiled tableware (standard cleaning cycle) and which shall be named "eco". The name "eco" shall be used once and exclusively for this standard test programme. The only other additional information which could be combined with the term "eco" is temperature'.

According to the Ecodesign regulation the test programme should be indicated as the 'standard programme', which is the standard cleaning cycle to which the information in the label and the fiche relates; that this programme is suitable to clean normally soiled tableware, and that it is the most efficient programme in terms of combined energy and water consumption. So there is no indication formulated of 'eco', but it has to be called 'standard'.

Within the Mandate M481 of the European Commission to CENELEC the standardization was asked: " to ensure that the prospective harmonised standard(s) defines univocal and common word(s), sign(s), pictogram(s) or symbol(s) to be displayed on the programme selection device of the machines and on the machines display (if any) or both, to clearly and easily identify the standard programme(s) referred to in the Commission Regulation 1016/2010 and in the Commission delegated Regulation 1059/2010."

The standardization defined the programme name "eco" in EN50242:2008/A11:2012:

"The programme to be tested shall be the cycle which cleans normally soiled tableware (standard cleaning cycle) and shall be named "eco". The name "eco" shall be used once and exclusively for this standard test programme. The only other additional information which could be combined with the term "eco" is temperature."

The test programme does not necessarily have to be the least energy consuming programme: for instance a programme designed for glass may require less energy to run. 'Normal soiled tableware' refers to the standard test load described in the standard.

Test load

The number of place settings corresponds with a number of standard items. If a machine is indicated as a machine for 12 place settings, the test has to be performed with 12 identical sets of plates, small plates, soup plates, saucers, cups, spoons, small spoons, teaspoons, forks, knifes and glasses. This is not related to common loading nowadays. People usually put other things in a dish washer, such as, pots, pans, cereal bowl, mugs and plastic items.

The revision of the standard IEC 60436 aims to develop a more realistic load for testing of dishwashers. That load will include more common items such as plastic items, stainless steel items and larger solid items (bowls).

[6] EN 50242:2008 (see http://ec.europa.eu/enterprise/policies/european-standards/harmonised-standards/ecodesign/dishwashers_en.htm)

The items currently proposed for the new standard are shown in the Figure underneath. The figure shows the items for a 12 place settings. Instead of one type of place setting the new standard uses two types of place settings. For an uneven number of place settings one more place setting type A is used.

Soiling

The new standard suggests including different types of soiling. These include coffee grounds and minced meat. More water may be necessary to rinse away the new soiling agent coffee grounds. The coffee may furthermore lead to a blockage of the filter system or influence the hydraulic system. Soils with a different fibre structure (minced meat), due to their application, may also influence the filter system or even block it.

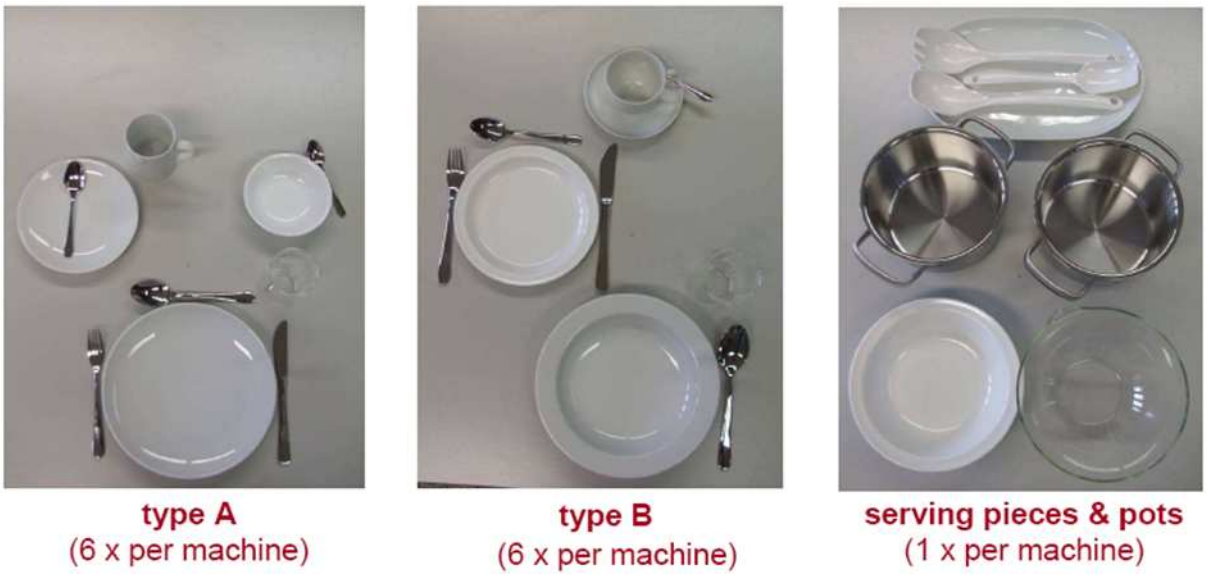


Figure 2-1 test load that will go into a 12 place setting machine in a test procedure

Table 2-4 Load items to be included in a certain number of place settings in a test

		Number of each type of load item to be included in each test load															
Rated dishwasher capacity (place settings):		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Item Id.	Item description																
A1	Dinner plate	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8
A2	Dessert plate	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8
A3	Dessert bowl	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8
A4	Mug	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8
A5 & B5	Glass	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
A6 & B6	Fork	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
A7 & B7	Knife	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
A8 & B8	Soup spoon	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
A9 & B9	Dessert spoon	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
A10 & B10	Tea spoon	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
B1	Soup plate	0	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8
B2	Melamine dessert plate	0	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8
B3	Saucer	0	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8
B4	Cup	0	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8
S1a	Small pot	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1
S1b	Oven pot	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
S2	Glass bowl	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1
S3	Oval platter	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
S4	Melamine bowl	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
S5a	Melamine serving fork	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
S5b	Large melamine serving spoon	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
S6	Small melamine serving spoon	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1
Total number of items		12	22	32	43	53	63	73	85	95	105	119	129	139	149	159	169
Total mass of crockery including glasses (kg) *		1,28	2,24	3,52	4,48	5,76	6,71	8,00	8,95	10,23	11,19	12,47	13,43	14,71	15,67	16,95	17,90
Total mass of cutlery excluding serving pieces (kg) *		0,21	0,43	0,64	0,85	1,07	1,28	1,49	1,70	1,92	2,13	2,34	2,56	2,77	2,98	3,20	3,41
Total mass of serving pieces (kg) *		0,82	0,82	0,82	1,64	1,64	1,64	1,64	1,97	1,97	1,97	2,74	2,74	2,74	2,74	2,74	2,74
Total mass of load (kg) *		2,32	3,49	4,98	6,97	8,47	9,64	11,13	12,63	14,12	15,29	17,55	18,72	20,22	21,38	22,88	24,05
* Loads prepared according to this table shall have the mass indicated ± 5%																	

This update of the revision is in a test procedure. An update of the test standard is to be expected in 2015. The Working group of standardisation is currently working on it.

Therefore it cannot be said yet how much the different load will result in a different energy consumption of the machine tested. In possible upcoming revision of ecodesign and energy labelling regulation a possible change in test load has to be considered.

2.1.5 Product definition

A household dishwasher is according to Ecodesign regulation 1059/2010 defined as: *"a machine which cleans, rinses, and dries dishware, glassware, cutlery and cooking utensils by chemical, mechanical, thermal, and electric means and which is designed to be used principally for non-professional purposes"*.

In the standard EN 50242 it is described as: *"a machine which cleans, rinses, and dries dishware, glassware, cutlery and, in some cases, cooking utensils by chemical, mechanical, thermal, and electric means. A dishwasher may or may not have a specific drying operation at the end of the program".*

Professional dishwashers are excluded from the regulations. They are subject of the preparatory study of LOT24 for ecodesign.

There is a contradiction in the ecodesign/labelling legislation between the scope of the measures ('…including those sold for non-household use') and the definition of the household appliances (…appliances used for non-professional purposes).

2.2 Market Analysis

2.2.1 Market and stock data

Dishwasher sales have continuously shown an increase over the last decades and both the 2009 IA and the CLASP study assume this to continue, although CLASP assumes a slightly higher sales volume. The most recent market data by GFK does show a recent stall in sales for years 2011 and 2012 but this is presumably a result of the economic crisis as people may postpone their purchases, effectively increasing average product life of their appliances.

Table 2-5 Sales of dishwashers

Sales in million units	2005	2010	2011	2012	2015	2020	2030
Impact Assessment 1016/2009 EU27	5.9 million	7.0			8.1	9.2	11.5
GFK 2013 / EU 23			7.5	7.4			
CLASP 2013		7.0				9.8	11.7

Dishwasher ownership is not evenly distributed: ownership has grown from the 1970's up to 40-50% in EU-15 in 2012. In the new member states the ownership was estimated at 10-15% in 2011. On average this results in 37%.

Both the Impact Assessment of the Regulation 1016/2010 [7] and CLASP predict a growth in penetration towards 70-75% for EU-15 and 30-40% for NMS-12. In total this results in 60-70% ownership in EU-27 in 2030.

The increase in penetration is expected to even out in the future as the average size of households is decreasing and smaller households might have limited space for dishwashers and/or will have less need for it.

Product life is assumed to be relatively constant at 13 years. The differences between CLASP are considered negligible and may be caused by different assumptions regarding uptake of dishwashers.

Based on these predictions sales and stock growth are shown in the next figures.

Figure 2-2 Dishwasher sales in EU-27

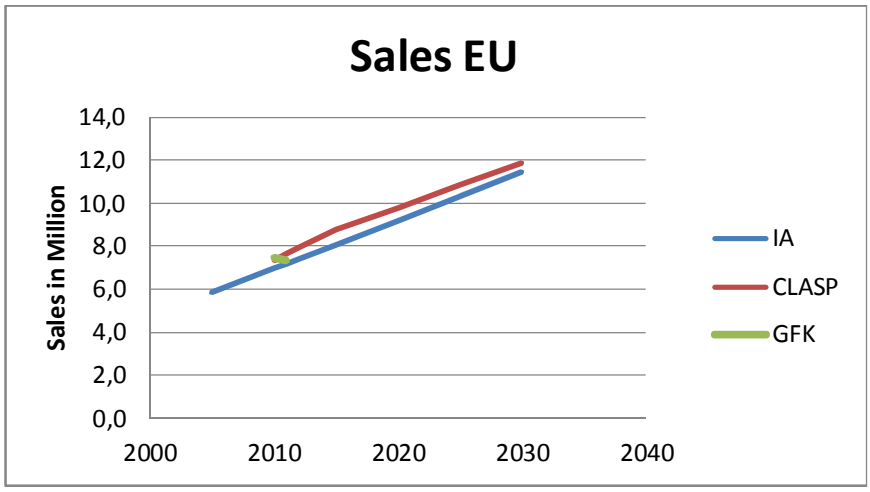
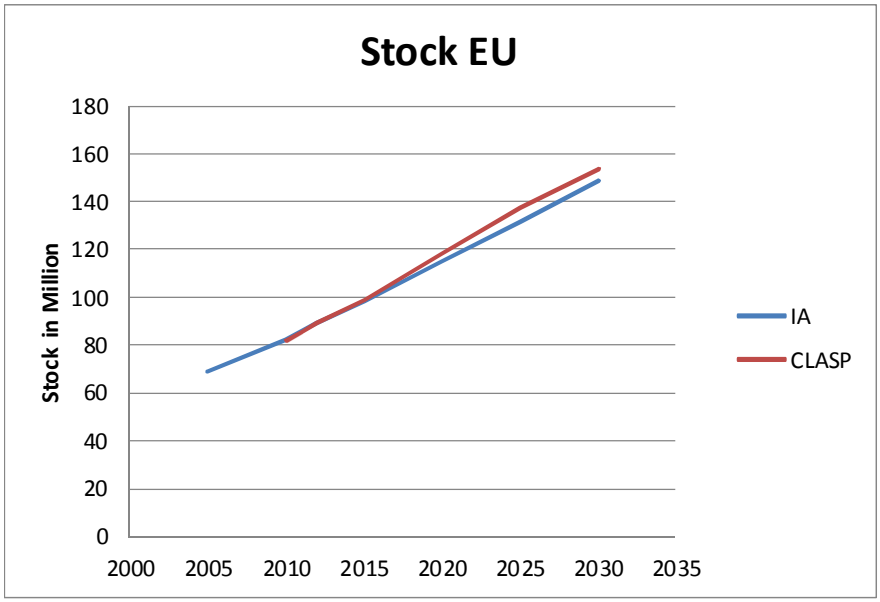


Figure 2-3 Dishwasher stock in EU-27



[7] Impact Assessment [SEC(2010)1356]

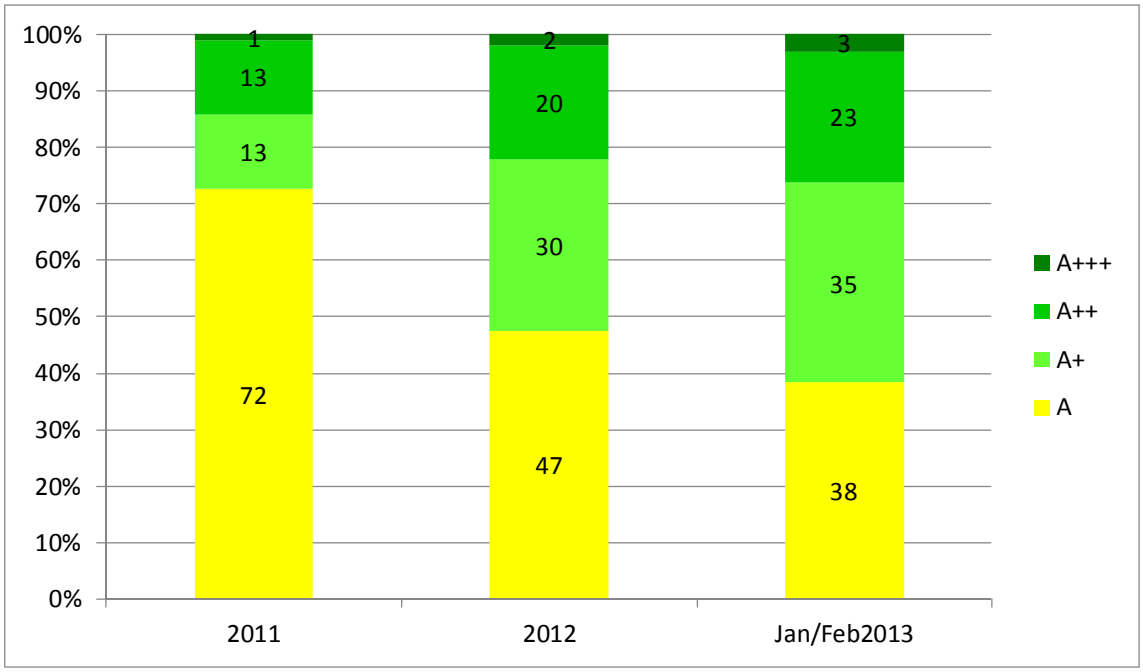
2.2.2 Trends in Energy Efficiency

Historical data

The first energy labelling directive was introduced in 1997. Ever since distribution over the energy classes have evolved and more appliances are introduced in the highest A-classes.

In 2010 almost all the appliances sold were in label class A and the label was not differentiating anymore and as a result there was no incentive towards the industry to improve the energy efficiency: appliances with higher energy efficiency would not be awarded with a better label than most of the other machines on the market. Therefore the new labelling regulation of 2010 introduced three new top classes: A+, A++ and A+++.

Figure 2-4 Energy efficiency class distribution of sold dishwashers 2011-2013 (source: GfK 2013))



The above GfK data for February 2013 show that within 3 years the sales of dishwashers in class A+ and higher has increased from 27% in 2011 to over 61% in January/February 2013 of which 3% are in the top class (A+++). This trend exceeds the expectations expressed in the Impact Assessment study.

Market Predictions

The graph below shows the distribution over classes as predicted in the business as usual scenario in the impact assessment study.[8] CLASP also performed a study on the impact of the current labelling and ecodesign regulations. They predicted a business as usual scenario as well. These predictions are also shown in the following graph.

Table 2-6 Predicted energy efficiency improvement

Year	Impact Assessment	CLASP
2005	56%	
2010/*2009**	50%	51%
2015/*2014*	48%	56%

[8] Commission Staff Working Document Impact Assessment. Brussels, 2010

2020/*2019*	47%	51%
2025	45%	47%
2030	44%	47%

**The impact assessment evaluated the years 2009, 2014 and 2019*

Comparing the GFK January/February sales of 2013 with the impact assessment prediction for year 2014, we see that the sales of the A class machines in GFK data are higher. However as Class A machines will be banned from the market from December 2013 for machines with 10 or more place settings and a width of more than 45 cm, the sales of A label machines will decrease in 2014. The A+++ category was predicted too pessimistic by the impact assessment: 2014 sales are here only 1% while by now the sales are already 3%.

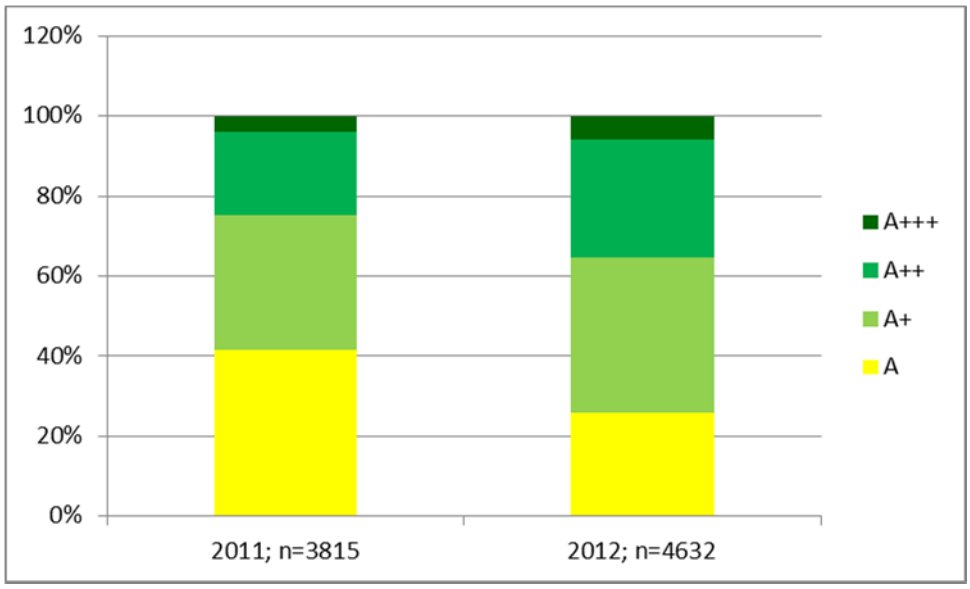
The CLASP analysis shows a more optimistic development of the energy classes sold. Since the sales of A+++ are now steady at 3% it is not likely that they will jump to 10% in 2 years in 2015. According to the CLASP prediction there will be no A class machines on the market in 2015 while these are still allowed until the end of 2016 for small appliances of 8 and 9 place settings (after that they are only allowed for a maximum of 7 ps). Therefore the sales are not likely to be zero.

2.2.3 Characteristics of dishwashers

Energy Efficiency

CECED databases showing all the models brought on the market by their members give a good representation of the characteristics of the models on the market

Figure 2-5 Distribution in energy classes for dishwashers (Source: CECED)



The databases show that about 6% of the models are represented in the top A+++ level. Related to the sales presented in Figure 2-4, only 3% of the sales are represented in A+++. Models in the top class are bought less by consumers.

Programmes

Machines currently on sale have a so-called "Eco programme" which can be selected on the machine, or is automatically preselected on the machine (according to generic ecodesign requirements). This programme generally uses less energy and less water than the normal

program. The eco programme is the programme on which the information on the energy label and the requirements of ecodesign are based. Dishwashers usually have many other programmes to choose from such as a programme for glassware, a programme for pots or pans, a rapid programme, an intensive programme and possibly an automatic programme.

The eco-programme is often indicated by manufacturers as a programme suitable for cups and plates (see Figure 2-6). People who use their machines for washing pans and pots as well are more likely to use a different programme that uses more energy. If the eco-programme is suitable for regular types of dishes, people are more likely to choose this option.

Figure 2-6 Example of indication of programmes on a machine

Capacity of the dishwashers

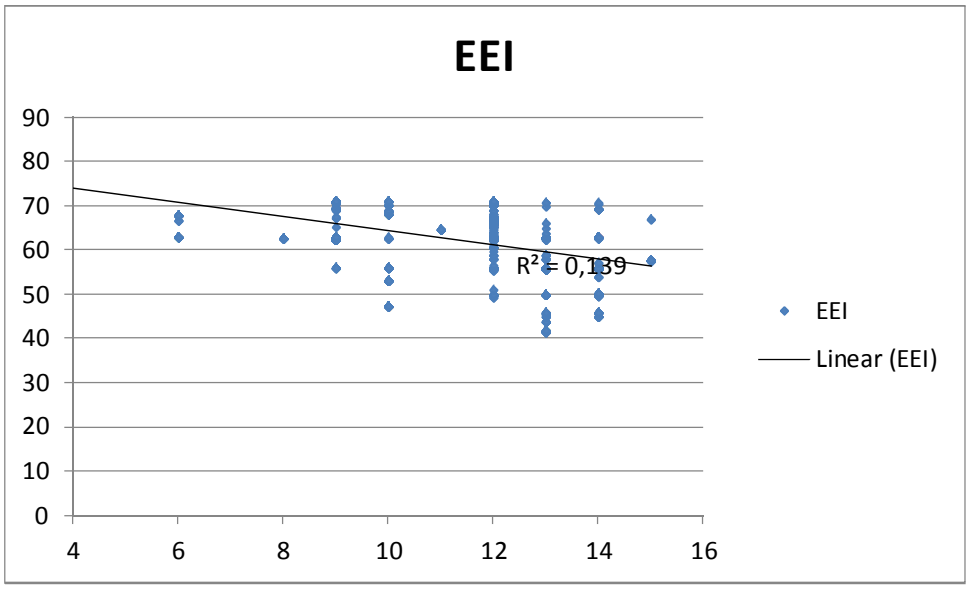
Analysis of CECED databases of dishwashers shows that in recent years the standard capacity of dishwashers has increased slightly. The average is still around 12 place settings, but especially the number of models with 13 and 14 place settings has grown.

Table 2-7 Capacity of dishwashers on the market

Capacity	2005; n=4342 (prep.study)	2011; n=3815 (CECED)	2012; n=4632 (CECED)
4	0.58%		
5	0.16%		
6	0.44%	1.5%	1.5%
8	0.39%	0.4%	0.4%
9	12.2%	11.4%	8.2%
10	1.36%	3.7%	4.0%
11		0.5%	0.3%
12	81.8%	48.2%	46.6%
13		24.3%	28.9%
14	0.62%	8.8%	9.5%
15	2.44%	1.3%	0.7%
Average nr. of ps	**11.6**	**11.9**	**12.1**

When the capacity of a dishwasher is increased, the EEI has been shown to increase as well, (see Figure 2-7) suggesting that the required extra energy to wash the additional load, is more than compensated for by the allowed extra energy consumption (the standard annual energy consumption is capacity dependent).

Figure 2-7 Capacity of dishwashers vs energy efficiency (Source: CECED database 2012)



The graph shows a correlation between the EEI and the capacity. The machines with a low EEI more often have a higher capacity than machines with a higher EEI. Modern machines tend to have a higher capacity and a lower energy efficiency index. This does not automatically mean that one leads to another.

Water consumption

Besides energy efficiency, water use is also part of energy labelling regulations. The revision of dishwashers asks for the possibility to include ecodesign requirements for water consumption. From the CECED databases and from the Base Case scenario of the Preparatory study, the water consumption is analysed.

Table 2-8 Water consumption of dishwashers

	N	Source	Water Consumption (l)	
			yearly	**per cycle** [1)]
2005	4342	Prep.study	4172	14,9
2011	3815	CECED	3161	11,3
2012	4631	CECED	3059	10,9

[1)] cycle as used for energy labelling

There is a continuous decline in water consumption visible. Even with a growing capacity in number of ps the total amount of water used per cycle has been decreasing in the last decade. The water consumption per cycle related to the number of place settings is given in the next table and shows that larger machines are generally more efficient with water.

Table 2-9 Water consumption related to the number of place settings

	water consumption			
Place settings	**prep.study. 2005**		**CECED. 2012**	
	l/cycle	*l/ps/cycle*	*l/cycle*	*l/ps/cycle* [1)]
4	10.8	2.7		
5	12	2.4		
6	7.3	1.22	7.5	1.26

8	12.1	1.51	8.8	1.09
9	13.7	1.52	10.0	1.11
10	13.5	1.35	10.8	1.08
11			15.0	1.36
12	15.2	1.27	12.5	1.04
13			9.0	0.69
14	14.4	0.93	10.2	0.73
15		0.96	13.1	0.87
average	**14.9**	**1.30**	**10.9**	**0.92**

[1)] cycle as used for energy labelling

Hot fill

Many of the machines on the market provide a hot-fill option. The warm water can be derived from a different source and does not need to be heated up in the dishwasher by electricity. This source can be more energy efficient, for instance when the water is derived from a solar water boiler or a very efficient combi-boiler. When the warm water is derived from an electric boiler this option does not save any energy. To use this option it is advantageous if a warm water source is available close to a place where the machine is placed.

2.3 User Analysis

2.3.1 Number of cycles per year

To calculate the yearly energy consumption, the 2010 Ecodesign regulation bases its calculation of EEI on 280 cycles a year. In the preparatory study a result of a questionnaire was presented where people stated to run the dishwasher 4.1 times a week resulting in 214 times a week. This means that the calculated yearly energy consumption on the label is an overestimation for the average household, based on the number of cycles.

2.3.2 Chosen programme

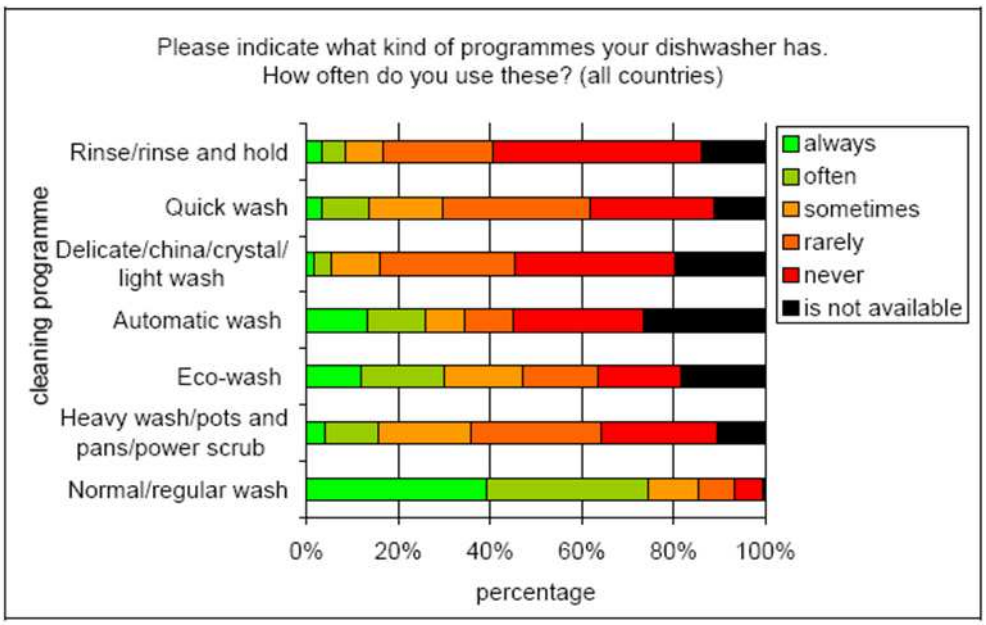
To calculate the yearly energy use, the label assumes the eco, or energy efficient programme. However people also use other programmes. Dishwashers usually have special programmes, for glassware and pots / pans, a rapid programme, an intensive programme and an automatic programme. Most of them consume more energy than the eco test programme. Dishwashers with an automatic programme have an automatic soil detection system to optimise the program to the amount of soil on the dishes.

The temperature of the normal programme is often between 60 and 65 °C, where the eco programme is more often 50°C. Temperatures of automatic programmes range from 40°C to 70°C to cover all possible levels of soils (fresh/light to heavy soil) and load sizes and material compositions.

The Preparatory Study investigation showed that people used most often the 'normal/regular' programme. Nowadays that program is most often replaced with the automatic programme. 52% of consumers use programmes of 65°C and higher (Paul Richter, Bonn University).

Generic ecodesign requirements require the eco-programme is preselected if a machine contains an automatic programme selection. The influence on the user behaviour is not yet known.

Figure 2-8: Dishwasher programs often used

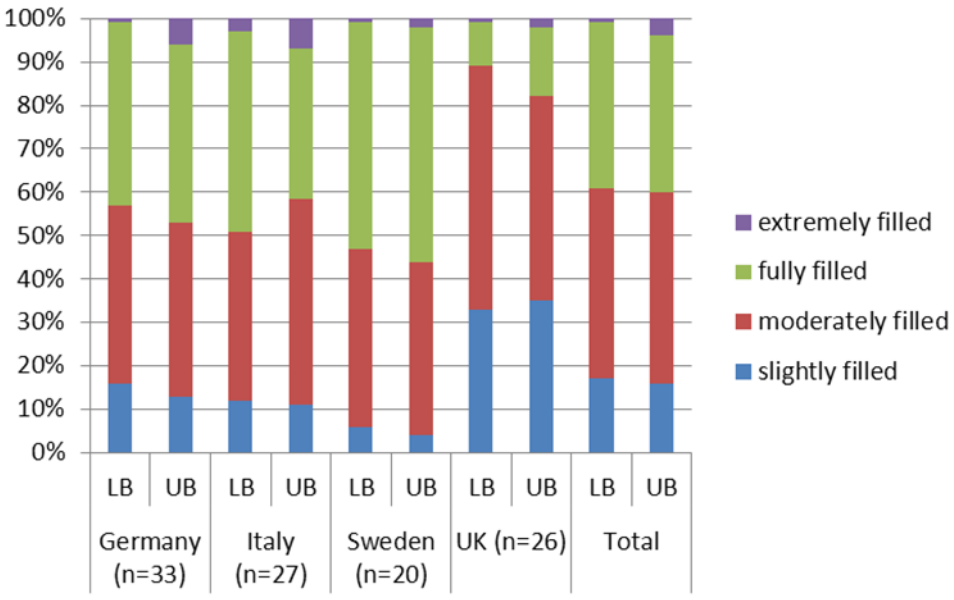


The preparatory study estimates that the real-life average dishwashing temperature is higher (estimated at 59.3 °C) than that used for the test standard . The significant increase of the energy consumption because of the higher temperature in real-life is in part compensated by the lower load (see next paragraph). The preparatory study estimates that the energy consumption per cycle is thus 'only' 9.1% higher than that of the standard test cycle.

2.3.3 Load size

While the standard test works with completely filled machines, consumers may not always fill the machine up to this extent.

Figure 2-9 Way of loading the dishwasher by consumers[9]



[9] In-house consumer Study on Dishwashing Habits in Four European countries: Saving Potentials in Four European countries: Saving Potentials in households with Dishwashing machine, C.P. Richter, 2010, Bonn University

Often the consumer assumes the machine is full, while there is actually room left or the machine is run because the consumer needs the dishes to be clean, for instance when he/she is running out of plates. The absolute energy consumption of a machine that is partly loaded is usually lower than that of machines that are fully loaded but the efficiency is also lower.

The preparatory study estimates that a 12-setting machine in real-life will be loaded on average with 9 settings. This lowers the real-life energy consumption because most machines can adjust the water and energy consumption to the detected load. However–as mentioned in the previous paragraph—because the real-life wash temperature is higher than in the test there is still a 9.1% higher-than-standard energy consumption assumed.

2.4 Technical analysis and saving potential

2.4.1 Best available technology --Energy & water

The most efficient machine in the CECED database has an EEI of 41%, which is 17% more efficient than the minimum requirement for an A+++ machine. This machine uses 1960 litre of water per year (7 litres/cycle at 280 cycles per year) and is designed for 13 place settings. The purchase price of this machine is around 1500 euro. It uses zeolite drying technology and has cycle duration of 195 minutes. The annual energy consumption is 194 kWh (approx. 0.69 kWh/cycle without standby).

2.4.2 New technologies

Temperature time trade-off

Generally, the dishwasher's effectiveness in cleaning will increase with more vigorous mechanical action, more detergent, higher water temperatures and longer wash cycles. These four factors are referred to as Sinner's circle. Increasing temperature and to al lower extend mechanical action, increases the energy consumption of a cycle. By decreasing the water temperature while enlarging the mechanical interaction or the cycle duration, the machine becomes more energy efficient. Therefore an energy efficient programme usually has a longer duration time.
As the current standard does not specify a minimum temperature to be reached in the cleaning cycle, the manufacturer can use 3 variables of the Sinner circle to optimise the balance between energy consumption and cleaning performance. In order to reduce energy consumption the duration will be increased. The most efficient appliances already claim a cycle of more than 3 hours (195 minutes).

Improved Drying technology

For drying the trade-off is between time, temperature and the efficiency of removing the water (vapour). Normally the drying performance is increased by a hotter last rinse which requires more energy or a ventilation system. Other techniques are condensation, increased ventilation, ab-/adsorption, open drying systems (i.e., automatic door opening), etc. .

One of the new technologies in dishwashers is Zeolite drying technology, which is proprietary technology. According to the industry this technology can save 20% of the (total) energy consumption. The technology uses a reservoir with the mineral zeolite. After washing the machine is heated and produces water vapour, this air is pumped through the reservoir, while the mineral absorbs the water and produces warmth. Therefore the machine can dry with lower temperature. This is already on the market and applied in some A+++ machines.

Other Improvements
Other techniques are improved pump and motor efficiency (high efficiency motors such as using inverters and permanent magnets), improved water spraying, sophisticated electronic

process controls and sophisticated electronic water and temperature controls. These techniques were all mentioned before in the 2007 preparatory study and the 1993 GEA analysis.

2.4.3 CLASP report

The CLASP analysis[10] describes a scenario in which 3 new label classes will be introduced in 2016: EEI≤45, EEI≤ 40 and EEI≤36. For a 12 settings machine this corresponds to a yearly consumption of 208, 185 and 166 kWh respectively. The most efficient machines currently available according the CECED 2012 database, could be placed in the first new category EEI < 45. This comprises 2% of the models available on the market. If the best machines improve a little more it might be possible that in 2016 machines can be placed in the second category EEI < 40.

Producers are stimulated to improve their products if this is rewarded with a better label. Therefore it can be concluded that these new categories open up more improvement potential. How fast these new label classes will fill up, depends on the introduction of new technologies and market price development. An economic analysis will be needed to assess stock improvement potential. Since the number of models in the A+++ are still low it is not expected that new classes will fill up fast.

CLASP also suggested new ecodesign requirements.

Table 2-10 Ecodesign scenarios by CLASP on dishwashers

Scenario	tier	max. EEI		from year	New label EEI
		Cat. 1	**Cat. 2**		
1	1	56	63	2019	45
2	1	56	63	2017	45 40
3	1 2	56 50	63 56	2016 2019	45 40 36

Category 1 are machines with 11 place settings or more and category 2 are machines with 10 place settings or less

The highest proposed requirement is an EEI of 50 by 2019. This is the actual label A+++ minimum. These are already on the market, but the number of appliances offered in this category is very small. A+++ appliances are generally more expensive and therefore purchase prices will be driven up. The analysis does not include a consideration of life cycle costs.

According to CLASP, the scenarios could lead to 1.4 to 5.7 TWh/year energy saving in 2030.

CLASP estimates the baseline ('BAU') electricity consumption of dishwashers at 33.4 TWh/yr in 2010 (stock 82.2 m units) increasing fairly linearly to 39.3 TWh/yr in 2020 (stock 118.2 m units) and 42.4 TWh/yr in 2030 (stock 153.4 m units). The savings estimated by CLASP are thus 3-13% of the 2030 total.

2.4.1 Assessment of impact

The CLASP 2010 baseline consumption of 33.4 TWh/yr is based on test standard energy consumption that –as has been argued by the preparatory study—is 10% lower than the real-life energy consumption, which on average is performed at a lower-than-rated load but also at

[10] Estimating potential additional energy savings from upcoming revisions to existing regulations under the ecodesign and energy labelling directives. CLASP, 2013

a higher-than-rated programme temperature. On the other hand, CLASP calculates 280 cycles per year, whereas consumer surveys show a dish-wash frequency of 214 cycles per year, i.e. 23% lower.

Overall, the CLASP baseline overestimates the baseline energy consumption by around 15%.

In comparison, the IA study accompanying the 1016/2010 regulation[11] starts from around 26 TWh in 2005 and projects for 2020 an energy consumption, with the current measures, of 33.7 TWh. For 2030 the IA study, following the preparatory study, also predicts a high energy consumption of approximately 38.9 TWh/yr, with the current measures, due to the expected increase of dishwasher ownership.

Given the current BAT value of EEI=41 there seems to be a case for at least one extra labelling class (>EEI45). There is no further proof that an EEI 40 or 36 is feasible. The ecodesign measures proposed by CLASP are technically feasible (EEI max 50), but there are not enough resources to establish whether it is also feasible without negative impact on competitiveness or affordability. For these reasons it is believed that the lower estimate of CLASP might apply, i.e. around 1.4 TWh/yr economical saving from the new measures would be more appropriate. A follow-up study, with consultation of stakeholders, would be required to verify feasibility.

The table below summarizes the energy related parameters discussed, recalculated for the EU-27 in 2013 and compared to the real-life situation in 1993. Note that this is a comparison of new machines and not a stock model; therefore total EU-27 consumption and emission data cannot be derived directly from these data but the 2013 data give at least a first rough indication of the (maximum) total EU consumption values that can be expected in 2025 (at complete stock change after 12 years, c.p.).

Table 2-11 Dishwashers, real-life base case, comparison 1993-2013 (estimate VHK)

Parameter, new dishwashers	1993*	2013
Real average programme temperature, in °C**	61	57
Real (rated) load, in number of place settings (ps)	7 (12)	9 (12)
Cycles/yr per unit (est.)	210	210
Energy consumption per real cycle, kWh/cycle***	1.4	0.9
Water consumption per real cycle, litres/cycle	24	10
Ownership EU-27, % of households******	21%	39%
Number of households EU-27, million	172	200
Number of dishwashers installed in EU-27, million*******	36	78
*=source: VHK for GEA 1995 in Group for Efficient Appliances, EnR, Background Report Vol. III, Long-term Efficiency Targets, a Technical and Economic Analysis, DEA, 1995.		
**=In 1993: 35% x (50-60 ºC) + 65% x 65 ºC. In 2013: 50% x <50ºC + 65% x 50 ºC		
***=In 2013: average EEI=50 means 0.825 kWh/cycle for standard cycle (ca. 50 ºC). But real temperature is higher (+15% in absolute degrees; +18% energy); real load is lower (-25%-->-8% in energy) and thus 0.825 + 10%= 0.907 kWh/cycle		
****= 1993: based on 26% in EU-15 (GEA) and <5% in NMS (est. VHK). In 2013: 46% in EU-15; 16% in NMS.		
*****=a straight count of 2013 values gives a total EU-27 electricity consumption of almost 15 TWh/year. This is the theoretical total at complete stock change (after 12 years) in 2025 (c.p.). Compare: The same straight count for 1993 machines results in a theoretical value of 10.6 TWh in 2005. This shows that, if the current pace of growing popularity persists, dishwashers will surpass washing machines in energy consumption within a few years, albeit at a lower level than predicted in the IA study and by CLASP.		

[11] SEC 2010 1357, OJ 2010

2.4.2 Non-energy aspects

Non-energy environmental aspects of dishwashers have been studied in 2005 under the preparatory study for washing machines and dishwashers. In addition the results of the more recent DG JRC led study on Integration of resource efficiency and waste management criteria in European product policies – Second phase[12] can be considered to be relevant as well even if the case study product was a washing machine.

The ecodesign preparatory study identified energy and water consumption during the use phase as the most relevant environmental aspects. Non-energy (or water) parameters were not covered by ecodesign requirements. Detergent consumption however was noted as a relevant parameter.

The DG JRC study of 2012, being rooted in the "A resource-efficient Europe – Flagship initiative of the Europe 2020 Strategy", deals more extensively with resource efficiency aspects. The study identified five parameters that could be used to better integrate resource efficiency into environmental product legislation, for instance through implementing measures under the Ecodesign Directive. These five parameters are:

1. recyclability/recoverability/reusability (RRR),
2. recycled content,
3. recyclability/recoverability/reusability benefits (RRRB),
4. use of hazardous substances,
5. durability.

These aspects were tested for suitability as ecodesign requirement in three product cases: washing machines and LCD televisions (all parameters), and imaging equipment (recycled content only).

The conclusions of this study are shown below. Although they are drafted on the basis of an assessment of washing machines the results are considered to apply to dishwashers just as well[13]:

- Improved disassembly of PCBs[14] would allow a larger amount of PCBs to be manually dismantled (instead of being shredded) resulting in higher recycling rates for copper, gold, silver, and PGMs[15]. The requirement would be drafted in terms of a maximum disassembly time, to be proven by test reports on the basis of self- declaration;
- Improved disassembly of motors would allow a larger recycling rate (+5%) of embodied metals (steel and copper). Furthermore, this requirement would be essential for the separation of neodymium magnets (when embodied), once commercial recycling routes of rare earth would be established. The requirement would be drafted in terms of a maximum disassembly time, to be proven by test reports on the basis of self-declaration;
- Improved disassembly of LCD screens would allow an easier separation of the LCD reducing the risks of contamination of other recyclable parts and increasing possible recovery of CRM (e.g. Indium). The requirement would be drafted in terms of a maximum disassembly time, to be proven by test reports on the basis of self-declaration;
- Other requirements could be:

[12] Final Executive Summary of Second phase (December 2012, plus preceding reports http://lct.jrc.ec.europa.eu /pdf-directory/

[13] F. Ardente, F. Mathieux; Stakeholder event of the project: Integration of resource efficiency and waste management criteria in European product policies – Second phase" Analysis of case-studies: Washing Machines

[14] PCB = Printed Circuit Board, as applied in the electronic parts of the product, Brussels – 10th September 2012

[15] PGM = Palladium Group Metals, many of these alos belong to CRM = Critical Raw Materials

- An information requirement for the content of Rare Earths in motor parts (self-declaration, accompanied with laboratory test reports);
- A declaration (or threshold) of RRR or RRR benefits[16];

The study showed that resource efficiency requirements could decrease the scores in environmental impact categories 'human toxicity', 'aquatic toxicity', terrestrial toxicity' and 'abiotic depletion potential'.

The presentation of the study results on 10 September 2012 however highlighted practical concerns of stakeholders regarding (in general terms) the feasibility and enforceability of such requirements, such as the lack of measurements standards, lack of data regarding product composition and difficulties in calculating the 'correct' end-of-life scenarios.

The BIO study amending the MEErP[17] builds upon these conclusions and in its December 2013 reports suggests to introduce as new modules to the MEErP method:

- Recyclability benefit rate– is considered possible, but would require modification of the Ecoreport tool;
- Recycled content – is considered possible but would require modification of the Ecoreport tool and additional indicator sets;
- Lifetime – proposal to present outputs as impacts per year of life time;
- Critical Raw Materials – is considered possible, but lack of data and characterisation factor hinder the implementation.

Abiotic depletion potential was considered but due to lack of data excluded as module for the MEErP. In the original MEErP 2011 ADP was not included due to lack of EU agreement on characterisation of materials. Material footprint was also considered in the BIO study but due to lack of data excluded as module for the MEErP.

The above describes the current (summer 2013) status. As integration of resource efficiency parameters into ecodesign requirements will require substantial efforts in data collection, methodological agreement by all parties involved, modification and enhancement of existing tools and an overall check according 2009/125/EC Article 15 criteria, which should assess the proportionality of such requirements.

2.5 Conclusion

Eligibility of product group regarding Article 15 criteria

The most recent data shows the product group of dishwashers is still economically significant. The growing household penetration and the limited increase in average efficiency lead to the conclusion that the environmental impact will also be significant. A technical improvement potential exists as machines have been identified exceeding class A+++ limits.

The best available label class for dishwasher is A+++. According to GFK data in 2012 3% of the products are sold in this energy class. CECED data showed that 6% of the models are offered in this label class. Hence, these models are on this moment less popular, probably related to a higher purchase price. There are models available on the market with an EEI of 41 (class A+++ requires EEI of 50).

Due to the Ecodesign requirements only machines in the top three energy label classes will be allowed on the market (with exemptions of small machines). This allows room for

[16] RRR are the parameters related to Reusability, Recoverability and Recyclability. These are calculated for each product. RRR benefits are an indicator of the improvement if the product scores better on RRR parameters.
[17] Material-efficiency Ecodesign Report and Module to the Methodology for the Ecodesign of Energy-related Products (MEErP), STAKEHOLDER CONSULTATION, Report to the European Commission, 29 July 2013

differentiation of energy efficiency of machines, but rather limited when compared to Energy Labelling main purpose (labelling to apply in seven energy efficiency classes).

In the future possible new classes can be introduced. There is on this moment technical potential for 1 more new label class, when an improvement of 10% related to the class A+++ is considered. The top 2% of the models on the market would fulfil these requirements.

→ The possibility for the introduction of new classes on the energy label has to be investigated with an economic assessment including lowest life cycle costs.

→ The possibility for tightening the ecodesign requirements on energy efficiency has to be investigated with an economic assessment including lowest life cycle costs.

Changes in performance standard EN 50242

Changes to EN 50242 currently discussed might incur a change in the test load (introduction of plastic items and other types of cooking utensils and a different type of soiling), making the test more comparable with real dishwasher use by consumers. Such changes are expected to affect the energy consumption per cycle and hence the EEI to be calculated and also the cleaning and drying performance. This will make the label program, called 'eco', more suitable for the most common types of dishes (including plastics, pots and pans), making it a better option for consumers to choose for.

→ Future revision of the label and ecodesign label should take into account the effects of a change in the standard.

Improve consistency in Ecodesign and Labelling Regulation and test standard

→ Further analysis should address the current inconsistency between the Energy Labelling and Ecodesign regulations as regards machines of less than 45/50 cm and 12 or more ps.

→ Further analysis should address the current inconsistency between the Energy Labelling and Ecodesign regulations as regards the threshold width of 45 cm (ecodesign) or 50 cm (labelling)

→ Further analysis of the regulations should address the inconsistency in definitions in the standard and regulations.

Current test program does not reflect real consumer behaviour

There is evidence that the programme on which the requirements of the regulations are based is not the most used programme. Other programmes than the eco programme are not considered in the regulation and improvement of these programmes is therefore not stimulated by legislation.

The number of cycles per year is overestimated in the calculation.

Figure 2-9 shows that nearly 50% of respondents state they fill their dishwasher moderately or lightly filled. For washing machines part load operation is introduced to account for under-loading. Consideration of for part load can be considered for more realistic energy consumption.

→A further analysis on the possibility to consider part load testing, testing at hotter (and colder) programs and frequency of use is recommended.

Possibility of requirements for water consumption hot water inlet

The water consumption has gone down in the last decade. Many machines have a possibility for hot water inlet.

→Possible requirements for water consumption should be investigated.

→ Possible requirements for hot water inlet should be analysed.

Review necessity to address off mode/left-on mode in regulation measures

Low Power modes of dishwashers are covered by the standby ecodesign regulation 1275/2008.

The effect of including the low power modes in the annual energy consumption for ecodesign and energy labelling has a small effect on the EEI.

→ The need for low power requirements and the inclusion of them in measures should be assessed during the follow-up analysis for the review.

Review necessity to address the contradiction in the ecodesign/labelling legislation between the scope of the measures and the definition of the household appliances

It would be consistent to remove "including those sold for non-household use" from the regulatory text.

3. Washing machines

Main author & final editing: VHK, Karin Brakkee & Martijn van Elburg

3.1 Legislation & standards

3.1.1 Revision articles

Regulation 1015/2010[18] on ecodesign of household washing machines calls for a review "in light of technological progress" and more specifically an assessment of verification tolerances, ecodesign requirements for rinsing and spin drying efficiency and the potential for hot water inlet. The review deadline is 1 December 2014.

Delegated regulation 1061/2010[19] on energy labelling of household washing machines calls for a review in light of technological progress and an assessment of verification tolerances. The review deadline is 20 December 2014.

3.1.2 Subject matter and scope

Both Regulations apply to electric mains-operated household washing machines and electric mains-operated household washing machines that can also be powered by batteries, including those sold for non-household use and built-in household washing machines.

The Regulations do not apply to household combined washer-driers.

Standard EN 60456 states that it applies to clothes washing machines for household use. Household use is not defined in the standard.

Professional washing machines are not "household" and therefore excluded from the regulations. They are subject of the ecodesign study of LOT24.

The assessment of the market did not result in identification of products or technologies that require a different definition of the product or a change in excluded products.

There is a contradiction in the ecodesign/labelling legislation between the scope of the measures (‘…including those sold for non-household use‘) and the definition of the household appliances (…appliances used for non-professional purposes).

3.1.3 Energy labelling 1061/2010

Before 2010 the energy labelling of washing machines was based on directive 95/12/EEC. The energy classes of washing machines were based on a standard energy use per cycle with a 60º C cotton wash.

In 2010 a new label system was introduced by Delegated Regulation1061/2010. There are two main differences:

- The energy efficiency index EEI is to be based on annual energy consumption, including low power modes.

[18] COMMISSION REGULATION (EU) No 1015/2010 of 10 November 2010 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for household washing machines (OJ L 293, 11.11.2010)

[19] COMMISSION DELEGATED REGULATION (EU) No 1061/2010 of 28 September 2010 supplementing Directive 2010/30/EU of the European Parliament and of the Council with regard to energy labelling of household washing machines (OJ L 314, 30.11.2010)

- The average wash cycle energy consumption is calculated as the average of three 60º C cotton cycles, two partially load 60º C cycles and two partially load 40º C cycles.

The energy efficiency index EEI is calculated as the declared annual energy consumption AE_c divided by the standard annual energy consumption SAEc.

The SAEc is calculated as:

$$SAE_c = 47{,}0 \times c + 51{,}7 \qquad \text{Equation 3.1}$$

Where c is the rated capacity of the washing machine for the standard 60 °C cotton programme at full load or the standard 40 °C cotton programme at full load, whichever is the lower.

$$AE_c = E_t \times 220 + \frac{P_o \times \frac{525600-(T_t \times 220)}{2} + P_l \times \frac{525600-(T_t \times 220)}{2}}{60 \times 1000} \qquad \text{Equation 3.2}$$

The AE_c for machines which automatically switch to the off-mode at the end of the programme, according the corrigendum of 16 November 2011[20], is calculated as:

$$AE_C = E_t \times 220 + \frac{\{(P_l \times T_l \times 220) + P_o \times [525\,600 - (T_t \times 220) - (T_l \times 220)]\}}{60 \times 1\,000}$$

Equation 3.3

Where:

- E_t is the Energy consumption per cycle
- P_o is the power in off mode in W.
- P_l is the power in left-on mode in W.
- T_t is the program time weighted over the 60 °C full, the 60 °C partial and the 40 °C partial load cycles

The energy consumption per cycle is the weighted energy consumption over the 60 °C full, the 60 °C partial and the 40 °C partial load cycles:

$$E_t = [3 \times E_{t,60} + 2 \times E_{t,60½} + 2 \times E_{t,40½}]/7 \qquad \text{Equation 3.4}$$

Where $E_{t,60}$, $E_{t,60\,½}$ and $E_{t,40\,½}$ are the energy use per cycle for the 60 °C full, the 60 °C partial and the 40 °C partial load cycles respectively.

During the preparatory stages of the Regulation 1061/2010 (see presentation to Consultation Forum in 2009[21]) the ratio to convert the 60° full load values were assumed to be 0.8 for the 60°C partial load and 0.64 for the 40°C partial load leading to an overall ratio of 0.84 (is 3*1 + 2*0.8 + 2*0.64). A recent analysis of the energy consumption of various cycles of 36 washing machines[22] showed that the correction factors were on average 0.85 and 0.65 respectively. Note that this analysis is based on a very limited number of models and that more data is needed to better define the average ratios between the 60º full load and other wash cycles in more detail. It should also be noted that there is a large variation in the ratios between the cycles. The 60full:60half ratio varies between 0.64 and 1.04 and the 60full:40half ratio varies between 0.39 and 0.97.

[20] CORRIGENDA Corrigendum to Commission Delegated Regulation (EU) No 1061/2010 of 28 September 2010 supplementing Directive 2010/30/EU of the European Parliament and of the Council with regard to energy labelling of household washing machines (Official Journal of the European Union L 314 of 30 November 2010)

[21] presentation to Consultation Forum in 2009, the preparatory stages of the Regulation 1061/2010

[22] VHK survey of 36 models, based on product information sheets and brochures. models are chosen from topten.eu and additional machines from different label categories

Table 3-1 Energy classes according Regulation 1061/2010

Class	1061/2010		
	EEI (%)	kWh/year*	kWh/weighted cycle*
A+++	EEI<46	175	0,77
A++	46≤EEI<52	198	0,87
A+	52≤EEI<59	225	0,99
A	59≤EEI<68	259	1,15
B	68≤EEI<77	293	1,31
C	77≤EEI<87	331	1,48
D	EEI≥87		
E			
F			
G			

* kWh/year and kWh/cycle are calculated assuming a capacity of 7 kg and 6 kWh/year low power mode energy consumption and that the label threshold is just met.

3.1.4 Ecodesign 1015/2010

Ecodesign Regulation 1015/2010 introduced generic requirements for washing machines stating that the programmes used for the test cycles should be "*the most energy efficient programmes suitable for cotton at 40 and 60 degrees*".

Specific requirements apply to the energy efficiency of the product, expressed as EEI. These are shown in Table 3-2 below.

Table 3-2 Overview of the requirements, classes phased out

Class	EEI (%)	Tier I Dec 2011	Tier II Dec 2013
A+++	EEI<46		
A++	46≤EEI<52		
A+	52≤EEI<59		
A	59≤EEI<68		Banned for all machines ≥ 4kg
B	68≤EEI<77	Banned for all machines	
C	77≤EEI<87		
D	EEI≥87		

In addition specific requirements apply to the water consumption of a full load (2011) and partial load (2013):

- Water use should not be more than $Wt \leq 5 \times c + 35$ (from December 2011).
- Water use should not be more than $W_t \leq 5 \times c_{½} + 35$ (from December 2013).

The industry was not in favour of this requirement because the link to rinsing efficiency was missing.

And the regulation introduced requirements regarding washing performance:

- The Washing Efficiency Index shall be greater than 1.03 (equivalent to former washing class A of Directive 95/12/EC).

There are no requirements for spin drying efficiency, nor for rinsing efficiency.

3.1.5 Transitional symbols

Following Commission Communication[23] 2012/C206/05 published on 13 July 2012 household washing machines have to show symbols indicating the cycles which clean normally soiled cotton laundry at 40 °C and 60 °C and which shall be used for the calculation of the energy consumption and other parameters for household washing machines. According to regulation 1015/2010, these cycles should be clearly identifiable on the programme selection device of the household washing machines or the household washing machines display, if any, or both, and indicated as 'standard 60 °C cotton programme' and 'standard 40 °C cotton programme'.

To facilitate the clear identification of the relevant standard cotton programmes or programmes setting(s) on the programme selection device of the household washing machines or the household washing machines display, the following transitional symbols providing presumption of conformity should apply:

Table 3-3 test Tolerances

Programme	Symbol
— for the 'standard 60 °C cotton programme':	
— for the 'standard 40 °C cotton programme':	
— for the 'standard cotton programme' in appliances where the selection device of the programme is separate from the selection device of the temperature	

In appliances where programme and temperature are selected using separate devices, the three arrows must be present on the selection panel.

These transitional symbols will ultimately be replaced by symbols provided in harmonised standard(s),

The implementation of this Communication has been difficult to track due to its fairly recent publication and the lack of a database that lists the conformity of models with these requirements. Based on a very limited study of product brochures and promotional materials it appears that some companies have not chosen this option to prove conformity with the requirement.

This issue is to be discussed in more detail in consultations of relevant stakeholders (industry and market surveillance parties) during a follow-up study.

3.1.6 Tolerances

Both the Ecodesign as the Energy Labelling Regulation define tolerances for verification. The table below is a combination of table 1 of Annex III of Ecodesign Regulation 1015/2010 and table 1 of Annex V of Regulation 1061/2010.

Table 3-4 test Tolerances

Measured parameter	Verification tolerances
Annual energy consumption	The measured value shall not be greater than the rated value (*) of *AE C* by more than 10 %.

[23] Commission communication in the framework of the implementation of Commission Regulation (EU) No 1015/2010 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for washing machines (2012/C 206/05), 13 July 2012

Washing efficiency index	The measured value shall not be less than the rated value of *I W* by more than 4 %.
Energy consumption	The measured value shall not be greater than the rated value of *E t* by more than 10 %.
Programme time	The measured value shall not be longer than the rated values of *Tt* by more than 10 %.
Water consumption	The measured value shall not be greater than the rated value of *W t* by more than 10 %.
Power consumption in off-mode and left-on mode	The measured value of power consumption *P o* and *P l* of more than 1,00 W shall not be greater than the rated value by more than 10 %. The measured value of power consumption *P o* and *P l* of less than or equal to 1.00 W shall not be greater than the rated value by more than 0,10 W.
Duration of the left-on mode	The measured value shall not be longer than the rated value of *T l* by more than 10 %.
Remaining moisture content	The measured value shall not be greater than the rated value of *D* by more than 10 %.
Spin speed	The measured value shall not be less than the rated value by more than 10 %
Airborne acoustical noise	The measured value shall meet the rated value

The verification tolerances for most of the parameters are defined as 10% of the measured value.

For a 7 kg machine with an A+++ label the calculated annual consumption will be maximum 175 kWh/year. This means that the annual consumption can have a maximum of 192 kWh/year. Assuming a low power mode consumption of 6 kWh yearly this results in a calculated energy consumption of 0.77 kWh/weighted cycle. Applying the verification tolerances of 10% gives 0.85 kWh/weighted cycle as threshold value for A+++ washing machines allowed on the market. The absolute value of the tolerance is 0.077 kWh/weighted cycle.

Tolerances however cannot be expressed as relative values indefinitely, at some point they will "hit" an absolute measurement errors. In this context it is worthwhile to assess the tolerance needed for possible future energy efficiency classes. CLASP has estimated savings potentials for the introduction of new energy efficiency classes at EEI 41, 37 and 33. Such EEIs result in energy consumption values (assuming 6 kWh low power mode consumption) of 0.68, 0.61 and 0.54 kWh/weighted cycle. The absolute differences between these classes are thus 0.07 kWh/weighted cycle. This difference is smaller than the current accepted absolute tolerance of 0.077 kWh/weighted cycle.

The last round robin test that could be used to assess reproducibility and repeatability was carried out in 2004. Various stakeholders underline the importance of a new round robin tests to obtain important information on real verification tolerances. Interesting in this respect is the ATLETE II program which will be finalised by 31 October 2014.

As there is not enough information on the actual absolute measurement uncertainties, it cannot be concluded that the proposed EEI's do not result in tolerances allowing more than one class jump.

Rounding

The text of the Regulation has caused some concern with stakeholders as it affects how 'rounding' of values is to be performed.

First, there is some concern on when rounding should occur; before or after a multiplication. As an example: Suppose a machine has a daily water consumption of 15.5 liter a difference of approximately 0.5*220 is 110 liters occurs if rounding to an integer occurs before or after multiplication.

Secondy, in Energy labelling Regulation 1061/2010, Annex IV, point 1.c it states "rounded up to the nearest integer", which can be interpreted as 15.1 will be rounded UP to 16 (to the next integer) whereas "rounding to the nearest integer would result in a value of 15.

Such issues are usually dealt with at the level of the technical standards, which is the preferred approach of many stakeholders concerned.

3.1.7 Related EU Legislation

Commission Regulation 1275/2008

Washing machines are covered by Commission Regulation 1275/2008 on standby and off mode power. This regulation allows as maximum power consumption 2 W in left-on mode, 1 W in off mode. After 7 January 2013 the maximum power is reduced to 1W and 0.5 W respectively. More details can be found in Annex A.

The test method for low power modes is harmonised in standard EN 50564:2011.

Assuming a cycle time of three hours, this results in a maximum yearly energy consumption of 12 kWh per year in low power modes for the period from 2010 until 2014 and 6 kWh per year maximum from 2014.

It must be noted that the left on power consumption is defined in regulation 1015/2010, while the standby is defined in regulation 1275/2008. These definitions are not equivalent: standby is a state in which no other function is available other than consumer information and reactivation function, for this state a maximum consumption is set; left-on is the state following end of cycle regardless of functionalities available. A product in left-on will be considered in standby if no functionality other than consumer information and reactivation is available. The power consumption indicated in the product fiche is the left on power consumption, which may be different from the stand by power consumption either because the left on state is not steady and is followed by an auto switch off, or because additional functionalities are still available."

It is generally accepted that there are no good reasons why washing machines using existing technology should not be able to reach their lowest power consumption within 30 minutes of the door being opened at the completion of the programme. Similarly, for washing machines with power management systems, there is no reason why they should not be able to revert to their lowest power state within 30 minutes of the door being opened at the completion of the programme. Measurement of 'left on mode' power can therefore commence at that point.

EN60456:2011 considered this fact and in agreement with EC a formula was implemented for the measurement standard. A revision of the regulations could include the measurement for energy consumption as follows:

- Post-programme phase LU (Unstable left on mode) – Beginning when the washing machine door is opened immediately after the completion of the programme. LU lasts for 30 minutes.
- Post-programme phase LO (Left on mode) – Beginning immediately after LU. LO lasts for 10 minutes. This value shall be used for fiche declaration of left-on mode.

EU Ecolabel

Regulation 66/2010 is the basis for the voluntary EU Ecolabel, designed to promote products which have a reduced environmental impact compared with other products in the same

product group. Commission decision 2003/240/EC[24] established ecological criteria for the award of the eco-label to washing machines under the old regulation 1980/2000, but this decision expired in 2007. No new criteria for washing machines have been established under the new regulation.

National Labels

Other (voluntary) labels exist in the Czech Republic and for the Nordic countries.

3.1.8 Non-European legislation and other initiatives

Worldwide many nations have adopted energy requirements and other environmental criteria for washing machines. These include mandatory and voluntary labels and minimum requirements, an overview is provided in Annex A of this study.

Stakeholders consulted in the course of this study have informed that:

- The USA Department of Energy introduced in the energy star regulation a 5% bonus if the product has smart grid connection capability.
- Australia standardization has announced its willingness to adopt the IEC rinsing method, which is under development. The development of a new rinsing method is under way in the US and the EU (AHAM will adopt a new standard soon; CENELEC is checking whether the same principle can be implemented for EN60456 under the mandate from EC).

IEC standards should be maintained as reference for EU ones.

3.1.9 Test standard

The standard EN 60456:2011[25] is used to assess the performance of washing machines. This standard has undergone a revision in 20111 which introduced a test cycle based on the tests for 60 full, 60 part load and 40 part load cycles.

The standard is available and in line with the current regulations but not yet published in the OJ.

The standard allows the program temperature to be a maximum value. The actual temperature used by the programme can be lower. This is supported by the sentence in Annex I of 1015/2010 which states that the booklet provided should contain sentences stating that the values are based on 'the 'standard 60 °C cotton programme' and the 'standard 40 °C cotton programme' and that these programmes are "*suitable to clean normally soiled cotton laundry and that they are the most efficient programmes in terms of combined energy and water consumption, in addition, an indication that the actual water temperature may differ from the declared cycle temperature".*

The test load consists of white cotton items only: sheets, pillow cases and towels. The partial load is half of the nominal load or rated capacity.

Stain test strips are attached to cotton base loads in order to assess washing performance.

The standard does describe measurement procedures for washing cycles for other fabrics, such as wool and synthetic. However the declaration in European regulations only the information of the cotton programme is used.

[24] Commission Decision 2003/240/EC of 28 August 2001 amending Decision 2000/45/EC as regards the validity of the ecological criteria for the award of the Community eco-label to washing machines

[25] EN-IEC 60456 (en) Clothes washing machines for household use - Methods for measuring the performance

3.2 Market Analysis

3.2.1 Market and stock data

Washing machine ownership has grown little in the last decades. Ownership has grown form the 1970's up to 90% in EU-15[26]. In the new member states the ownership was lower in 2000 (about 70%), but had grown recently to 90% as well (Bertoldi[27]). It is not expected that ownership will increase to 100% as a certain share of households use common laundry rooms. The sales are primarily (90%) replacements.

CLASP assumes higher sales than the 2009 IA. Sales and stock growth are shown in the next figures.

Figure 3-1 Sales in EU-27

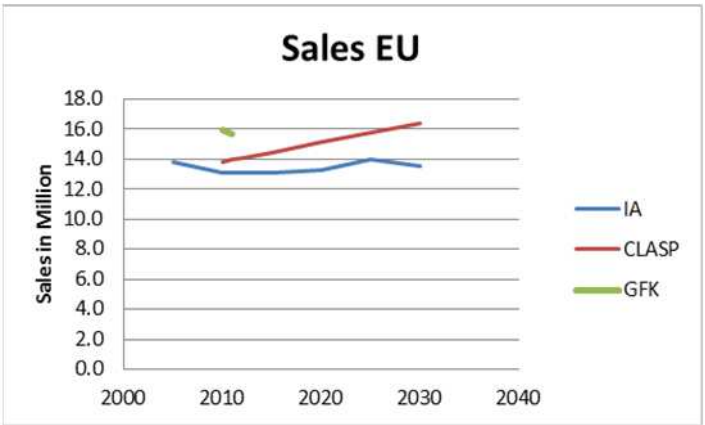
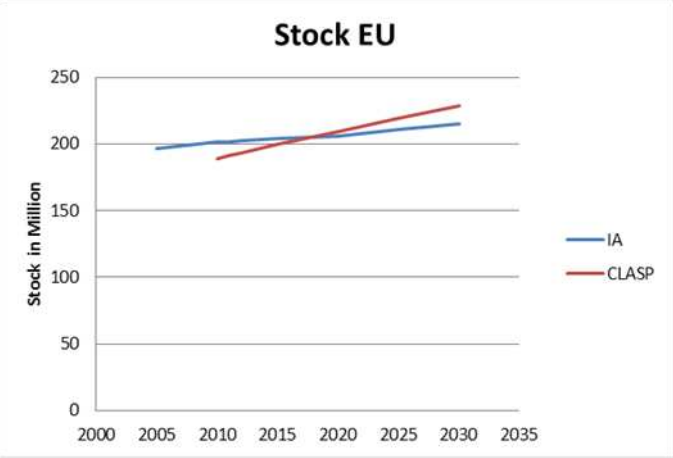


Figure 3-2 Stock in EU-27



The IA and CLASP data is supplemented by recent GFK data for sales in the last two years, for 23 EU-countries. The GFK sales show a small decline which may be attributed to the economic crisis:

Table 3-5 Sales of washing machines in 2011 and 2012 in EU-23

Year	Sales (units)
2011	15,9 million
2012	15,6 million

[26] Preparatory Study, Lot 14: Domestic Dishwashers and Washing Machine, Final Report
[27] Energy Efficiency Status Report 2012, Electricity Consumption and Efficiency Trends in the EU-27 Paolo Bertoldi, Bettina Hirl, Nicola Labanca, Joint Research Centre, 2012

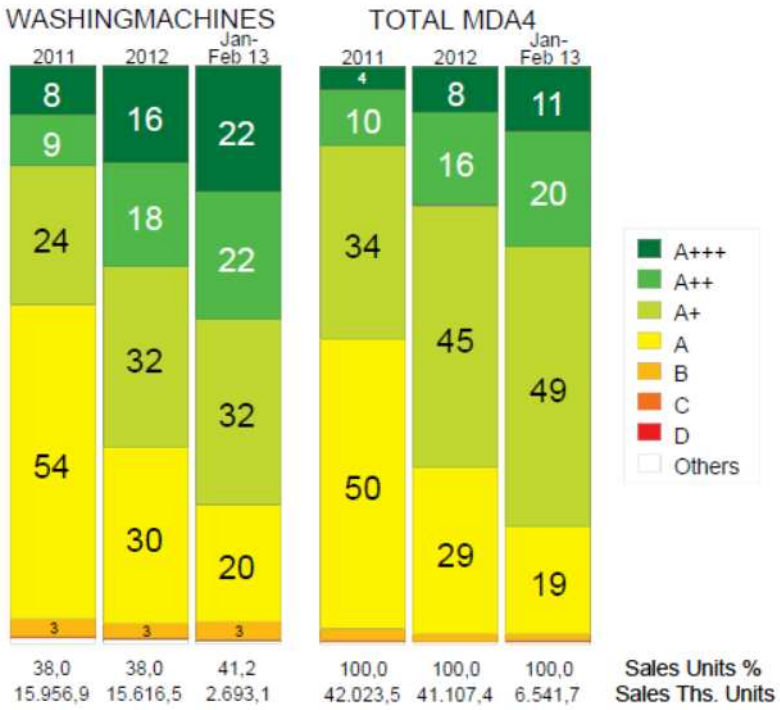
3.2.2 Trends in energy efficiency

The delegated regulation 1061/2010 for washing machines introduced in 2011 three extra classes to the efficiency scale: A+, A++ and A+++.

Sales data

In 2010 almost all the sold appliances were in label category A. After 2010 also models in A+, A++ and A+++ were sold on the market.

Figure 3-3 The distribution in energy classes for washing machines [28]



The new classes introduced in 2010 appear to be filling up quickly. The most recent data available (GfK Jan-Feb 2013) show that 22% of the now sold machines belong to the highest efficiency class of A+++.

Market Predictions

The sales show that 44% of the sales are now in the top 2 classes, with 22% in the top class. This development happened within 3 years after the introduction of these three top classes. This rapid evolution was not predicted in the Impact Assessment study for Wash appliances (2008) According the Jan-Feb 2013 sales trend sketched by GfK, the average EEI is close to 56 (assuming average EEI per class is identical to bottom limit of that class). This exceeds the expectations of the Impact Assessment, where the EEI at lowest life cycle cost was calculated at an EEI of 59.

CLASP assumes a development in energy efficiency which is a more positive than the one of the Impact Assessment (lower EEI means higher efficiency).

[28] MDA4 means the total of washing machines, dishwashers, fridges and freezers in 23 EU countries (Luxemburg, Cyprus, Malta and Bulgaria are excluded)

Table 3-6 Predicted energy efficiency improvement

Year	Impact Assessment	CLASP
2005	66%	66%
2010/*2009**	61%	62%
2015/*2014*	58%	56%
2020/*2019*	53%	51%
2025	52%	47%
2030	50%	47%

**The impact assessment evaluated the years 2009, 2014 and 2019*

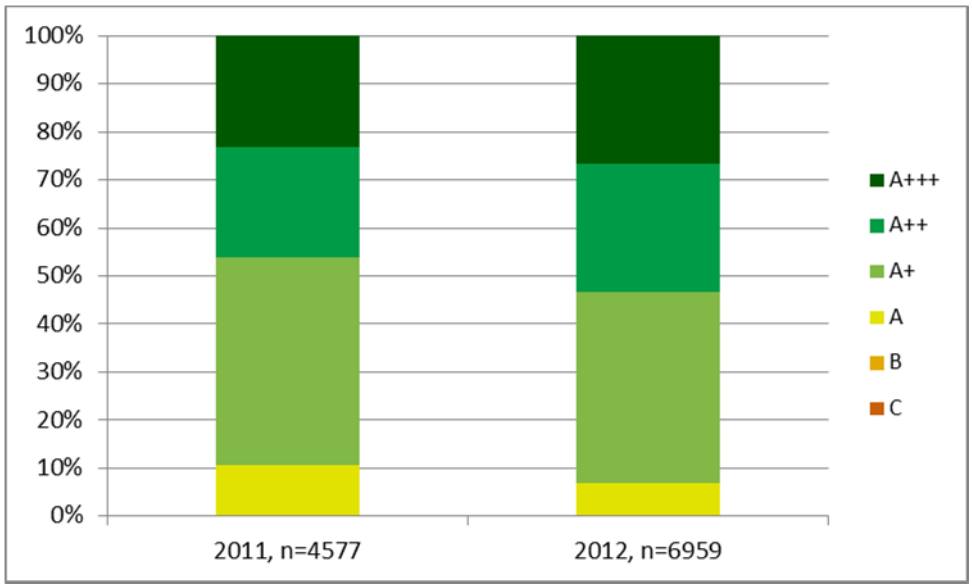
A possible explanation of why the CLASP scenario is more positive is because the CLASP analysis was published in 2013 and could use 2012 data, which includes label ratings based on the weighting method, whereas this information was not available during the Impact Assessment in 2009.

3.2.3 Characteristics of washing machines

Energy Efficiency

The CECED databases of 2011 and 2012 show us the number of models that are offered in the current label classes.

Figure 3-4 Distribution of label classes in new models based on database CECED

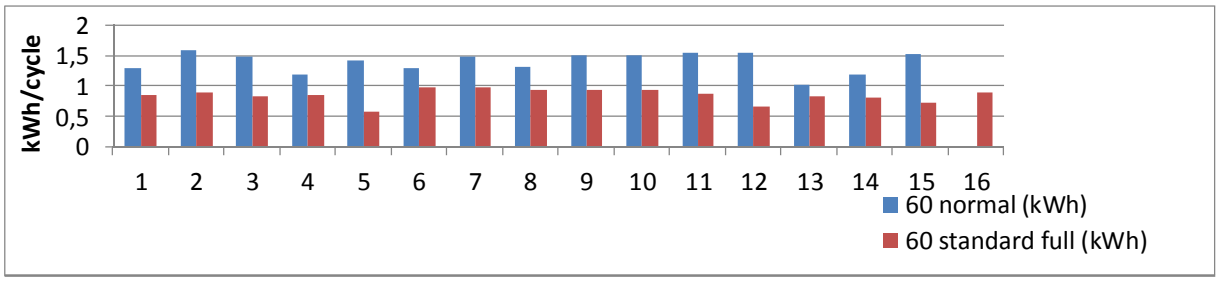


The most energy efficient programme

The regulation asks for a 'standard programme to wash cotton at 40 and 60 degrees. Most modern washing machines have several programmes that can wash cotton at 40 and 60 degrees. The most efficient one is often declared as eco programme or energy saving programme. In the regulation this programme is referred to as the 'standard' programme. This

programme uses less energy and less water than another cotton washing programme at 60 and 40 degrees. This 'normal' programme can have energy consumption twice that of the standard programme, which is shown in the next graph.

Figure 3-5 The difference between the normal 60 degrees cotton program (blue) and that of the standard (or energy efficient) 60 degrees cotton programme (red) of 15 machines.



Stiftung Warentest has tested washing machines using the 60 degrees cotton programmes[29]. Their conclusion was that none of the machines actually washes with 60 degrees but at 45 to 50 degrees. This saves considerable energy. The reduced temperatures are compensated through a longer cycle duration time: where the normal 60 degrees cotton programme needs between 2 and 3 hours, the standard cotton 60 degrees programme runs for 3 to 5 hours[30].

The manufacturer can determine the cycle temperature and duration of the program used for the standard EN60456 test, as long as it is declared by the manufacturer as suitable for washing cotton and it is clearly identified on the selection panel and indicated as "standard cotton programme". Since the eco or energy saving cotton programme scores better on energy efficiency this programme has to be the one used for the standard test.

Hygiene

As higher water temperature effectively kills bacteria, lowering the washing temperature can cause a health risk. AISE[31], the branch organization for the detergent industry, promotes low temperature washing (30 degree or lower, see par. 3.3.2), but also advises to take relevant precautions for laundry that can be considered a 'higher risk' to deliver appropriate hygienic effectiveness. This can be done by washing at higher temperatures (60°C or higher). Preferably with oxygen bleach containing powder detergent.

AISE furthermore advises to regularly run a 60°C wash cycle with a detergent that contains active oxygen bleach. This will prevent the development of malodours and forming of biofilms.

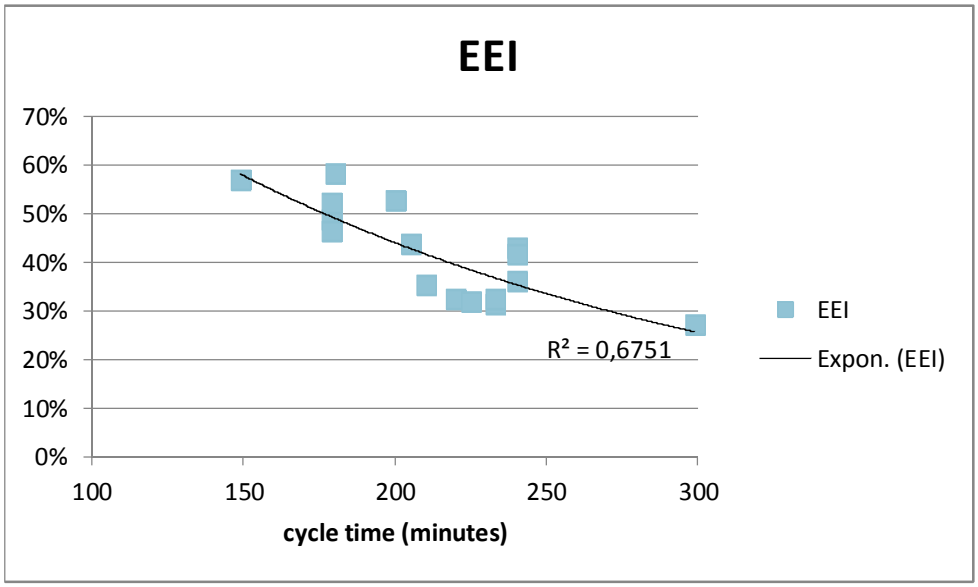
There is no hygiene test in the standard EN 60456.

Trends in programme time

A longer cycle time opens the possibility to wash with lower temperatures with the same washing result and can therefore increase the energy efficiency. The relation between the energy efficiency index and program time of eleven machines is shown in the graph below.

[29] Test magazine, Stiftung Warentest Germany, Januari 2013
[30] Own survey, see footnote 22
[31] international Association for Soaps, Detergents and Maintenance Products

Figure 3-6 Relation between the cycle time and the energy efficiency of eleven washing machines.



The graph shows that machines with highest label ratings (lowest EEI) have highest cycle duration.

Discussion of possible impacts

The risk of the longer cycle time is that people might not use the energy efficient program but will use the normal cotton program instead. They might simply not have the time to wait for 5 hours before they can start the next load.

Low-power modes (standby, left-on)

Based on a limited analysis of models on the market, it appears many washing machines have standby-modes that are higher than the maximum allowed 2.0W. These values vary from 0.05 W to 2.77 W. However the off-mode is in most cases lower than the requirement, varying from 0.05 to 0.6W.

In the preparatory study a total standby consumption of 11.8 kWh per years was assumed; 1.6W for left-on, 2.5 for delay-start and 0.5 for off mode (Task 3). The consumption by low power modes of machines that are on the market today varies between 0 and 12 kWh(based on anecdotal data). In many cases low power modes contribute to 2-3% in the total annual energy consumption or some 33% of the total bandwidth between class A++ and A+++.

Table 3-7 Low power mode consumption

Low power mode	Average real life power[32]
left-on	1.6W
delay-start	2.5W
Off	0.5W

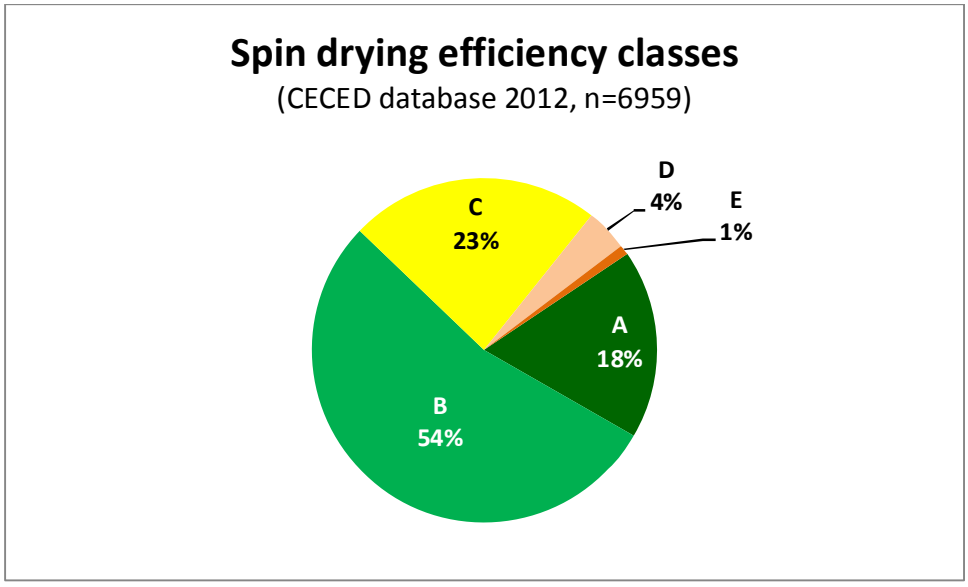
[32] Data from Preparatory study 2005.

Spin drying performance

Spin drying performance ("efficiency" in the current wording) is part of the label information. The spinning performance is expressed in a class from A to G, being A the most performing. There are no ecodesign requirements on spinning performance.

Spin drying is an energy consuming function. As spin drying is more efficient than tumble drying in terms of energy consumption, improving the performance of spinning can save energy if consumers use both a washing machine and a tumble dryer. However, since higher spinning speeds have higher wrinkling effects, it may increase energy consumption when ironing is applied. The review should assess the appropriateness of setting requirements on spin-drying performance.

Figure 3-7 Spin drying efficiency (CECED data 2012)



Article 7 of the ecodesign regulation asks for an assessment of the possibility for spinning performance requirements. If for instance the minimum requirement for spin drying would be C level, 95% of the market would be able to fulfil this requirement. If the requirement would be a B level minimum, only 72% meet the requirements. Further research needs to be done to assess the saving potential of requirements in this area.

The assessment of the effect of such requirements should take into account the fact that drying habits of consumers vary throughout the EU.

Water consumption

Besides energy efficiency, reduction of water use is also part of ecodesign regulations. The analysis of the most recent CECED datasets shows that water consumption has reduced significantly in the last 8 years and is still decreasing. Direct comparison however is difficult as the more recent CECED data applies to the weighted cycle of 3 full loads and 4 partial loads.

Table 3-8 Water consumption of washing machines

	N	Source	Water Consumption (l)	
			yearly	Per cycle
2005	4342	Prep.study	11154	50.7

2011	3815	CECED	9769	44.4*
2012	4631	CECED	9379	42.6*

*The water use per cycle is calculated as a weighted water consumption of the 60 full, 60 part load and 40 part load cycles. In the preparatory study only the 60 full cycle was assessed.

Rinsing efficiency

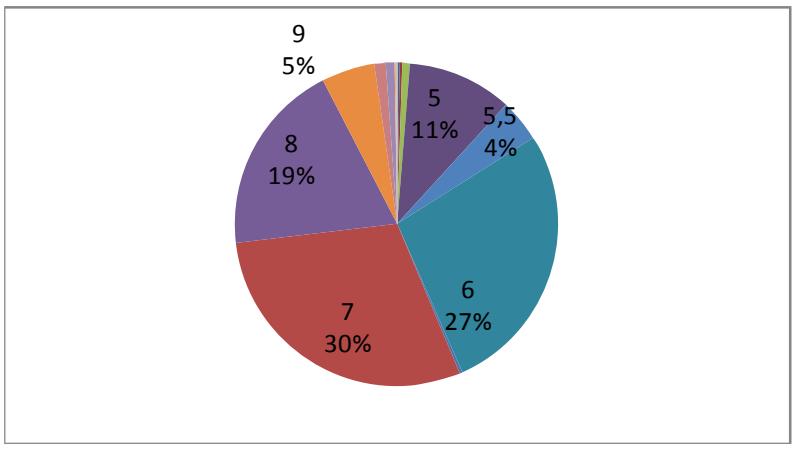
Reducing the amount of water can have a negative effect on the rinsing performance: residues of detergents will remain on the fabric. Nonetheless rinsing efficiency is not part of the label information or as ecodesign requirement as during conception of the regulations in 2009 the rinse test lacked reproducibility and repeatability. There is no information available on the rinsing performance of washing machines.

The current EN 60456:2011 standard includes a test for rinsing efficiency, based on alkalinity. This test has a decent repeatability but lacks reproducibility of the results between laboratories[33]. A review shall assess the opportunity of setting requirements on rinsing efficiency. Setting requirements on rinsing without a reliable measurement method (reproducible and repeatable results) should however not be forced. Additional ecodesign requirements on water consumption also have to be seen in correlation with rinse performance requirements.

Capacity of the washing machines

When establishing the current regulation for washing machines the standard consumption was based on an average wash load capacity between 5 and 6 kg indicated in the preparatory study. In recent years however the standard capacity of washing machines has increased. Consumers can buy machines up to capacities of 12 kg, with an average of 7 kg (based on CECED data from 2012).

Figure 3-8 distribution of rated capacities, first figure is in kg rated capacity, the second figure is the % share in the CECED database (CECED data, 2012)

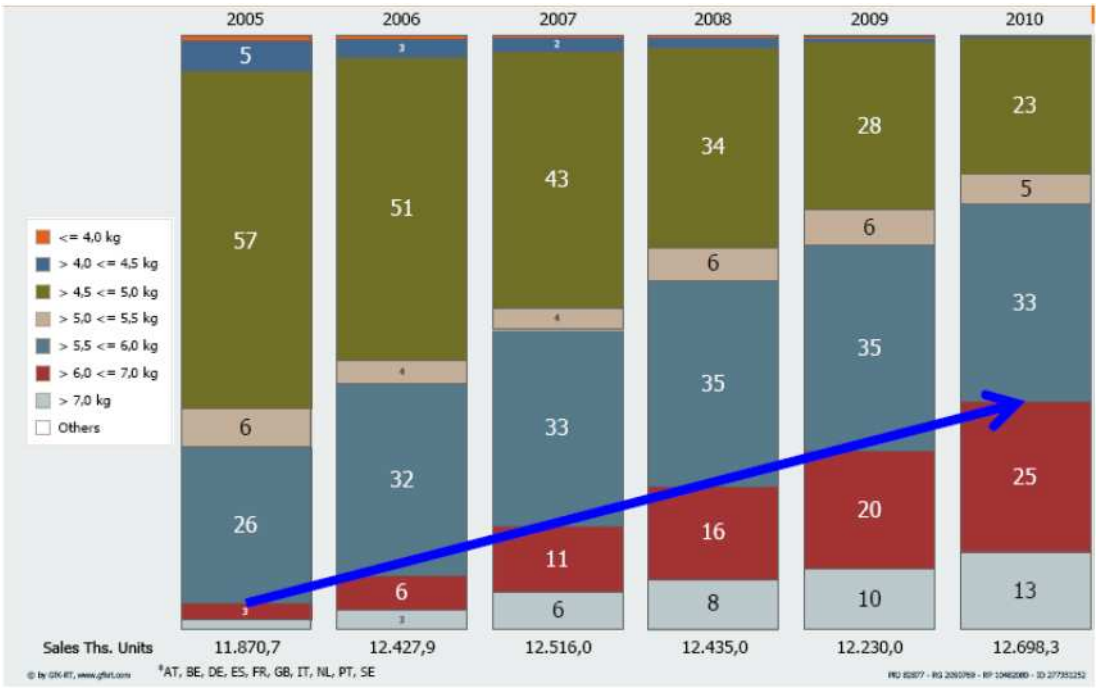


[33] Latest learning of factors influencing the accuracy of testing alkalinity in washing processes by Rainer Stamminger & Nina Wallenborn, University of Bonn, presentation

This trend is also shown by Bertoldi[34], including the base years 2005 to 2010.

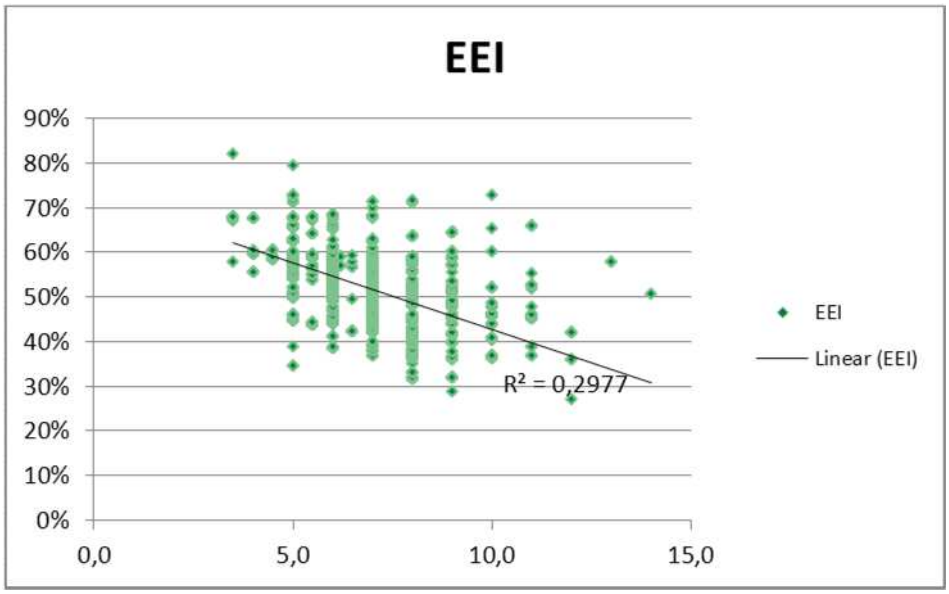
According to stakeholder CECED this partly because of an increased consumer demand for larger washing machines, offering better options for washing large loads, and the manufacturers' response by offering larger capacity products with similar external dimensions.

Figure 3-9 Trend in capacity of washing machines according to Bertoldi



Since capacity is part of the equation, a higher capacity with the same energy consumption will reduce the energy efficiency index.

Figure 3-10 The correlation between the capacity of washing machines and EEI



[34] Energy Efficiency Status Report 2012, Electricity Consumption and Efficiency Trends in the EU-27 Paolo Bertoldi, Bettina Hirl, Nicola Labanca, Joint Research Centre, 2012

The graph shows a weak correlation between the EEI and the capacity (R^2 value is 0.03). In general one could conclude that washing machines with a low EEI more often have a higher capacity than machines with a higher EEI.

Various stakeholders are not at ease with the trend of larger capacity machines being relatively more often more efficient, as this could lead to oversizing of machines. Even if these larger machines wash more efficienctly per kg, they fear that more part load washing will occur and the relative savings (per kg nominal load) are lost.

Further research is needed to assess whether larger machines can more easily claim higher energy performances and whether larger machines are used less often, because consumers will wash more laundry in one cycle.

3.3 User Analysis

3.3.1 Number of cycles per year

According to a recent study by the University of Bonn the number of cycles has changed from 4.0 to 3.8 cycles per week average in Europe. This means that an assumption of 220 cycles per year overestimates the annual energy consumption. 200 would be a better estimation.

A historic analysis by Kemna and Stamminger shows a trend towards a lower wash frequency. Until the early 1980s, there were around 277 wash cycles per machine per year and this frequency reduces to around 234 in 2005 (4.5 cycles per week).

Supportive of this trend, the A.I.S.E. survey shows that the average weekly wash frequency in 2011 is around 3.5 cycles per household per week, which corresponds to an annual average of 182 wash cycles per household.

The Stamminger survey (2011) reports an average weekly frequency of 3.8 cycles per household per week, which corresponds to an annual average of 198 wash cycles per household. While there are differences in the data gathering methodologies, these surveys confirm the general trend towards lower wash frequencies.

The above assessment means that the current calculation of annual consumption based on 220 cycles/year is overestimating the frequency of use, and 200 cycles/year or lower would be a better approximation.

The reason for the continuous reduction of wash cycles per year per machine is most likely a combination of demographic factors (the average household size has decreased during that period) and machine characteristics (the average capacity of a new washing machine has increased, from about 4.8 kg in 1997 to 6.0 kg in 2008). This trend started around 2002 and is continuing, and is expected to further reduce the wash frequency.

3.3.2 Chosen programmes

The real energy consumption of a washing machine depends on how a consumer uses the machine. This can differ from the rated annual consumption as shown on the product information. The rated energy is based on standard test result.

The University of Bonn and AISE have investigated what are the programme temperature that people use. The table below shows the preliminary figures from their independent assessments.

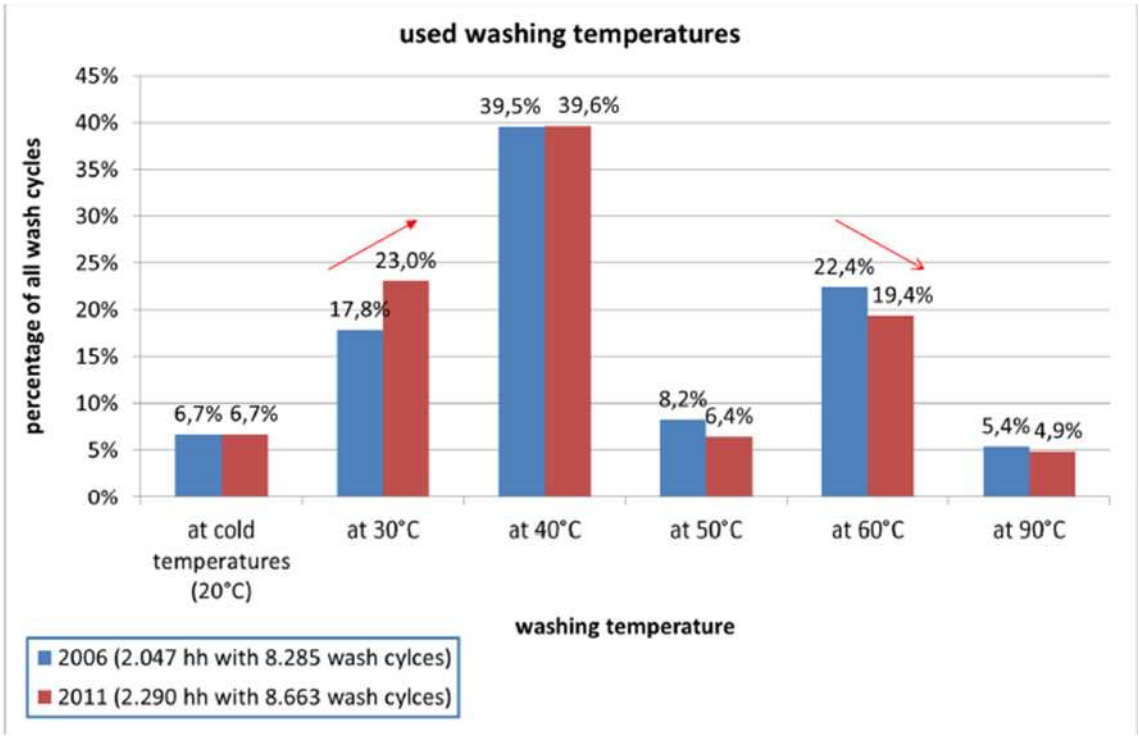
Table 3-9 Average programme temperature used by consumers

	AISE[35]		Bonn University			
Method	Internet survey		Internet survey		Washing diary	
n	200	200	226	238	100	236
Year	**2008**	**2011**	**2006**	**2011**	**2006**	**2009**
Average temperature	43.3	42.2	46.8	45.0	45.2	44.5

In the context of the upcoming *'I prefer 30'* campaign, the authors of both studies have – together—made an estimate for 'Europe' and concluded, also after straightening out minor methodological differences[36], to an average EU wash temperature for the year 2011 of 41°C.[37]

Both studies show that the average programme temperature that people use decreases[38]. This means that people use more often the 30◦ programme instead of 60◦ and 90◦C. The real temperature of the used programme can differ from the declared programme. Distributed over the different programme temperature the next figure shows the distribution of the programme temperatures in 2006 and 2011.

Figure 3-11 Development of washing temperatures (Source: Bonn study)



[35] Study every 3 years. Latest available data 2011. New results will be available by end 2014.

[36] For instance, minor differences between the outcomes can probably be explained by the set-up of the questionnaires, e.g. the definition of temperature classes. E.g. AISE asks respondents to indicate how often they wash at "60 degrees or higher" (value 60), whereas the University of Bonn also differentiates between 60 and 90 degree washes (weighted value above 60).

[37] Source: *The Case for the 'A.I.S.E Low Temperature Washing' Initiative, Substantiation Report'*, October 2013. At website www.Iprefer30.eu

[38] The minor differences between the outcomes can probably be explained by the set-up of the questionnaires. E.g. AISE asks respondents to indicate how often they wash at "60 degrees or higher" (value 60), whereas the University of Bonn also differentiates between 60 and 90 degree washes (weighted value above 60).

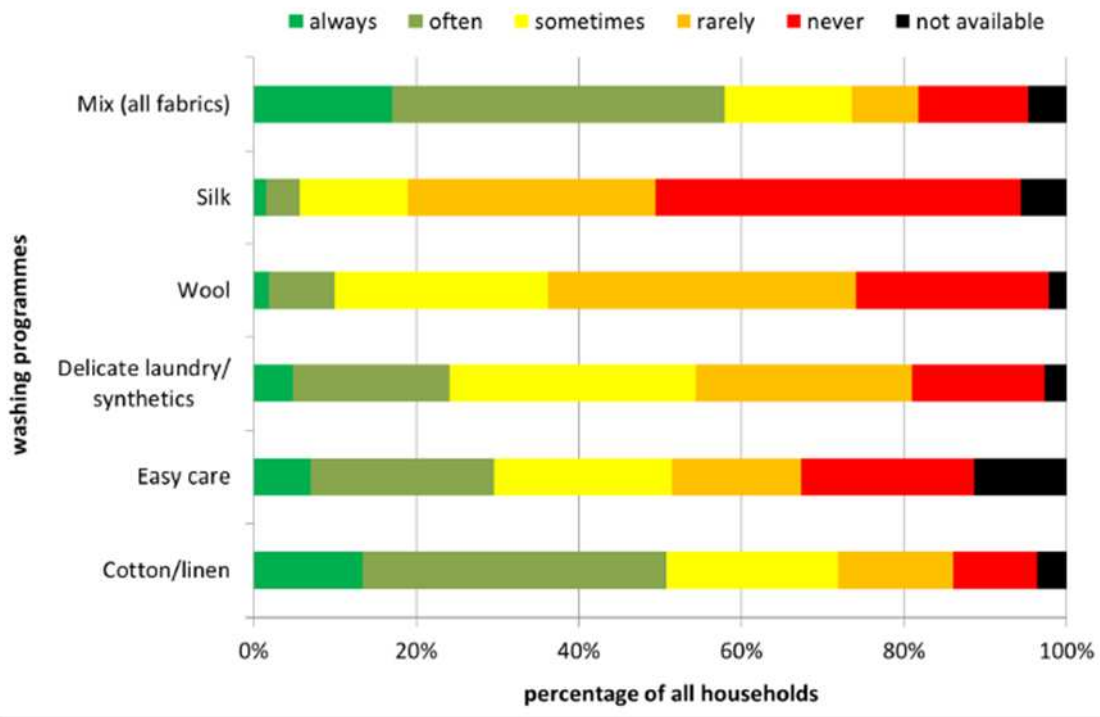
The most preferred programme temperatures are 40◦C (about 40%), 30◦C (about 20%) and 60◦C (about 20%). One can conclude therefore that some 60% to 70% of wash cycles are at 40ºC or lower temperatures.

Note that the detergent industry, through their association AISE, has been campaigning for low(er) temperature washing for around two decades. In 2013 AISE is about to launch the "I prefer 30" campaign, supported by a broad range of stakeholders, including EC Commissioner Hedegaard (DG CLIMA). [39]

The energy consumption for laundry washing in EU, estimated at 22.1 TWh/yr (Ref: Pakula and Stamminger, 2009) is a substantial share of household energy use.

Besides a choice in temperature, consumers often can choose the programme to be suitable for the type of fabric they are washing. Besides cotton there are programmes for wool, synthetics and silk.

Figure 3-12 Average use of washing programmes (Source: Bonn study)



The research by Bonn University shows that although the cotton programme is indeed still the most 'popular' (with 50% of respondents claiming to use cotton cycles "always" or "often') the synthetic cycle is also used frequently (30% says always or often) and the blend cycle (cotton with other textiles) is the clear winner with over 50% stating to use it always or often.

Besides these programmes people also indicated they used extra options such as 'Eco' and 'quick'. How often people use an 'eco-setting' (if available) is not much investigated. Some information on this is provided by Which!:

UK consumer organization 'Which?' asked 949 people which washing programmes they use and how often[40]. The data is organised into people using programs daily, every few days, once a week etc. The following programs are used once a month or more:

- 40˚C cotton program -52%
- Quick wash program -47%

[39] See www.Iprefer30.eu
[40] Information shared by ANEC/BEUC

- 40˚C synthetic program -46%
- 60˚C cotton program and mixed load -37%

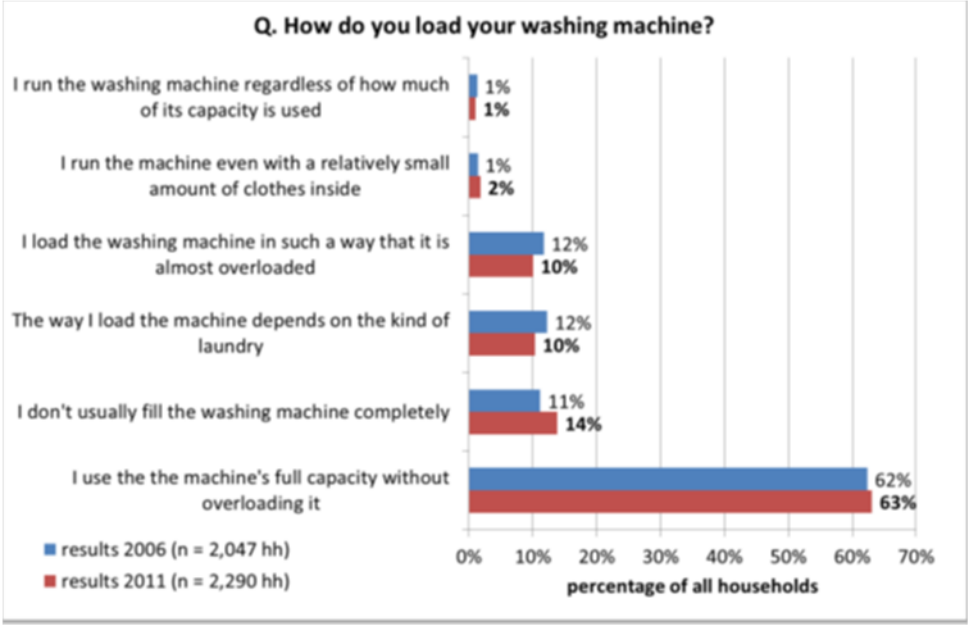
Of these 949 people, 618 said that they had an eco setting on their washing machine of which,

- 286 people say they never use it (46%)
- and 71 people say they use the eco mode once a month or less (11%)

3.3.3 Load

The label rating is based on the weighing of test results at full load and partial load. The University of Bonn asked in the 2011 questionnaire whether or not people fully load their machines.

Figure 3-13 Loading of washing machines (Source: Bonn study)



Most people claim to fully load it. However, it is not clear what people consider to be 'full' people might think their machines are full with 80%, for instance. Therefore the actual amount of loading remains inconclusive as there is no feedback on the actual kg washed by respondents. This issue should be assessed in more detail in order to better advice on the ration of full loads and part loads to be considered for a review of the methodology for measurement and calculation of washing machine performance.

Based on work by the University of Bonn and their own survey, AISE estimates that the average load has increased. A figure of on average 3.8 kg/cycle is mentioned.

3.3.4 Conclusion

The test series overestimate the average programme temperature. The test series use 5 out of 7 programmes with 60 degrees, while in real life this is only 1 out of 5. It does not include programmes for non-cotton fabric and it does not include other programme options such as quick wash, although frequently used by consumers. The effect of all these different programmes used in real life should be investigated to conclude on the measurement and calculation methods to apply when assessing energy and washing performance of washing machines.

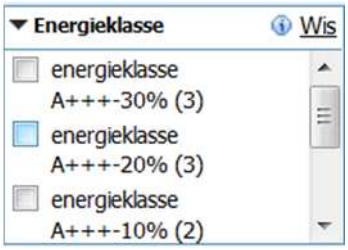
3.4 Technical Analysis and saving potential

3.4.1 Best available technology - energy

The most efficient machine in the CECED 2012 database has an EEI of 27, which is 41% more efficient than the minimum requirement for an A+++ machine (EEI 46). This machine uses 11900 litre of water (or 54 litres per weighted cycle) and has a rated capacity of 12 kilograms, which makes it one of the largest in the dataset.

Not listed in the CECED database of 2012, but reported at the … fair are machines with a rated energy efficiency of "A+++ -50%", corresponding to an annual electricity consumption of less than 100 kWh/year. This trend of expressing the energy efficiency as a value below A+++ is also visible in the market, e.g. at various websites[41]. Clearly there is a market demand for energy efficiency classes above A+++.

Figure 3-14 Example of use of 'extra' energy classes (by retailer)



The best available machine with a more common capacity of 8 kg (n>=500) has an EEI of 32. The purchase price of this machine is around 700 euro. It has an option for hot water supply and has cycle duration of 220 minutes.

In general the performance of a washing machine is the result of four elements: temperature, time, agitation and detergent. As the detergent is fixed by the test standard and the agitation is less easy to adapt as it is determined by hardware to a large degree, reduction of washing temperatures and extension of cycle duration are applied as these can be relatively easy programmed into the software run by the washing machine.

Other options applied by BAT machines are:

- High efficiency motors (inverter driven, permanent magnet motors);
- Load sensing devices and controls that adapt the program to various loads.
- Hot and cold water supply (not included in calculation of EEI).

The best rated machines in terms of EEI have a long cycle time. The increase in highly efficient machines seems to be mainly caused by increasing the programme time.

Best available technology not yet applied

- It is technically possible to replace the electric heating element of a washing machine by a heat pump driven heater. The heat pump will extract heat from the ambient and use this to heat up water.
- Smart grids / demand response. This does not actually save energy consumed by the appliance, but could enhance the overall efficiency of the grid electricity supplied. Smart appliances that allow for demand-response are key players in this process of managing both the demand for and supply of energy.

[41] Site: www.kieskeurig.nl, accessed on July 7, 2013

3.4.2 New technologies

Relevant elements with potential for reducing energy consumption are the trade-off between wash-time and temperature, improved motor efficiency and improved sensors.

Temperature time trade-off

The majority of the used energy in a wash cycle is used to heat up the water for washing. Reducing the temperature is therefore the way to reduce the energy consumption. Wash programmes claiming to be 60◦C are often a lot less than that. Stiftung Warentest tested the 60◦C cycle of common wash machines and found that they often use temperatures between 44 and 50◦C. To compensate for a loss in cleaning performance, the wash cycle duration is enlarged up to 300 minutes (5 hours). The down side of this improvement is that consumers can think of this option as 'inconvenient' and switch to shorter more energy consuming programmes.

Motor efficiency

The most common motor systems are universal motors and brushless motors. The latter are more energy efficient and used by the majority of the market.

Sensors

Innovative sensors can for instance serve automatic load detection, recognizing the amount of load and adjust the amount of water and other parameters. Alternatively machines often offer a part load program option.

Hot fill

A small amount of the machines on the market provide a hot-fill option. These machines have two water inlets: one for cold and one for warm water. The warm water can be derived from a different source and does not need to be heated up in the washing machine by electricity. This source can be more energy efficient, for instance when the water is derived from a solar water boiler. When the warm water is derived from an electric boiler this option does not save any energy. To use this option a warm water source has to be available close to a place where the machine is placed. A lot of households do not have such a source near the washing machine.

Several stakeholders asked to support the up-take of hot fill ready machines by simply indicating on the energy label if the machine accepts hot-fill water or not. This option is mainly relevant in countries where some households use solar energy. However, the energy savings potential from hot fill water prove to be marginal mainly because the quantity of hot (60°C) water necessary for an average 41°C wash cycle is minimal.[42] A problem with hot fill lies also with the fact that since only few litres of hot water are required for the washing cycle, the water arriving in the machine from the pipes will be cold: unless the distance between the heating source and the machine is very low the water arriving in the machine is the colder water stocked in the pipes (CECED). In addition, the filling of warm water which will then remain in the pipes will cool down, which will increase the heat losses of the hot-fill system.

Shock wave technology

An experimental new technology is 'shock wave', currently tested at the WFK institute in Germany. This technology is not available for consumer use and it is not clear whether this technology will become available for consumer use.

[42] E.g. a typical 6 kg machine consumes at rated capacity about 17 litres for the wash cycle only (i.e. excluding rinsing cycles which are anyway cold), but in reality 'full' is often no more than 70% of the rated capacity (see GEA, 1995) and thus the wash cycle needs only around 12 litres . In a 41 ºC wash this means that only 6-7 litres of (60 ºC) hot fill water is needed (the rest is cold at 15 ºC).

Bubbles and steam

Recently washing machines with a so-called "eco bubble" technology were introduced. This technology introduces detergent/air/water bubbles (to create wet foam) in the wash water during the wash cycle, allegedly creating a better wash performance at lower temperatures. Initial tests from consumer organizations however reported little difference to washing performance versus "non-bubble" machines. Recent test results from consumer organizations using a modified test method (not equal to EN 60456) have reported ecobubble washing machines delivering a competitive performance.

Some washing machines have introduced washing combined with steam. The addition of steam allegedly washes the clothes more efficiently, with less water and therefore requires less energy. Consumer organisations[43] are critical as regards machines using steam in washing cycles and report higher energy consumption values (up to 160% of the energy consumption of the same cycle without steam). As 'refresh' cycle they consider the function to make sense.

3.4.3 CLASP report

The CLASP analysis describes a scenario in which 3 new label classes will be introduced in 2016: EEI≤41, EEI≤ 37 and EEI≤33. The most efficient machines could already be placed in the last new category. At the moment 0.5% of the market could be placed in this category.

CLASP assumes that the creation of further energy efficiency classes will provide an incentive to manufacturers to improve products and to be rewarded with a better label. How fast these new label classes will fill up, depends on the introduction of new technologies and market price development. An economic analysis will be needed to assess stock improvement potential.

CLASP also suggested new ecodesign requirements.

Table 3-10 Scenarios by CLASP on washing machines

Scenario	from year	Energy Labelling	Ecodesign	
		New label EEI	tier	max. EEI
1	2018	41	1	52
	2022		2	46
2	2017	41	1	52
	2020	37	2	46
3	2016	41	1	52
	2018	37	2	46
		33		

The highest proposed requirement is an EEI of 46. This is the actual label A+++ minimum. These are already on the market, but the number of appliances offered in this category is small but growing. A+++ appliances are generally more expensive and therefore purchase prices will be driven up. Too evaluate what a proper set of requirements can be a LLCC analysis should be done.

[43] http://www.consumentenbond.nl/test/woning-huishouden/huishouden/wasmachines/extra/stoomwasmachine/, 2010

CLASP mentions that the scenarios could lead to 2.9 to 7.3 TWh/year energy saving in 2030. This is based on developments similar to the ones mentioned in the previous paragraph on 'new technologies'.

CLASP estimates the baseline ('BAU') energy consumption of washing machines at 47.5 TWh/yr in 2010 decreasing fairly linearly to 40.8 TWh/yr in 2020 and 37.7 TWh/yr in 2030. The savings estimated by CLASP are thus 7-19% of the 2030 total (at complete stock change).

3.4.4 Assessment of impact

The CLASP baseline projection of 47.5 TWh/yr is based on the weighted unit energy consumption for the test series (as in the regulation[44]), measured according to the test standard. This means that the full load test at 60 °C has been performed at the rated load capacity, i.e. a 6 kg machine is tested with a 6 kg load, and the half-load tests at 40 and 60 °C at 3 kg load. The weighted average is 4.2 kg. Furthermore, it means that CLASP's weighted average wash temperature is 54°C[45]. Furthermore, CLASP assumes 220 cycles per year in 2010 for a stock of 170 million machines in use.

In real-life, according to the Ecodesign preparatory study[46], average wash temperature in 2005 was 45.6°C. The 'Standard Base Case' (at rated average 5.36 kg load) sold in 2005 had an energy consumption of 0.998 kWh/cycle, whereas the 'Real-life Base Case' (at real-life 3.4 kg and 45.6°C) had an energy consumption of 0.791 kWh/cycle. The preparatory study assumed 234 cycles/year in 2005 for a stock of 167 (2005) or 177 (2009) million machines in use.

The EU totals of the preparatory study according to the Standard Base Case are similar to the figures found by CLASP. The approximation of the Real Life Base Case is used in the Impact Assessment (IA) study[47] accompanying the regulations 1015/2010 and 1061/2010. The IA for washing machines assumed a real-life consumption that is a factor 0.69 less than calculated on the basis of appliance specifications, which is mainly due to the smaller load, lower average washing temperatures, colder water inlet temperature and differences in frequency of use. The IA study mentions that the annual electricity and water consumption of products subject to this regulation was estimated to have been 35 TWh and 2213 million m^3, respectively, in the Union in 2005. It predicted, following the preparatory study, that unless specific measures are taken, annual electricity and water consumption is predicted to be 37.7 TWh and 2051 million m^3 in 2020. The preparatory study showed that the electricity and water consumption of products subject to this regulation can be significantly reduced.

The recent AISE Substantiation dossier of October 2013 estimates, based on work by Pakula and Stamminger, the energy consumption for laundry washing in Europe at 22.1 TWh/a.[48]
This is mainly due to the lower wash temperature (from 45.6 to 41 °C), which would account for around 20% saving, and –presumably also because of the growing capacity per machine-- the lower number of wash cycles, around 180 (AISE) to 190 (Bonn) cycles per year, which also results in 20% lower total consumption with respect of the IA study and the preparatory study (234 cycles/year).[49]

All in all, the BAU-projection by CLASP for 2010 is around two times too high and thus also the estimate of the absolute saving potential is unrealistic. When applying CLASP's most optimistic

[44] Et = [3 × Et,60 + 2 × Et,60½ + 2 × Et,40½]/7
[45] 9 kg at 60°C and 3 kg at 40°C.
[46] Presutto, M. et. al. 2007.
[47] SEC 2010 1354 EN.
[48] 23 European countries: AT, BE, BG, HR, DK, FI, FR, DE, EL, HU, IE, IT, NL, NO, PL, PT, RO, SK, ES, SE, CH, Turkey, UK, RO, Total inhabitants 579 million (compare EU-27 ca. 500 million).
[49] According to AISE, a reduction of the current wash temperature with 3°C would yield an electricity saving of approximately 12%.

relative saving estimate of 19% on a 2030 figure of around 18 TWh/yr[50], the savings from machine improvement –at a very conservative estimate of the future trend in lowering the wash temperature-- would be at the most 3 TWh/yr.

Note that in the underlying omnibus study there are no resources to further investigate whether the lower or the higher estimate of CLASP is correct; in order not to underestimate the saving potential the higher estimate is assumed to be appropriate.

The table below summarizes the energy related parameters discussed, recalculated for the EU-27 in 2013 and compared to the real-life situation in 1993. Note that this is a comparison of new machines and not a stock model; therefore total EU-27 consumption and emission data cannot be derived directly from these data but the 2013 data give at least a first rough indication of the (maximum) total EU consumption values that can be expected in 2025 (at complete stock change after 12 years, c.p.).

Table 3-11 Washing machines, real-life base case, comparison 1993-2013 (estimate VHK)

Parameter, new washing machines EU-27	1993*	2013
Programme temperature, in °C	54	41
Real (rated) load, in kg	3 (4.5)	3.8 (7)
Cycles/yr per unit (est.)	230	185
Wash cycle time, minutes	100	200
Energy consumption per real cycle, kWh/cycle**	1.27	0.57
Water consumption per real cycle, litres/cycle***	75	36
Washing machine ownership EU-27, % (est.)	80%	90%
Number of households EU-27, million	172	200
Number of washing machines in EU-27, million******	138	180

***=source: VHK for GEA 1995 in Group for Efficient Appliances, EnR, Background Report Vol. III, Long-term Efficiency Targets, a Technical and Economic Analysis, DEA, 1995. This was the preparatory study for the first washing machine energy label, implemented in 1996, under Framework Directive 92/75/EC.**
****= 2013 value based on average 40 °C part load programme plus 12% for slightly higher load (+10%) and 1 °C higher wash temperature. 1993 value from GEA 1995 real-life base case recalculated for 54 °C (instead of 60 °C). Note that these values do not take into account the effect of measurement tolerances.**
*****= based on average CECED database value (42.6 litres) minus 6 litres for lower load, i.e. less water absorbed in load.**
******= a straight count of 2013 values gives a total EU-27 electricity consumption of 19 TWh/year. This is the theoretical total at complete stock change (after 12 years) in 2025, in the unlikely event that none of the other parameters change over the 2013-2025 period (c.p.). Compare: The same straight count for 1993 machines results in a theoretical value of 40 TWh in 2005.**

3.4.5 Non-energy aspects

Non-energy environmental aspects of washing machines have been studied in 2005 under the preparatory study for washing machines and dishwashers and more recently in the DG JRC led study on Integration of resource efficiency and waste management criteria in European product policies – Second phase[51].

The ecodesign preparatory study identified energy and water consumption during the use phase as the most relevant environmental aspects. Non-energy (or water) aspects were not

[50] This assumes, as CLASP does, that at a full stock change with the current efficiencies of new machines there will be a 20% saving in 2030, not taking into account further saving through lower wash temperatures.
[51] Final Executive Summary of Second phase (December 2012, plus preceding reports http://lct.jrc.ec.europa.eu /pdf-directory/

proposed for ecodesign requirements. Detergent consumption however was noted as relevant aspect.

The DG JRC study of 2012, being rooted in the "A resource-efficient Europe – Flagship initiative of the Europe 2020 Strategy", deals more extensively with resource efficiency aspects. The study identified five parameters that could be used to better integrate resource efficiency into environmental product legislation, for instance through implementing measures under the Ecodesign Directive:

6. recyclability/recoverability/reusability (RRR),
7. recycled content,
8. recyclability/recoverability/reusability benefits (RRRB),
9. use of hazardous substances,
10. durability.

These aspects were tested for suitability as ecodesign requirement in three product cases: washing machines and LCD televisions (all parameters), and imaging equipment (recycled content only).

For washing machines the study concluded[52] that:

- Improved disassemble-ability of PCBs[53] would allow a larger amount of PCBs to be manually dismantled (instead of being shredded) resulting in higher recycling rates for copper, gold, silver, and PGMs[54]. The requirement would be drafted in terms of a maximum disassembly time, to be proven by test reports on the basis of self-declaration;
- Improved disassemble-ability of motors would allow a larger recycling rate (+5%) of embodied metals (steel and copper). Furthermore, this requirement would be essential for the separation of neodymium magnets (when embodied), once commercial recycling routes of rare earth would be established. The requirement would be drafted in terms of a maximum disassembly time, to be proven by test reports on the basis of self-declaration;
- Improved disassemble-ability of LCD screens would allow an easier separation of the LCD reducing the risks of contamination of other recyclable parts and increasing possible recovery of CRM (e.g. Indium). The requirement would be drafted in terms of a maximum disassembly time, to be proven by test reports on the basis of self-declaration;
- Other requirements could be:
    - An information requirement for the content of Rare Earths in motor parts (self-declaration, accompanied with laboratory test reports);
    - A declaration (or threshold) of RRR or RRR benefits[55];

The study showed that resource efficiency requirements could decrease the scores in environmental impact categories 'human toxicity', 'aquatic toxicity', terrestrial toxicity' and 'abiotic depletion potential'.

The presentation of the study results on 10 September 2012 however highlighted practical concerns of stakeholders regarding (in general terms) the feasibility and enforceability of such requirements, such as the lack of measurements standards, lack of data regarding product composition and difficulties in calculating the 'correct' end-of-life scenarios.

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[52] F. Ardente, F. Mathieux; Stakeholder event of the project: Integration of resource efficiency and waste management criteria in European product policies – Second phase" Analysis of case-studies: Washing Machines

[53] PCB = Printed Circuit Board, as applied in the electronic parts of the product, Brussels – 10th September 2012

[54] PGM = Palladium Group Metals, many of these alos belong to CRM = Critical Raw Materials

[55] RRR are the parameters related to Reusability, Recoverability and Recyclability. These are calculated for each product. RRR benefits are an indicator of the improvement if the product scores better on RRR parameters.

The study amending the MEErP[56] builds upon these conclusions and in its July 2013 reports suggests to introduce as new modules to the MEErP method:

- Abiotic depletion potential was considered but due to lack of data excluded as module for the MEErP. In the original MEErP 2011 ADP was not included due to lack of EU agreement on characterisation of materials;
- Material footprint was considered but due to lack of data excluded as module for the MEErP;
- Recyclability benefit rate– is considered possible, but would require modification of the Ecoreport tool;
- Recycled content – is considered possible but would require modification of the Ecoreport tool and additional indicator sets;
- Lifetime – proposal to present outputs as impacts per year of life time;
- Critical Raw Materials – is considered possible, but lack of data and characterisation factor hinder the implementation.

The above describes the current (summer 2013) status: Integration of resource efficiency parameters into ecodesign requirements will require substantial efforts in data collection, methodological agreement by all parties involved, modification and enhancement of existing tools and an overall check according 2009/125/EC Article 15 criteria, which should assess the proportionality of such requirements.

Detergents

Some machines have an automatic dosing system or advice on the proper amount of dose. These options can reduce the use of detergent.

3.5 Conclusion

3.5.1 Energy saving

It is estimated that through additional measures a further 3 TWh/year saving vs. the baseline is possible in 2030 through new, more stringent Ecodesign measures.

3.5.2 Ecodesign and Energy labelling

The current labelling scheme is quickly losing its capacity to discriminate between machines as almost half the machines sold have a rating in the two highest energy classes A++ and A+++. The sales are quickly approaching a situation where the majority of available models occupy the two highest energy efficiency classes. According the Energy Labelling Directive, such a situation alone calls for a review of the implementing measure. One possible way to solve this problem is to no longer treat the washing time, which can be up to 5 hours in some cases, as a 'free variable' but to incorporate it in some way in the labelling scheme and/or in the test and measurement methods.

Further study on the feasibility of this option is required, e.g. to assess what the current wash cycle duration is and what consumers deem acceptable.

The label energy efficiency classes are based on a test method that does not reflect consumer behaviour: people wash less frequently, use lower temperatures, and do not always use the cotton programme.

[56] Material-efficiency Ecodesign Report and Module to the Methodology for the Ecodesign of Energy-related Products (MEErP) STAKEHOLDER CONSULTATION, Report to the European Commission, 29 July 2013

A revision of the measurement and calculation method for both Ecodesign and Energy Labelling implementing measures should improve the relation with average washing habits. This revision should be synchronized with the developments of the test standard EN 60456.

Also the differences in definitions in standards and regulations should be lifted; reduction of ambiguity of text is possible.

A review should analyse the energy related to real life behaviour related to washing machines and should conclude on realistic saving potential of the actual labelling scheme.

A review should also to address the contradiction in the ecodesign/labelling legislation between the scope of the measures and the definition of the household appliances. It would be consistent to remove "including those sold for non-household use" from the regulatory text.

3.5.3 Tolerances

The current verification tolerances of 10% could lead to verification problems in cases the EEI to be verified is very small.

The ATLETE II project is expected to provide more information on the actual testing tolerances.

3.5.4 New targets

There are no requirements on rinsing and spinning performance. Spinning efficiency is measured and printed on the energy label. Phasing out of the least efficient spinning performance classes might be possible. This possibility has to be investigated with an economic assessment including lowest life cycle costs.

→ The possibility for setting ecodesign requirements on spinning efficiency has to be investigated with an economic assessment including lowest life cycle costs.

For Rinsing performance there is a standard test, which has limited reproducibility. Reproducible data is needed before requirements on rinsing are possible. Recent consultations with laundry experts made clear the problems of rinsing tests are not yet solved to a degree that would allow a regulatory purpose.

→ More research should be done on the possibility to measure rinsing performance for regulation purposes.

The programmes on which the standard and the regulation are based are probably not the most used programmes. The real improvement potential of therefore depends on the improvement of other programmes as well. These programmes are not considered in the regulation. Improving other programmes is not stimulated with the current legislation.

→ A review should analyse the possibly to set incentives on other programmes as the ‘standard programme’

4. Washer-Driers

Main author & final editing: VHK, Karin Brakkee & Martijn van Elburg

Washer-driers are appliances that combine the functionalities of tumble driers and washing machines. Household washer-driers are obligated to be sold with an energy label. There are no requirements for washer-driers as part of the ecodesign regulation. They are a relative small category in the wet appliances.

4.1 Legislation & standards

4.1.1 Revision articles

Commission Directive 96/60/EC on energy labelling of household washer-driers does not contain a clause or article stating the date and subjects for a revision of the measure. The more recent regulations for washing machines do include revision articles.

In regulation 1061/2010 on energy labelling of household washing machines it is stated that "household combined washer-driers fall within the scope of Commission Directive 96/60/EC of 19 September 1996 implementing Council Directive 92/75/EEC with regard to energy labelling of household combined washer-driers and should therefore be excluded from the scope of this Regulation. However, considering that they offer similar functionalities to household washing machines, a revision of Directive 96/60/EC should take place as soon as possible."

In regulation 1015/2010 on ecodesign of washing machines it is stated that household combined washer-driers have particular characteristics and should therefore be excluded from the scope of this Regulation. However, considering that they offer similar functionalities as household washing machines, they should be addressed as soon as possible in another implementing measure of Directive 2009/125/EC.

4.1.2 Legislation

EU Energy label Directive 96/60/EC

In commission directive 96/60/EC[57] the label for washer-driers is described. This directive implements the former energy labelling directive 92/75/EEC. This directive is replaced by the new directive for energy labelling 2010/30/EU. Several regulations implementing this new directive were introduced ever since. Specific product groups such as washing machines, dishwashers, cold appliances and tumble dryers adopted new regulations, including a new design for the label. For washer-drier there is no new design yet.

The energy classes of washer-driers are distributed according to Table 4-1 based on a standard energy use per cycle with a 60 °C cotton wash including drying.

Table 4-1 Energy classes in kWh per kg wash load from the directive 96/20/EC

Class	E (kWh per kg)
A	E<0.68

[57] COMMISSION DIRECTIVE *96/60/EC* of 19 September 1996 implementing Council Directive 92/75/EEC with regard to energy labelling of household combined washer-driers (OJ L 266, 18.10.96)

B	0.68≤E<0.81
C	0.81≤E<0.93
D	0.93≤E<1.05
E	1.05≤E<1.17
F	1.17≤E<1.29
G	E≥1.29

The values in kWh refer to a complete cycle including washing spinning and drying, based on a 60 °C cotton wash cycle and a cotton dry drying cycle with a full load wash capacity. Since the drying capacity of washer-driers are always lower than the washing capacity, two subsequent cycles for drying have to be performed. The information on the label is therefore based on 1 washing cycle and 2 drying cycles.

The label of washer-driers is not in line with the other wet appliances; the label scale is not based on an estimated yearly energy use including standby use expressed in an energy efficiency index (EEI). The washing efficiency can be excluded, when the highest performance will be obligatory.

If the energy label for washer-driers is to be reviewed there is great need for a new programme portfolio. Just testing at 60°C full load does not represent the current consumer use. All arguments used for the washing machine portfolio are also valid for washer-dryers.

Ecodesign

There is no regulation for washer-driers implementing the 2009/125/EC directive for ecodesign. Washer-driers are excluded from the ecodesign regulation of washing machines and tumble dryers. Therefore the washer-driers do not to meet criteria set for separate washers and driers, which are:

For washing machines:

- The Energy efficiency index of washing should not be more than 68, the actual energy efficiency label A (from December 2011).
- The washing efficiency shall be greater than 1.03 for machines with a washing capacity higher than 3 kg, comparable with washing efficiency class A (from December 2011).
- Water use should not be more than $W_t \leq 5 \times c + 35$ (from December 2011).
- The Energy efficiency index of washing should not be more than 59, the actual energy efficiency label A+ (from December 2013).
- Water use should not be more than $W_t \leq 5 \times c_{½} + 35$ (from December 2013).

For tumble driers:

- The Energy efficiency index of drying should not be more than 85, the actual energy efficiency label C (from November 2013).
- The condensation efficiency shall be greater than 60% for condensing driers, comparable with condensation efficiency class D (from November 2013).
- The Energy efficiency index of drying should not be more than 76, the actual energy efficiency label B (from November 2015).
- The condensation efficiency shall be greater than 70% for condensing driers, comparable with condensation efficiency class C (from November 2015).

Non-EU legislation

International Policies

Worldwide some nations adopted energy requirements and other environmental criteria for washer-drier appliances. Those include mandatory and voluntary labels and minimum requirements. A list of policies is included in Annex I.

Switzerland has banned washer-driers less efficient than class C[58].

4.1.3 Standard

The standard EN 50229: 2007 used to measure the energy performance of washer-driers is based on the standard of washing machines EN 60456: 2005 and the one for driers EN 61121: 2005. Both the standards for washing machines and tumble driers have updated standards, respectively from 2010 and 2013. The actual EN 50229 refers to the old out-dated standards.

Currently the standardisation commission for washer-driers is updating the standard EN 50229 to meet up with the new standards for washing machines and dryers. The test will still collect the same information, such as the energy consumption for the washing and drying cycle at 60◦C.

The standard is under revision and is expected to be published in the summer 2014. This standard is still based on the “old” test portfolio of the 60°C cotton program. This standard has not incorporated the changes from the washing machine and tumble dryer standards (e.g. 3-2-2 approach of washing machine). The revision is considered 'maintenance work' however, some modifications have to be made to be adapted to the standards of washing machines and tumble driers, in particular for the drying part.

4.1.4 Product definition

The directive applies to electric mains operated household washer-driers. Washer-driers for non-household use and appliances that can use other energy sources are excluded.

According to the standard EN 60456 a washer-dryer is a washing machine which includes both a spin extraction function and also a means for drying the textiles, usually by heating and tumbling.

4.2 Market Analysis

4.2.1 Sales and Stock

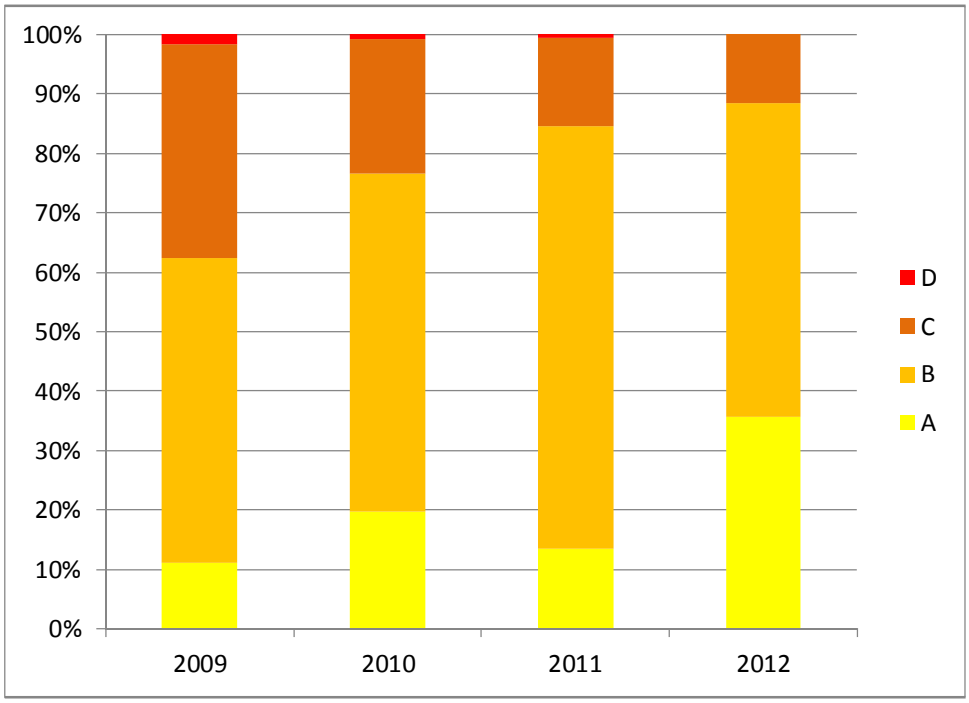
Sales of washer-dryers in the EU were above 700,000 in 2012 (Gfk data). This corresponds to about 4% of the 16 million unit washing machine market. This is an average figure and the sales vary considerably depends on the country. The market for washer-driers is growing as there is a higher consumer acceptance due to higher rated capacities for washing and/or drying.

4.2.2 Trends in Energy efficiency

Washer–driers are a minor category in sales of wet appliances. According to the sales data of CECED the models that are currently for sale are distributed over four classes.

[58] Energieverordnung (EnV) 730.01 of 7 December 1998 (Status 1. October 2012)

Figure 4-1 Number of washer-driers offered in different energy classes (CECEC data).



4.2.3 Characteristics of washer-driers

Programmes on washer-driers

Washer-driers usually have programme options both for washing and for drying. Washing programmes include options for different types of fabric (cotton, wool, silk), easy care, eco and quick programmes. Drying options include fast drying, intense drying and options for different types of fabric.

About 71% of the machines have a 'wash-and-dry' option[59], a continuous programme that allows consumers to wash and dry in one go without interaction or reloading by the consumer. This is the most used drying option where available, according to Schmitz and Stamminger. This option can save energy as when having a continuous wash-and-dry cycle one may transfer energy from the washing to the drying part and thus reduce the total amount of energy. Stopping, unloading and reloading in between, causes the load to get cold and thus loose energy.[60] Data on this effect is not available.

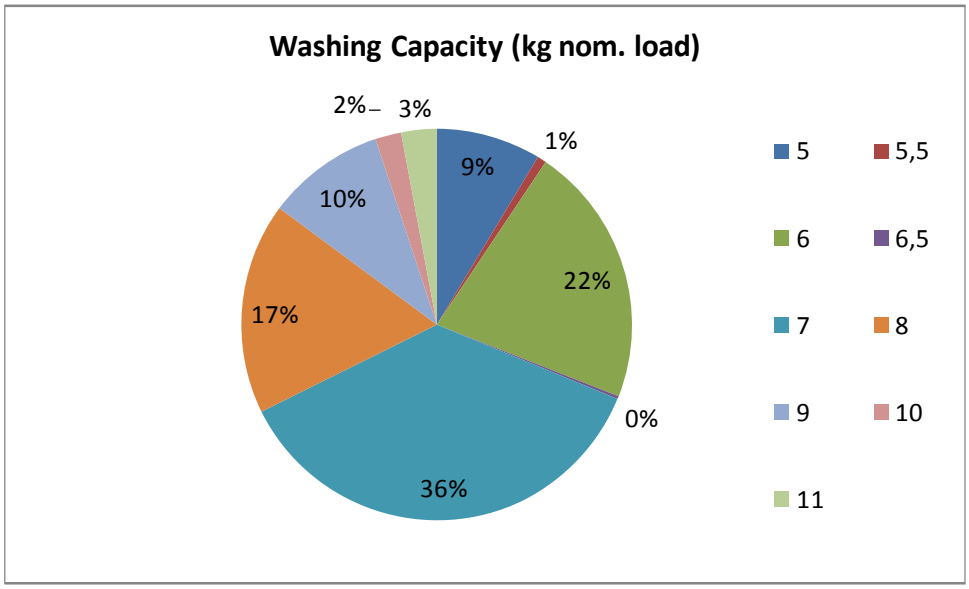
Capacity of washer-driers

The databases of CECED show a development in the distribution of washer-drier capacity.

[59] Schmitz and Stamminger, Usage of Washer-Dryers in Europe, SOFW-Journal, 138, 5-2012

[60] Comment by Rainer Stamminger

Figure 4-2 Washing capacity (kg) of washer-driers (CECED 2012)



The most frequent capacity of washing for washer-driers is 7 kilograms. For drying the most used capacity is 5 kilograms. The capacity of washer-driers has grown in the last years. Table 4-2 shows the average capacity for washing and for drying.

Table 4-2 average capacity for washing and drying in the CECED database

	N	Average Washing Capacity (kg)	Average Drying Capacity (kg)
2009	334	6.2	3.8
2010	396	6.7	4.3
2011	380	6.7	4.3
2012	417	7.2	4.7

Water consumption

Washer-driers often use water to condensate water vapour in the drying process. Therefor they use more water than other washing machines. They use about 19 litres water in the drying cycle[61]. Washing machines use on average 43 litres/cycle, based on the CECED data of 2012 for washing machines. Some washer-driers use air instead (as do conventional dryers) and even the use heat pump drying techniques have been reported.

Table 4-3 Water consumption of washer-driers

	N	Water Consumption (l)		
		Average	Min	Max
2009	334	97	45	150
2010	396	98	57	195
2011	380	94	49	164
2012	417	101	57	164

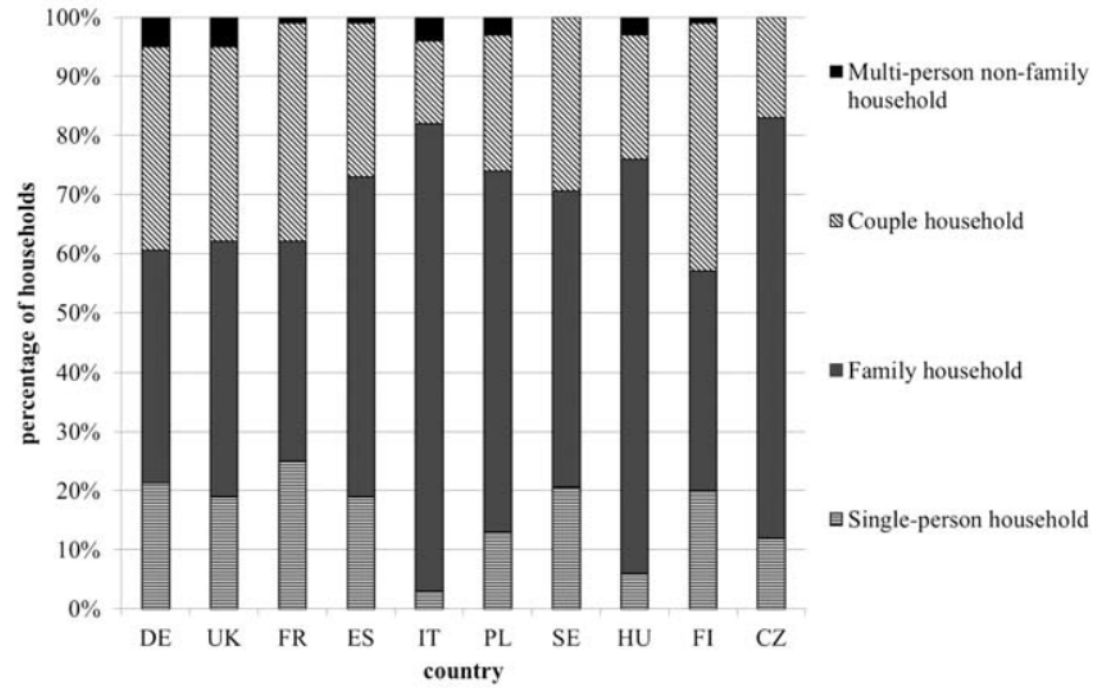
[61] Consumentenbond, Consumentengids December 2010

4.3 User Analysis

4.3.1 Households

A washer-drier is only used by a small number of households in Europe. The average size of a household owning a washer-drier is 2.8 according the study quoted before[62]. A little higher than the average household size.

Figure 4-3 Family size of households with a washer-drier.



The reason for people purchasing a washer-drier, according to this study, was:

- Lack of space for separate washing machine and tumble dryer (52%)
- The option to dry laundry sometimes (40%)
- Cheaper than two separate machines (34%)
- They want a continuous wash-and-dry programme 25%

The main reason for purchasing is space saving. Strangely 37% of the households own a washer-drier have an extra washing machine and 18% an extra tumble dryer.

4.3.2 Number of cycles per year

According to a recent study by the University of Bonn, the number of cycles used is 4.3 cycles per week average in Europe. This means 224 cycles per year. This is a little higher than the usage of single washing machines. Of the three to four times per week the machine is used for washing, only once the drying function is used (29%). Additionally the wash-and-dry function is used for machines that have this function (71%). It is used 24% of the times of washing.

People with washer-driers prefer drying the laundry outside on a clothes line or indoor in a heated room.

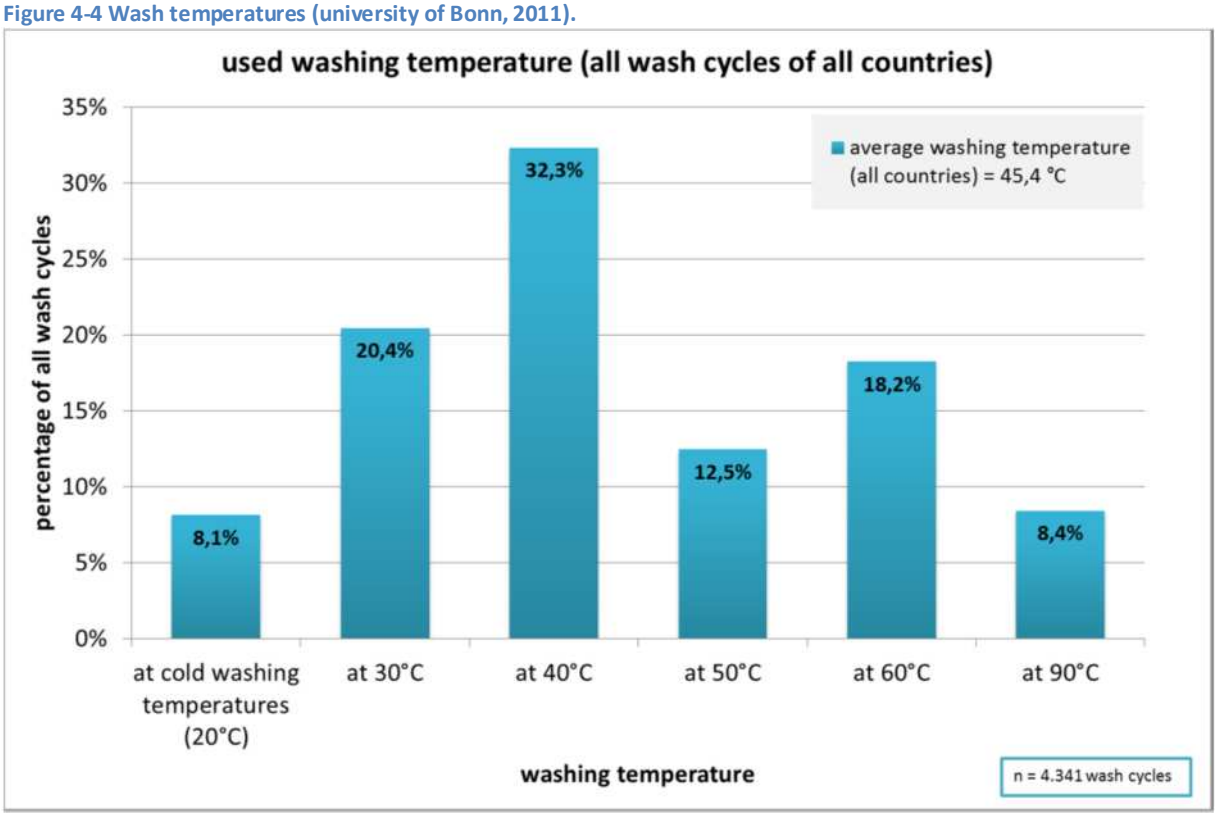
[62] Schmitz and Stamminger, Usage of Washer-Dryers in Europe, SOFW-Journal, 138, 5-2012

4.3.3 Chosen programmes

The real energy consumption of a washing machine depends on how a consumer uses the machine.

University of Bonn has investigated the frequency of use of the various programme temperatures. On average the programme temperature is 45.4°C, about the same as for single washing machines. The real temperature of the used programme can differ from the declared programme . Distributed over the different programme temperature the next figure shows the distribution.

Figure 4-4 Wash temperatures (university of Bonn, 2011).



Besides a choice in temperature, consumers often can choose the programme best suited for the type of fabric they are washing. Besides cotton there are programmes for wool, synthetics and silk.

4.3.4 Load

People estimate their washer capacity as 7.5 kilograms and their drying capacity as 6 kg. According to the CECED databases the washing capacity is often 1.5 to 2 times the drying capacity. It seems that people overestimate the drying capacity.

Conclusion

The test series overestimate the average programme temperature. It does not include programmes for non-cotton fabric and it does not include other programme options such as quick wash, although frequently used by consumers. It overestimates the relevancy of the drying programme. In the test two cycles for drying are used versus one for washing. In real life only one drying programme is used every two to three washes (including wash-and-dry option). The effect of all these different programmes used in real life compared to the test programme in relation to the energy consumption should be investigated to conclude on the real energy consumption of wash-and-dry cycles.

4.4 Technical Analysis and saving potential

The energy label is based on this wash-and-dry cycle, including two drying cycles and one wash cycle. Based on the CECED database of 2012 on average the wash cycle of 60°C consumes about 20% of the energy of the total wash-and-dry cycle. Therefore the efficiency of the wash cycle is of minor importance in relation to the energy label. This is in contrast with the consumer behaviour: if only 1 drying cycle is performed every 4 wash cycles the (the energy of one drying cycle is approximately twice the energy of a washing cycle) the impact of drying should be about 33% of the total energy consumption.

4.4.1 Best Available technology

The best machine on the market, according to the 2012 CECED database had a consumption of 0.62 kWh/kg. This is an A label machine. Washer-driers with heat pump technology belong to the most energy-efficient washer-driers available but no data could be retrieved yet.

Policy options

In 2010 a new directive on energy labelling was introduced. For a product group three extra classes, A+, A++ and A+++ can be added as long as the total is not more than seven classes. A revision of the labelling scheme of washer-driers can include these new classes. This can be an incentive for producers to introduce more efficient machines to the market.

For washing machines and tumble driers new regulations implementing 2010/30/EC have come into force. No longer is the energy per cycle used, but an energy efficiency index based on the total yearly energy use including standby. The average energy consumption per cycle for washing machines is the average of three times the 60º C cotton program, two partially load 60º C cycles and two partially load 40º C cycles. For dryers this is weighted over three times a full load and four times a half load using the cotton dry programme. Standby use is also calculated in the total. Wash quality has disappeared from the label. A label including a yearly annual consumption can provide the consumer with more realistic data

Possibilities for ecodesign requirements for washer-driers

Currently there are no ecodesign requirements for washer-driers. If there would be requirements introduced, the following options are possible:

1. Washer-driers should meet the requirements for washing machines for the washing-only option
2. Washer-driers should meet the requirements of both washing machines and dryers
3. Washers-driers should meet new requirements to be made for washer-driers

1). Washer-driers can be seen as washing machines with an extra function of drying. Therefore it is possible to only the washing cycle and let them meet the ecodesign requirements of washing machines. This would also prevent that washer-driers can be a loophole for bad washing machines. In that case they have to have:

- An energy label (based on washing only) of at least an A and in the near future an A+. Based on the energy consumption of the washing cycle 97% of the washer-driers of 2012 (CECED data) would meet the A label (assuming 12 kWh low power energy consumption and using a correction factor of 0, 84 for the weighted energy consumption of Equation 3.4). However only 27% can be indicated with an A+ label.
- A cleaning efficiency of at least the A class. This class is indicated on the label of washer-driers. In 2012 94% of the machines were indicated with the A class washing performance.
- The water use on the label of the washer-driers is expressed as total water use of the whole cycle (washing and drying). Information of the water use of the washing only

part is not available. Some machines use water in the drying cycle to cool the water vapour air. Therefore the total water use of washer-driers can be much higher than that of washing machines. It is therefore not possible to say if the wash-only part can meet the requirement for water use. Only 12% of the machines meet the "tier 1" requirement, when the total cycle water use is considered.

2). If both the washing and the drying ecodesign requirements have to be met for washer-driers both cycles can be measured individually. As stated in point 1 most washing machines may meet the washing ecodesign requirements. This is different for drying.

- The condensation efficiency is not given for the washer-driers so it is not possible to say if the requirements can be met at that point.
- The energy efficiency of drying only would meet the D label class for most machines. Dryers have to meet the C class from November 2013.

3). If there would have to be a new set of requirements for washer-driers, research needs to be done to see what the effect would be of these requirements. Since the washer-driers are just a small group of household products the effect would be low. However the exclusion of this type of machine can lead to a loophole for inefficient machines and therefore it would be a good idea to develop requirements for this category.

4.4.2 Non-energy aspects

Non-energy environmental aspects of washer driers have not been studied through a preparatory study under Directive 2005/31/EC or 2009/125/EC. However the results of the 2005 preparatory study for washing machines and dishwashers can be considered to apply to washer-driers as well. In addition the results of the more recent DG JRC led study on Integration of resource efficiency and waste management criteria in European product policies – Second phase[63] can be considered to be relevant as well even if the case study product were washing machines.

The ecodesign preparatory study on washing machines identified energy and water consumption during the use phase as the most relevant environmental aspects. Non-energy (or water) aspects were not proposed for ecodesign requirements. Detergent consumption however was noted as relevant aspect.

The DG JRC study of 2012, being rooted in the "A resource-efficient Europe – Flagship initiative of the Europe 2020 Strategy", deals more extensively with resource efficiency aspects. The study identified five parameters that could be used to better integrate resource efficiency into environmental product legislation, for instance through implementing measures under the Ecodesign Directive:

1. recyclability/recoverability/reusability (RRR),
2. recycled content,
3. recyclability/recoverability/reusability benefits (RRRB),
4. use of hazardous substances,
5. durability.

These aspects were tested for suitability as ecodesign requirement in three product cases: washing machines and LCD televisions (all parameters), and imaging equipment (recycled content only).

[63] Final Executive Summary of Second phase (December 2012, plus preceding reports http://lct.jrc.ec.europa.eu /pdf-directory/

The conclusions of study apply to washing machines but are considered to apply to washer-driers just as well[64] with these being:

- Improved disassemble-ability of PCBs[65] would allow a larger amount of PCBs to be manually dismantled (instead of being shredded) resulting in higher recycling rates for copper, gold, silver, and PGMs[66]. The requirement would be drafted in terms of a maximum disassembly time, to be proven by test reports on the basis of self-declaration;
- Improved disassemble-ability of motors would allow a larger recycling rate (+5%) of embodied metals (steel and copper). Furthermore, this requirement would be essential for the separation of neodymium magnets (when embodied), once commercial recycling routes of rare earth would be established. The requirement would be drafted in terms of a maximum disassembly time, to be proven by test reports on the basis of self-declaration;
- Improved disassemble-ability of LCD screens would allow an easier separation of the LCD reducing the risks of contamination of other recyclable parts and increasing possible recovery of CRM (e.g. Indium). The requirement would be drafted in terms of a maximum disassembly time, to be proven by test reports on the basis of self-declaration;
- Other requirements could be:
    - An information requirement for the content of Rare Earths in motor parts (self- declaration, accompanied with laboratory test reports);
    - A declaration (or threshold) of RRR or RRR benefits[67];

The study showed that resource efficiency requirements could decrease the scores in environmental impact categories 'human toxicity', 'aquatic toxicity', terrestrial toxicity' and 'abiotic depletion potential'.

The presentation of the study results on 10 September 2012 however highlighted practical concerns of stakeholders regarding (in general terms) the feasibility and enforceability of such requirements, such as the lack of measurements standards, lack of data regarding product composition and difficulties in calculating the 'correct' end-of-life scenarios.

The study amending the MEErP[68] builds upon these conclusions and in its July 2013 reports suggests to introduce the following modules to the MEErP method:

- Recyclability benefit rate– is considered possible, but would require modification of the Ecoreport tool;
- Recycled content – is considered possible but would require modification of the Ecoreport tool and additional indicator sets;
- Lifetime – proposal to present outputs as impacts per year of life time;
- Critical Raw Materials – is considered possible, but lack of data and characterisation factor hinder the implementation.

Abiotic depletion potential was considered but due to lack of data excluded as module for the MEErP. In the original MEErP 2011 ADP was not included due to lack of EU agreement on characterisation of materials. Material footprint was also considered but due to lack of data excluded as module for the MEErP.

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[64] F. Ardente, F. Mathieux; Stakeholder event of the project: Integration of resource efficiency and waste management criteria in European product policies – Second phase" Analysis of case-studies: Washing Machines
[65] PCB = Printed Circuit Board, as applied in the electronic parts of the product, Brussels – 10th September 2012
[66] PGM = Palladium Group Metals, many of these alos belong to CRM = Critical Raw Materials
[67] RRR are the parameters related to Reusability, Recoverability and Recyclability. These are calculated for each product. RRR benefits are an indicator of the improvement if the product scores better on RRR parameters.
[68] Material-efficiency Ecodesign Report and Module to the Methodology for the Ecodesign of Energy-related Products (MEErP) STAKEHOLDER CONSULTATION, Report to the European Commission, 29 July 2013

The above describes the current (summer 2013) status: Integration of resource efficiency parameters into ecodesign requirements will require substantial efforts in data collection, methodological agreement by all parties involved, modification and enhancement of existing tools and an overall check according 2009/125/EC Article 15 criteria, which should assess the proportionality of such requirements.

4.5 Conclusion

Washer-driers still have an old label based on an out-dated directive for energy labelling. There are no requirements for washer-driers as part of the ecodesign regulation. They are a relative small category in the wet appliances.

- ➔ Performance information for a new label designed according to directive 2010/30/EU should be investigated
- ➔ Possibility for ecodesign requirements should be investigated. A study on the improvement potential of such requirements should be investigated and an economic analysis should be performed including lowest life cycle cost.

The standard EN 50229 is currently updated to be in line with the newest standards for washing and drying. Possible new energy labelling and/ or ecodesign regulations should be in line with developments in the standard.

The standard test does not meet real consumer behaviour. It also overestimates the impact of the drying part of the washer-driers.

- ➔ The possibility to change the standard test and the energy labelling methodology should be considered to meet real consumer behaviour.

There are many similar aspects comparing with a pure washing machine. This is why future changes to legislation, standards, portfolio for the energy of washer-dryer should be carefully aligned with the approach adopted for washing machines. If there is a preparatory study for washing machines, washer-dryers should be included.

5. Cold appliances

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5.1 Legislation & standards

5.1.1 Revision

Regulation 643/2009 on ecodesign of refrigerating appliances also calls for a review "in light of technological progress" and more specifically the possibilities for removing or reducing the values of the correction factors. The review deadline is 12 August 2011.

Additionally, Regulation 643/2009[69] on ecodesign of refrigerating appliances calls for a review of more specifically "the need to adopt requirements for wine storage appliances". This review deadline is 12 August 2011.

Delegated regulation 1060/2010[70] on energy labelling calls for a review in light of technological progress, verification tolerances and possibilities for removing or reducing the values of the correction factors. The review deadline is 20 December 2014.

5.1.2 The EU Energy label 1060/2010

In 2010 the current Delegated Regulation 1060/2010 for the energy labelling of refrigerating appliances came into force. The review was scheduled for 2014, no longer than 4 years after its entry into force. In recital it is stated that the review should take technological progress in account. According to Article 7, this review should in particular assess:

- The verification tolerances set out in Annex VII of 1060/2010;
- Possibilities for removing or reducing the values of the correction factors set out in Annex VIII.

The label is based on an energy efficiency index (EEI), calculated as the ratio of the declared yearly energy consumption related to a reference consumption value based on the volume and functions of the refrigerator.

As regards the labelling classes the 2010 regulation introduced slight changes to the preceding 2003 directive:

- An extra class A+++ is introduced;
- The A+ limit is raised to 44% but will be lowered again to 42% in 2014
- The A++ limit is raised compared to the 2003 Directive.

The classes are defined as shown in Table 5-1.

Table 5-1 Energy classes related to an Energy Efficiency index from the regulation after 2010

Class	EEI in 2003/66/EG (Before 2010)	EEI (%) until 30 June 2014	EEI (%) from 1 July 2014
A+++	--	EEI<22	EEI<22
A++	EEI<30	22≤EEI<33	22≤EEI<33
A+	30≤EEI<42	33≤EEI<44	33≤EEI<42
A	42≤EEI<55	44≤EEI<55	42≤EEI<55
B	55≤EEI<75	55≤EEI<75	55≤EEI<75
C	75≤EEI<95	75≤EEI<95	75≤EEI<95
D	95≤EEI<110	95≤EEI<110	95≤EEI<110
E	110≤EEI<125	110≤EEI<125	110≤EEI<125
F	125≤EEI<150	125≤EEI<150	125≤EEI<150
G	≥150	≥150	≥150

If the appliance is a wine storage or if appliances are classified in energy classes D to G, classes E, F and G are shown on the label. In other cases a maximum of 7 classes is shown on the label, with D as the lowest.

The design of the label is also modernized and brought in line with other label developed under Directive 2010/30/EC.

Contrary to most other energy labelling regulations is that the steps between the top classes are not relative to each other: they decrease by an absolute 11% for each step. This means that the effort to gain an extra efficiency class is increasingly difficult, as shown in the overview below:

- 55% to 44%: 20 % improvement
- 44% to 33%: 25% improvement
- 33% to 22%: 33% improvement

The calculation of the Energy index and the yearly energy use has stayed the same.

SAEc is the standard yearly energy use of a cooling appliance, calculated by:

$$SAE_c = V_{eq} \times M + N + CH \qquad \text{Equation 5.1}$$

Where

- V_{eq} is the equivalent Volume of the cold appliance, calculated as the sum of each compartment volume, corrected for the nominal temperature, the thermodynamic factor and correction factors FF, CC and BI for "frost-free", "climate class" and "built-in";
- M and N are indicators specific for household refrigerating appliance category (from no-star to chest freezer, etc.);
- CH is equal to 50 kWh/year for household refrigerating appliances with a chill compartment with a storage volume of at least 15 litres.

The equivalent volume of a free-standing fridge of 100 litres with only fresh-food compartment with no frost-free function is 100 litres. If the appliance would be under 58 cm width and build-in the equivalent volume would be 120 litres. A wine storage appliance and a freezer of 100 litres have equivalent volumes of 65 and 215 litre respectively.

Correction factors

According to the regulation this review should assess the possibilities to reduce or remove the correction factors. The correction factors to be considered are given in Table 5-2 :

Table 5-2 Correction factors

Compartment	Conditions	Value
FF	No-frost	1.2
	Otherwise	1
CC	Tropical (T)	1.2
	Sub-tropical (ST)	1.1
	Otherwise (SN and N)	1
BI	Built-in and under 58 width	1.2
	Otherwise	1
CH	Chill compartment	50 (kWh)

In 2012 Defra and Intertek[71] performed a 173 page study on the applicability of the correction factors. This study was commented on by CECED[72].

FF, Frost-free correction factor

The frost-free correction factor FF increases the equivalent volume (and thus the reference consumption) by a factor 1.2 in case the product offers frost-free functionality.

Frost-free is achieved by adding a circulating fan and a heating element close to the evaporator. The heating element periodically melts ice build-up on the evaporator. The fan ensures this ice build-up takes place in the designated spot.

Compared to static appliances the functionality of no-frost uses more energy during the standard test. However, the extra energy consumed by static appliances during real use due to frost build up is not considered in the standard test. The DEFRA/Intertek study however claims it is possible to produce frost-free appliances that are as efficient as conventional appliances under standard test conditions. The report recommends a reduction of the frost-free correction factor. CECED disagrees as the technical analysis of the Defra report justifies the use of the correction factor. This apparent diverging of views on the same issue should be further analysed before a decision of the FF factor can be made.

CC, Climate class correction factor

ST and T type of refrigerator are optimized for higher ambient temperatures (+16 to +38/+43ºC). To achieve this, its refrigeration capacity is larger than for a similar N product (16-32ºC). This compromises its efficiency at 25 °C. If operated at high temperatures, compared to a similar N product it uses less energy. Defra/Intertek advises to remove of the climate class correction factors, because that will encourage the incorporation and development of more efficient technologies. The technical data supplied in the report is however not sufficient to evaluate whether the current values of 1.1 or 1.2, for ST and T respectively, need revision with state of the art products.

BI, Built in correction factor

[71] Defra/Intertek, "Assessment of the applicability of current EC correction factors and tolerance levels for domestic refrigerating appliances, Final Report Version 1.0, August 2012

[72] CECED's comments to the Defra/Intertek study on correction factors and tolerances for cold appliances, November 2012

The built-in product delivers the service that it can be built into a kitchen, which compromises its efficiency. Defra advises to remove the correction factor, because of the fact that only for smaller sized built-in appliances is corrected. CECED claims this may be incorrect indeed, and it might be necessary to include wider sized built-in appliances. Another option is that a different product category could be applied.

CH, Chill compartment factor

DEFRA advises to remove the factor, because providing a colder storage area should be reflected in the energy efficiency information, just as a frozen food compartment does. As the number of products with chill compartment is still growing and there is an inherent complexity in using correction factors for such products, an appropriate method would probably be to create a separate category for products with a chill compartment.

As indicated above CECED has provided counter-arguments to the DEFRA/Intertek conclusion that correction factors could be reduced or discarded[73]. CECEDs position is that correction factors have a place when appliances with differences in functionality are to be considered under a common or shared category.

The above DEFRA/Intertek conclusion appears to assume that current reference lines are "ideal" and current product categorisation is "perfect". CECED claims that it is easy to list examples demonstrating this not to be the case.

CECED therefore states: *"rather than accepting the simple conclusion that correction factors can be removed, states it would be much better to review the total framework and to study whether the actual product categorisation and their reference lines are still appropriate. After all, these have been designed before 1995 and since then the products have experienced very significant development.*

In other countries, additional functionality is often integrated in the labelling framework by adding product categories, rather than correction factors. In the EU regulations 10 categories are defined, but effectively only 5 of them are used, while in the USA more than 20 categories are used".

The above discussion makes clear that there are apparent diverging views on the issue of amending correction factors, and the obvious conclusion is therefore that this issue needs to be dealt with through additional analysis.

5.1.3 Ecodesign 643/2009

The ecodesign regulation for cold appliances 643/2009 was adopted in 2009 and is to be revised no longer than 5 years after the implementation. Several steps of the regulation will come into force on specific dates. Here follows a list of generic requirements:

From 1 July 2010:

- For wine storage appliances, the following information shall be displayed in the instruction booklet provided by manufacturers: 'This appliance is intended to be used exclusively for the storage of wine'.
- For household refrigerating appliances, information shall be provided in the instruction booklet provided by manufacturers concerning: the combination of drawers, baskets and shelves that result in the most efficient use of energy for the appliance, and how

[73] CECED's comments to the Defra/Intertek study on correction factors and tolerances for cold appliances, November 2012

to minimise the energy consumption of the household refrigerating appliance in the use-phase.

From 1 July 2013:

- The fast freezing facility, or any similar function achieved through modification of the thermostat settings, in freezers and freezer compartments, shall, once activated by the end-user according to the manufacturer's instructions, automatically revert to the previous normal storage temperature conditions after no more than 72 hours. This requirement does not apply to refrigerator-freezers with one thermostat and one compressor which are equipped with an electromechanical control board.
- Refrigerator-freezers with one thermostat and one compressor which are equipped with an electronic control board and can be used in ambient temperatures below + 16 °C according to the manufacturer's instructions shall be such that any winter setting switch or similar function guaranteeing the correct frozen-food storage temperature is automatically operated according to the ambient temperature where the appliance is installed.
- Household refrigerating appliances with a storage volume below 10 litres shall automatically enter in an operating condition with a power consumption of 0.00 Watt after no more than 1 hour when empty. The mere presence of a hard off switch shall not be considered sufficient to fulfil this requirement.

Specific ecodesign requirements:

- Household refrigerating appliances within the scope of this Regulation with a storage volume equal to or higher than 10 litres shall comply with the energy efficiency index limits in Table 5-3 and Table 5-4.

The Energy Efficiency Index (EEI) of household refrigerating appliances is calculated in accordance with the procedure described in section 5.1.2.

Table 5-3 Compression-type refrigerating appliances

Application date	*Energy Efficiency Index (EEI)*	*Corresponding Class*
1 July 2010	EEI< 55	A
1 July 2012	EEI< 44	A+
1 July 2014	EEI< 42	A+ (from July '14)

Table 5-4 Absorption-type and other-type refrigerating appliances

Application date	Energy Efficiency Index (EEI)	*Corresponding Class*
1 July 2010	EEI< 150	F
1 July 2012	EEI< 125	E
1 July 2015	EEI< 110	D

The specific ecodesign requirements in Tables 1 and 2 shall not apply to wine storage appliances or absorption-type refrigerating appliances and other-type refrigerating appliances belonging to Categories 4 to 9. A preparatory study for wine storages is planned for the future. Possibilities for ecodesign requirements for wine storages are part of that study.

5.1.4 Tolerances

Verification tolerances are primarily to compensate for the reproducibility between test labs. Round Robin tests indicate that there is a variety in the measurements of variables.

Different from other appliances, test tolerances of refrigerators are expressed both in a relative and an absolute value. Since the improvement step between categories is larger than the allowed verification tolerance, overlap is not possible.

Table 5-5 Test Tolerances

Measured parameter	Verification tolerances
Rated gross volume	The measured value shall not be less than the rated value (*) by more than 3 % or 1 l, whichever is the greater value.
Rated storage volume	The measured value shall not be less than the rated value by more than 3 % or 1 l, whichever is the greater value. Where the volumes of the cellar compartment and fresh food storage compartment are adjustable, relative to one another by the user, this measurement uncertainty applies when the cellar compartment is adjusted to its minimum volume.
Freezing capacity	The measured value shall not be less than the rated value by more than 10 %.
Energy consumption	The measured value shall not be greater than the rated value (E_{24h}) by more than 10 %.
Power consumption of household refrigerating appliances with a storage volume below 10 litres	The measured value shall not be greater than the limit value laid down in Annex II, point 1(2c), by more than 0.10 W at the 95 % confidence level.
Wine storage appliances	The value measured for the relative humidity shall not exceed the nominal range by more than 10 %.

The energy label and ecodesign Regulations set out a verification procedure for market surveillance purposes which states verification tolerances of 3% for volume measurements and 10% for energy consumption.

In the Defra/Intertek report is stated that the current level of tolerance and two stage testing regime is still considered to be appropriate.

The conclusion is based on results of a ring test organised in 2009 by the European manufacturers association in collaboration with various test laboratories to consider the current variation between test measurements, along with data for a European-wide test project Atlete I in 2011[74]. Atlete concluded that 57% of the appliances falsely claim a value in one or more categories.

The current tolerance is tighter than in previous Regulations as a result of manufacturers taking more responsibility and account of appliance production variability. The tolerance should only be accounting for differences between testing laboratories and should not be used by manufacturers to deliberately make lower energy claims than appropriate.

Although there are changes in the test standard (see above mentioned developments) there is no significant news regarding test tolerances.

Relevant European legislation and other initiatives

The EU Ecolabel

The voluntary Ecolabel (regulation 66/2010) is designed to promote products which have a reduced environmental impact compared with other products in the same product group.

[74] Atlete I results, downloaded from www.atlete.eu

Commission decision 2004/669/EC[75] established ecological criteria for the award of the eco-label to refrigerators under the old regulation 1980/2000, but this decision expired in 2007. No new criteria for refrigerators have been established under the new regulation.

National Voluntary ecolabels

Several countries have their own national ecolabel. In the table below the ecolabels are shown that cover refrigerators and freezers in European countries.

Non-EU legislation and other initiatives

International Policies

Worldwide a lot of nations adopted energy requirements and other environmental criteria for cooling appliances. Those include mandatory and voluntary labels and minimum requirements. A list of policies is included in Annex A.

Australia and New Zealand have already announced that in 2015 their energy regulations will be based on the new global standard. China will use the global standard from mid-2014.

Switzerland has introduced ecodesign requirements for[76]:

- Wine storages: these should have a minimum EEI of 55
- Other cold appliances, which should have a minimum EEI of 33

5.1.5 Standard

The standard for testing the performance of cold appliances is the EN 62552: 2013, superseding the former standards EN153 and ISO15502.

A new standard will soon be published at IEC level (IEC 62552-1, 62552-2, 62552-3): The CDV documents received 100% approval in August; next IEC 59M meeting will be held in December and an FDIS document will be then issued. The standard will be available in 2014.

The main reason for the development is to improve its use globally. This upcoming standard includes significant changes compared to the present standard. Changes include:

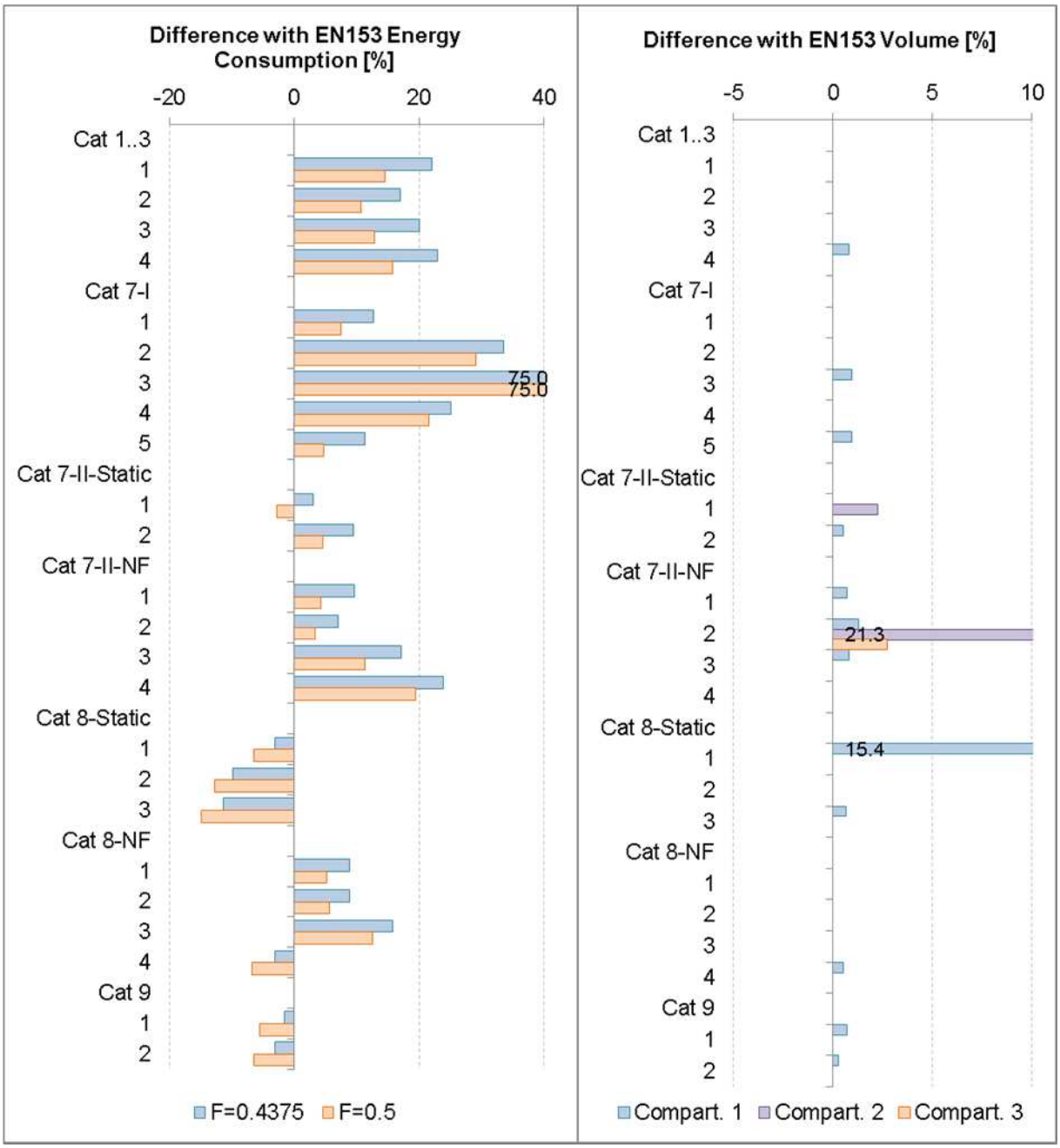
- The ambient temperature is no longer set at 25 °C but will be regionally defined as a function between 16 and 32 degrees.
- The fresh food target temperature is changed from 5 to 4 °C.
- The total energy consumption will be calculated as E_{16} *F*365+ E_{32}*(1-F)*365. E_{16} is the energy consumption at 16 degrees; E_{32} is the energy consumption at 32 degrees. In Europe the factor F will be set a t = 0.5. The ambient temperature may be dependent on the category. For category 7 the ambient temperature is 25°C.
- The frozen food target temperature is changed from -18 °C for the warmest package to an average temperature of -18 °C for 5 or more distributed sensors;
- Suitable for frost-free appliances with variable defrosting algorithms;
- Inclusion of new types of compartments such as wine coolers, pantry or zero star compartments;
- Reduction of ambiguity to avoid circumvention or manipulation of test.

Industry supports the introduction of the new standard in combination with the new label. ReGent[77] investigated the effect on typical cold appliance categories. This is shown in Figure 5-1. The new standard changes the rated annual consumption.

[75] Commission Decision 2004/669/EC of 6 April 2004 establishing revised ecological criteria for the award of the Community eco-label to refrigerators and amending Decision 2000/40/EC

[76] Energieverordnung (EnV) 730.01 of 7 December 1998 (Status 1 October 2012)

Figure 5-1 difference of the rated energy consumption and equivalent volume within the new standard EN 62552and the old standard EN 153



The categories used in the above figure are the most common categories:

Table 5-6 Categories that are most common

Category	Description
1, 2 and 3	Fridges with or without chill compartments

[77] Impact of the new IEC 62552 global standard to cold appliance energy consumption rating, Martien Janssen, Re/genT B.V., 2013, the Netherlands

7, single control (Type I)	Combination appliances such as top and bottom mounted freezers
7, double control (Type II) + Category 10, static type	Combination appliances
7, double control (Type II) + Category 10, No-Frost	Combination appliances
8, static	Upright Freezers
8, No-Frost	Upright Freezers
9	Chest Freezers

The above figure shows that for most refrigerators and combined models the energy consumption will be higher. For static upright freezers and chest freezers the consumption however will be reduced. The changes in the calculation of the volume are modest, except for a few specific combined models.

Whether the ambiguity related to volume determination (as signalled by Defra/Intertek 2012) is addressed by this standard is something that needs to be assessed in a follow-up study.

5.1.6 Product definition

A 'household refrigerating appliance' is defined according to the regulation as "an insulated cabinet, with one or more compartments, intended for refrigerating or freezing foodstuffs, or for the storage of refrigerated or frozen foodstuffs for non-professional purposes, cooled by one or more energy-consuming processes, including appliances sold as building kits to be assembled by the end-user".

That includes:

- 'refrigerator': a refrigerating appliance intended for the preservation of foodstuffs with at least one compartment suitable for the storage of fresh food and/or beverages, including wine;
- 'food freezer': a refrigerating appliance with one or more compartments suitable for freezing foodstuffs with temperatures ranging from ambient temperature down to –18 °C, and which is also suitable for the storage of frozen foodstuffs under three-star storage conditions; a food freezer may also include two-star sections and/or compartments within the compartment or cabinet;
- 'wine storage appliance': a refrigerating appliance that has no compartment other than one or more wine storage compartments;

The categories were decided 20 years ago so a revision of the categories might be necessary considering the current configuration of the market. Some categories could be eliminated while it could be useful to add others.

Any attempt to study the revision of the correction factors should study in parallel the possible revision of the current categories. A detailed study is called for.

There is a contradiction in the ecodesign/labelling legislation between the scope of the measures ('…including those sold for non-household use') and the definition of the household appliances (…appliances used for non-professional purposes).

5.2 Market Analysis

5.2.1 Sales en stock

The IA of cold appliances of 2009 presented annual sales of some 14 million units in year 2005. According to the GFK sales data for 2011-2012, given for 23 EU-countries, this has not changed much.

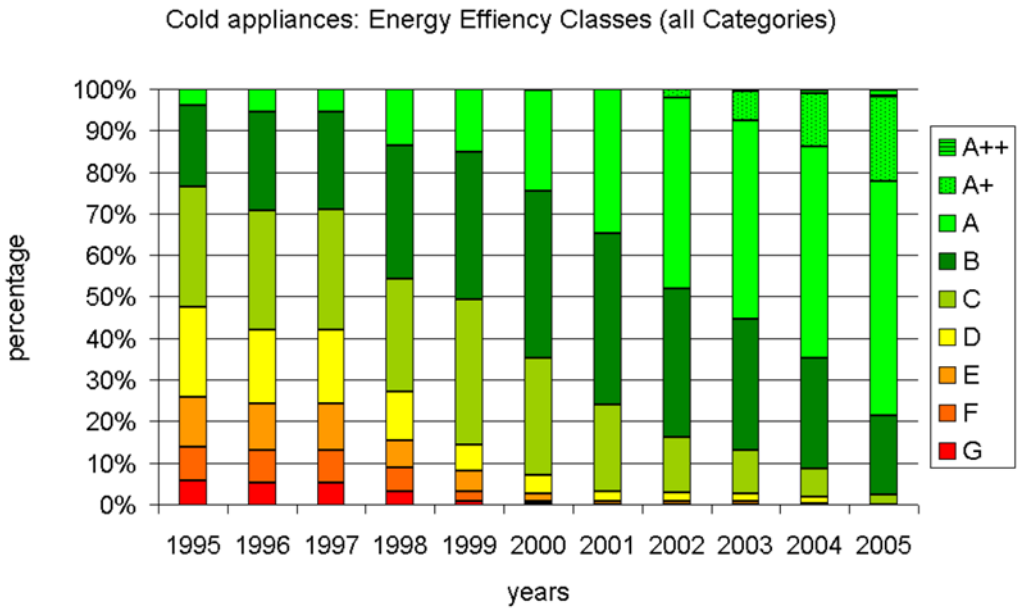
Table 5-7 Sales of freezers and refrigerators in the EU (23 countries)

Year	Sales (units) Refrigerators	Sales (units) Freezers
2011	14,6 million	3,9 million
2012	14,3 million	3,7 million

5.2.2 Trends in energy efficiency

The preparatory study showed a continuous increase of higher label ratings. In 2005 about 80% of all cold appliances were class A or higher.

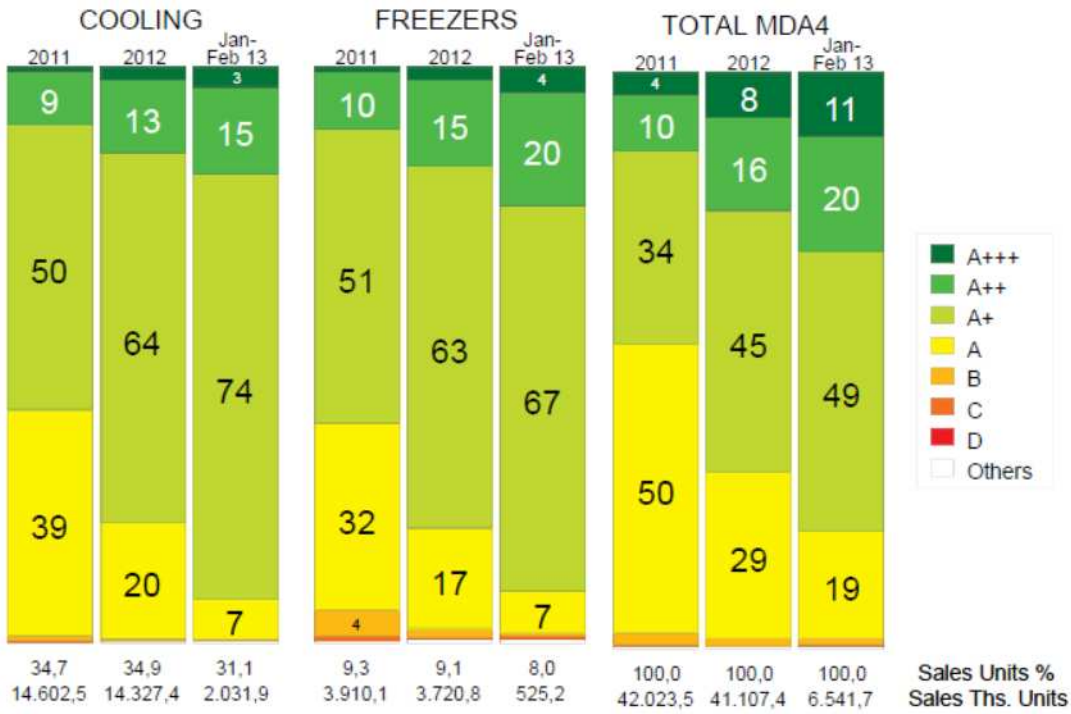
Figure 5-2 The distribution in energy classes for cold appliances EU-27 from the Impact Assessment[78]



The most recent data available shows that this increase in efficiency has continued up to today, with data for Jan-Feb 2013 showing A+++ being 3% to 4% of sales of cooling and freezing appliances respectively. Note that since year 2011 no more cold appliances of label A are allowed on the market.

[78] COMMISSION STAFF WORKING DOCUMENT, Impact Assessment, 2009

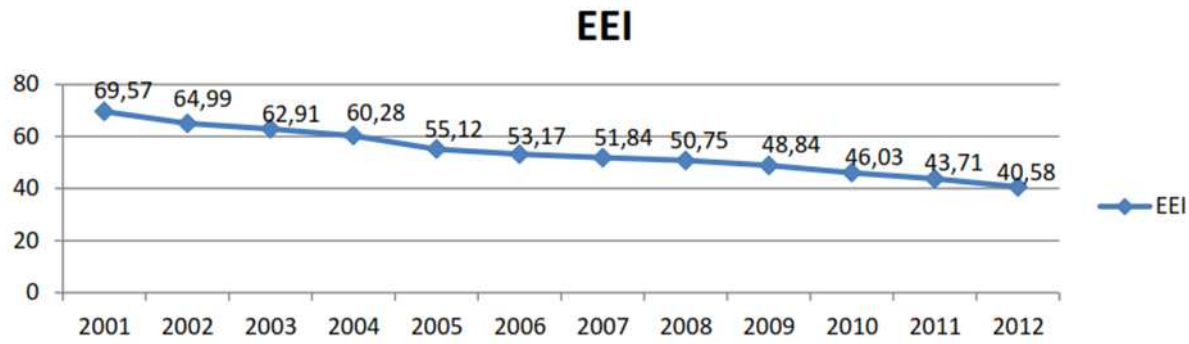
Figure 5-3 The distribution in energy classes for cold appliances related to the MDA4, this is the total of washing machines, dishwashers, fridges and freezers in 23 EU countries (Luxemburg, Cyprus, Malta and Bulgaria are excluded)



The new class A+++ is only 2% of the total sales. Compared to other white goods this is relatively low. The explanation can be that the step from A++ to A+++ is relatively high. From EEI 33 to 22, the appliance has to become 33% more efficient. For washing machines this step is only 10%.

For the years 2001 to 2012 the total average EEI of cold appliances is illustrated by the graph below (Source: CECED 2013).

Figure 5-4. Trend in EEI 2001-2012



Wine storages

There is not much known about wine storages. For this analysis products from a retailer site (kieskeurig.nl, 29 September 2013) were assessed and of the 136 wine storage appliances, 5 were A+, 19 were in the A class, 20 in B class and 5 in C class (the rest is unknown). Most of the appliances had a glass door; however none of the ones in the A+ class had a glass door.

5.2.3 Characteristics of cold appliances

The CECED databases of 2010 and 2011 present the models offered by label classes.

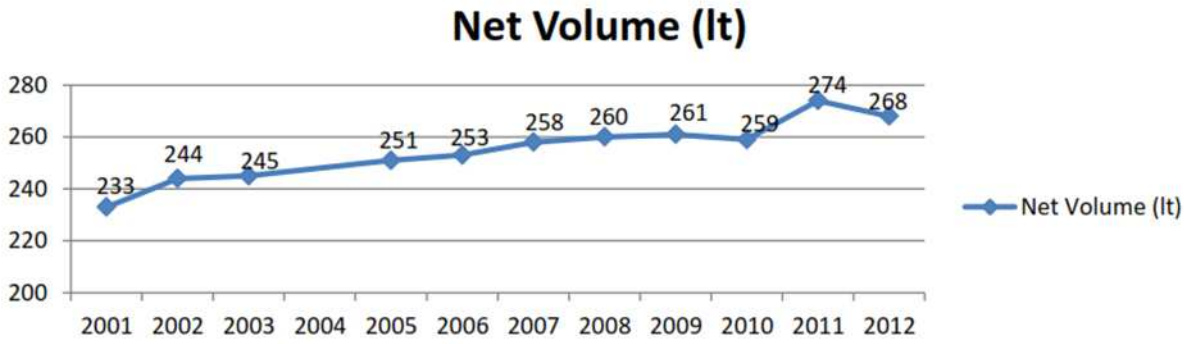
Table 5-8 models in the CECED database

Energy Class	2010			2011		
	#	%	Average AEc (kWh)	#	%	Average AEc (kWh)
A+++	-			104	1	156
A++	1152	10	180	1642	14	202
A+	5802	51	250	6509	56	272
A	4091	36	283	3269	28	306
B	411	4	337	67	1	384
C	25	0	428	17	0	553

The introduction of A+++ started in 2011. They represented 1% of the market in 2011, which is about the same as the share in sales. The amount of appliances offered in category A+ and A++ is slowly growing. However the absolute energy consumption within the highest classes is growing. This can be the result of a larger volume and the use of extra functions such as no-frost.

For the years 2001 to 2012 the average net volume of cold appliances is illustrated by the graph below (Source: CECED 2013).

Figure 5-5. Trends in net volume 2001-2012



Categories

The tendency is that both the number of compartments in general and that the number of appliances with chill compartments has increased. More detailed information is found in the CECED database.

Table 5-9 Categories represent in the regulation 1060/2010

Category	2010			2011		
	n	%	Average of Gross volume (l)	n	%	Average of Gross volume (l)
1	1549	14%	258	1505	13%	247
2	2	0%	343	26	0%	87
3	80	1%	143	126	1%	268
4	16	0%	105	4	0%	115
5	40	0%	113	33	0%	120
6	4	0%	127	2	0%	143
7	7138	62%	296	7433	63%	332
8	1665	15%	205	1884	16%	207
9	555	5%	262	657	6%	257
10	384	3%	339	44	0%	320

Most cold appliances are offered in category 7 (refrigerator-freezer), followed by category 8 (upright freezer) and category 1 (refrigerator, without freezing space). Furthermore there is a small amount of Chest freezers. The other categories are hardly represented. The average volume of class 7 category has grown.

No-frost

No-frost technology causes higher energy consumption because the air is circulated preventing frost to grow in the appliance. Cold appliances without no-frost may add up a layer of frost reducing its efficiency and have to be defrosted regularly. These last effects are not accounted for in test standards. In 2010 31% of the appliances were offered with no-frost technology. In 2011 this was 45% indicating the share of appliances offered with no-frost functionality is growing.

5.3 User Analysis

There are a few consumer related variables that determine the energy consumption of refrigerating appliances:

- Frequency and duration of door opening;
- Ambient temperature of the room;
- Amount and type of food stored.

5.3.1 Door opening

Every time the door of a fridge is opened, warm air from the room replaces cold air in the fridge. This air has to be cooled, causing energy consumption. In the standard EN 62552: 2013

test no door-opening is simulated. This causes higher energy consumption in real life conditions compared to test result and the value on the energy label.

5.3.2 Ambient temperature

Ambient temperature is important for energy consumption. In current test conditions the ambient temperature is 25°C. In real life most kitchens have a cooler temperature. Therefore the energy consumption can be lower.

5.3.3 Food

The type and the amount of food stored also influences the energy consumption. Food containing more water needs more energy to cool. This depends on the initial temperature the food had before putting it in the fridge. More food results in less available space, less air that can leave the fridge when opening the door. Test standards are performed with empty cooling spaces. For freezing spaces so-called cold packages are added.

The main purpose of refrigerators and freezers is to preserve food and drinks and to serve this at the right temperatures. This performance is currently not actually tested, as test standards are primarily focused on registering the inner temperatures, and not focused r tuned on how the preservation and presentation functions are best performed.

This aspect could be ignored if it weren't for the fact that many foodstuffs represent and (indirect) energy consumption much more relevant than that of the refrigerator itself.

5.4 Technical Analysis and saving potential

5.4.1 Technologies

Vacuum insulation panels and variable speed compressors are the best available technologies. Highly efficient appliances already contain vacuum insulation panels and variable speed compressors.
Other improvement options relate to:

- Electronic controls which allow better regulation of the compartment temperatures and better control of the refrigeration cycle. The deployment of electronically regulated technology has enabled separate and more efficient operation of the fresh-food compartment and the frozen food compartment;
- Increased compressors efficiency levels and refined evaporators and condensers;
- Variable speed compressors

The implementation of this technology implies a significant cost increase.

5.4.2 Energy related aspects

The most efficient machines currently available according the Top Ten (topten.eu), could not be placed in the any of the new category. The most efficient models have an EEI of 21.4%, just above the 22% target of A+++.

In the IA the best available technology was identified to be at an EEI between 27 and 32.

The CLASP analysis[79] describes a scenario in which EEIs of less than 14 are achieved. The scenarios describe a situation in which one or two new label classes will be introduced.

[79] Estimating potential additional energy savings from upcoming revisions to existing regulations under the ecodesign and energy labelling directives. CLASP, 2013

Scenario 1: one class of EEI≤15 in 2016; Scenario 2 and 3: EEI≤ 18 and EEI≤14 in 2016 and 2018 (steps of 4 EEI points). For a category 7 refrigerator with 120 litre cooling and 80 litre freezer space, climate class N, freestanding and no-frost this corresponds to a yearly consumption of 100, 83 and 78 kWh respectively.

Policy options

Producers are stimulated to improve their products if this is rewarded with a better label. The steps of the Energy classes are relatively large. The A label steps all differ 11% of the standard energy consumption (SAEc). The step from A++ to the highest A+++ is from 33 to 22 an improvement of 33%. This is a large step to make relating technical improvement. Technologies leading for instance to an improvement of 20% is not 'rewarded'. This might discourage industry to make smaller improvements. Therefore introduction of label steps in between the current A++ and A+++ or redefinition of the label steps might stimulate technology. New classes should reflect relative improvement; for instance 10% improvement related to the last class. These could open up more improvement potential. How fast renewed label classes will fill up, depends on the introduction of new technologies and market price development. An economic analysis will be needed to assess stock improvement potential. Since the number of models in the A+++ is still small there is a large improvement potential CLASP also suggested new ecodesign requirements.

Table 5-10 Ecodesign scenarios by CLASP

Scenario	tier	max. EEI	from year	Extra label class EEI
1	1	38	2016	15
	2	35	2019	
2	1	36	2016	18
	2	28	2019	14
3	1	33	2016	18
	2	22	2019	14

The first two scenarios propose steps that are in between the actual label boundaries. The most stringent requirement allows an EEI of 22 or less (current class A+++).

The effects on affordability are not assessed by CLASP. A+++ appliances are generally more expensive (see 5.4.3, example shows price increase above A++ of 160%) and therefore purchase prices will be driven up. At the moment this price increase is extremely difficult to recuperate through less energy consumption[80]. Too evaluate what a proper set of requirements can be a LLCC analysis should be done. This was omitted in the CLASP analysis

The scenarios described by CLASP could lead to 5.4 to 18 TWh/year energy saving in 2030.

Stakeholder CECED has commented on the CLASP analysis that:

- The relative difference between one energy class and another should be approx. 20% (e.g. EEI 100, 80, 64, 51, 41, 33, 26, 21, etc.)
- Ecodesign limits should be always aligned with class boundaries
- A LCCA is needed for determining minimum efficiency performances requirements

[80] The price increase between A++ and A+++ is roughly 450 euro which represents some 2080 kWh assuming a kWh price of 22 eurocent. Assuming a 12 year product life this is 173 kWh/year. The

To assess the potential for additional energy savings, a more in depth preparatory study is required. This study should be supported by market data and researches on market trends and user behaviour in view of defining a new energy label and ecodesign requirements.

5.4.3 Price development

The figure below shows the price evolution of an upright, more than >90cm high, no-frost freezer in different energy classes.

Figure 5-6. Freezer price trends 2000-2011 (GfK 2012)

Over the last decade, the average purchase price of an 'A' (originally being the most efficient) went down by 50%. The 'A+++' in this example is priced 450 euros more than an 'A++' appliance, while the 'A++' is only 100 euros more than an 'A+' in 2010. The price difference between an A+ and an A++ appliance is compensated over its lifetime by the savings on energy consumption; for the price difference between A+++ and A++ this is not the case. This graph is already a few years old. More recent data needs to be gathered to see if the price of A+++ has already gone down.

The figure does show a "learning effect" in the last decade. A reduction of the A+++ pricing level may be expected. The data however is too limited to allow a calculation of when price levels of A+++ are such that they comprise the least life cycle cost point.

5.4.4 Non-energy aspects

Traditionally, the main non-energy aspects of refrigerators regard the Global Warming Potential (GWP) of refrigerants and blowing agents, as well as specific problems with recycling of the cabinet.

For new, standard size new domestic refrigerators and freezers the problem of GWP of refrigerants and blowing agents is no longer critical. The refrigerant of choice in the domestic

sector is isobutane and the blowing agent for the poly-urethane insulation foam is cyclopentane. Both isobutane and cyclopentane have a very low GWP.

As far as the domestic refrigerating appliances are concerned, there are no lessons to learn from the Regulation EU No 206/2012 for room air conditioners and comfort fans. Room air conditioners have a considerably larger capacity than standard household refrigerators and thus the volume of refrigerant required is much higher. In fact, it is so much higher that isobutane, which is highly flammable, cannot be used because of the fire safety regulations in many countries.

As regards recycling, there are several specialist recycling companies that employ dedicated automatic shredder lines which recuperate the steel and plastics. These shredder lines are preceded by some manual pre-disassembly of cables, mercury switches, glass shelves and other interior parts. Refrigerant and compressor oil is then removed from the cooling circuit before the product enters automatic processing.[81]

The ecodesign preparatory study on cold appliances identified energy consumption during the use phase as the most relevant environmental aspects. The GWP of the refrigerant was also considered a relevant aspect, especially for large 'American' side-by-side fridges which then mostly used R134a as a refrigerant, but was not proposed for ecodesign requirements, also to avoid overlap with parallel EU-legislation (e.g. F-gas regulation).

The DG JRC study of 2012[82], being rooted in the "A resource-efficient Europe – Flagship initiative of the Europe 2020 Strategy", deals more extensively with resource efficiency aspects. The study identified five parameters that could be used to better integrate resource efficiency into environmental product legislation, for instance through implementing measures under the Ecodesign Directive:

1. recyclability/recoverability/reusability (RRR),
2. recycled content,
3. recyclability/recoverability/reusability benefits (RRRB),
4. use of hazardous substances,
5. durability.

These aspects were tested for suitability as ecodesign requirement in three product cases: washing machines and LCD televisions (all parameters), and imaging equipment (recycled content only).

The conclusions of the study[83] apply to washing machines and focus primarily on provisions for improved disassembly of printed circuit boards (PCBs), motors and LCD screens. The merits of these measures to refrigerators, with its typical problem of separating inner-liner, foam and steel cabinet, are very limited.

Integration of new resource efficiency parameters into ecodesign requirements will require substantial efforts in data collection, methodological agreement by all parties involved, modification and enhancement of existing tools and an overall check according 2009/125/EC Article 15 criteria, which should assess the proportionality of such requirements. At the moment there is no proof that such an effort, if successful, would have a significant impact in terms of a noticeable increase in materials recovery.

[81] An animation of a modern refrigerator recycling plant can be found at http://www.simsrecycling.co.uk/Resources/Fridge-recycling-process

[82] Final Executive Summary of Second phase (December 2012, plus preceding reports http://lct.jrc.ec.europa.eu /pdf-directory/

[83] F. Ardente, F. Mathieux; Stakeholder event of the project: Integration of resource efficiency and waste management criteria in European product policies – Second phase" Analysis of case-studies: Washing Machines

5.5 Wine storage appliances

5.5.1 legislation and standards

EU legislation

Wine storage appliances are currently subject to delegated regulation 1060/2010 on energy labelling of household refrigerating appliances. Similar to other refrigerating appliances they need to carry the energy label at the point of sale.

Wine storage is not subject to ecodesign requirements set out in Regulation 643/2009, but in Article 7 Revision, it is stated that:

The Commission shall assess the need to adopt specific ecodesign requirements for wine storage appliances no later than two years after the entry into force of this Regulation.

As the Regulation entered into force August 2009, the review was due for August 2011.

Definition

According article 2, item 10) of 1060/2010 'wine storage appliance' means a refrigerating appliance that has no compartment other than one or more wine storage compartments.

Using the categorisation scheme as laid out in 1060/2010, based on standard ..., this comprises refrigerating appliances that only have a cellar/wine storage compartment, designated as category 2, with a nominal temperature of +12ºC (range between +5 / +20ºC). In Annex I (item l) the term 'wine storage compartment' is further defined as:

(l) ‘wine storage compartment’ means a compartment exclusively designed either for short-term wine storage to bring wines to the ideal drinking temperature or for long-term wine storage to allow wine to mature, with the following features:

> (i) continuous storage temperature, either pre-set or set manually according to the manufacturer’s instructions, in the range from + 5 °C to + 20 °C;
>
> (ii) storage temperature(s) within a variation over time of less than 0,5 K at each declared ambient temperature specified by the climate class for household refrigerating appliances;
>
> (iii) active or passive control of the compartment humidity in the range from 50 % to 80 %;
>
> (iv) constructed to reduce the transmission of vibration to the compartment, whether from the refrigerator compressor or from any external source;

According the product fice (Annex III) wine storage appliances should be marked or identifiable as such by the inclusion of the following information: ‘This appliance is intended to be used exclusively for the storage of wine’. This point shall not apply to household refrigerating appliances that are not specifically designed for wine storage but may nevertheless be used for this purpose, nor to household refrigerating appliances that have a wine storage compartment combined with any other compartment type.

Switzerland

On 1 january 2014 the Swiss 'Energieverordnung' (EnV, 730.01[84]) of 7 December 1998 was amended on various accounts, including an article dealing with specifically wine storage appliances or wine coolers. In article 2.3 of Annex 2.2 wine coolers (defined as such in Regulation 643/2009) should have an energy efficiency index of less than 55 (according delegated Regulation 1060/2010, Annex I, VI, VIII and IX for energy labelling of cold appliances). This corresponds to energy efficiency class A or better.

The possibility of introducing requirements for wine storage appliances have been discussed in Australia in 2004, but sofar have not resulted in such requirements[85].

5.5.2 Market analysis

There is very few data available regarding the European market for wine storage appliances. It appears from anecdotal evidence that France and the UK are the largest markets in the EU (as the UK is allegedly the largest wine importing country in the EU).

One source[86] , based on gfk sales data, mentions the market of wine storage appliances in the UK to have grown since 2005 with double digit values, averaging at 35%. Data for 2008-2011 clearly show a halt in sales due to the crisis.

The source mentions that growth occured in particular in the DIY sector and mass merchandisers, of smaller, entry-level products. In the UK, in 2010, some 45% of sales occured in DIY and kitchen shops. More affordable single temperature wine cabinets make up the majority of sales in the UK with over 85% share. The table below shows more UK market data from the same source.

Table 5-11 UK Sales of wine storage appliances (plus market value)

	market / units (change and size)	market / value (change)	market value (size)	average prices (change)
2005	growth 35%			
2006	28000 units			
2007	42000 units (+30%)			
2008	(no data, decline -10% expected)		10 million GBP	
2009	(no data)		8.8 million GBP	
2010	decline of 19% (from 2009)			dropped 20%
2011	growth 5%	increase 20%	+1.2 million	increase 15%

Using the above data, the UK market size can be reconstructed as shown in the table below. All data beyond 2011 are based on assumptions regarding future growth rates.

In order to upscale this data to the EU it is assumed (no source or data found, so the following estimate has to be treated with caution) that the French market is some 10% bigger than the UK (on basis of inhabitants, France is only 2% larger, but on basis of dwellings, France is 20% larger).

[84] Source: www.admin.ch/ch/d/sr/7/730.01.de.pdf
[85] Source: Wine storage cabinets, prepared for the Australian Greenhouse Office under the National Appliances and Equipment Energy Efficiency Program, report No: 2004/13 (No Action Proposal)
[86] Source: http://www.kbbreview.com/market_analysis_wine_coolers.htm

If it is then assumed that France and the UK make up 2/3 of the EU market of wine storage appliances (no source or data for this assumption), the total EU market may be as shown in the table below. And assuming a product life of 15 years, the stock can be calculated as well. The analysis takes into accoun that stock is not likely to exceed a penetration rate of 10% of households (assuming

Table 5-12 Calculation of EU27 sales and stock of wine storage appliances

Sales wine storage appliances	2005	2010	2015	2020	2025	2030
UK (estimated)	0,02	0,03	0,06	0,14	0,28	0,45
assumed annual growth	+35%/yr	-19%/yr	+25%/yr	+20%/yr	+15%/yr	+10%/yr
FR (estimated)	0,02	0,03	0,06	0,15	0,31	0,49
EU 27 (estimated)	0,07	0,09	0,18	0,44	0,89	1,43
Stock (estimated)	0,3	0,8	1,7	3,5	7,5	13,8
Household penetration (% of hh)	0%	0%	1%	2%	3%	6%

Table 5-13 Brand names of wine storage appliances in three countries

Germany[87]	France[88]	United Kingdom [89]
Amstyle (1)	Artevino (14)	EuroCave
Bauknecht (2)	Aucune (18)	Caple
Bosch (2)	Avintage (1)	Bosch
Candy Hoover (4)	Bosch (5)	Haier
caso (9)	Candy (4)	Husky
Climadiff (4)	Caso (2)	Royal Sovereign
dilego (1)		Samsung
Dometic (2)		Sandstrom
Eurocave (1)		Stoves
Exquisit (2)		
Haier (3)		
Klarstein (1)		
La Sommeliere (1)		
Liebherr (20)		
Miele (1)		
Samsung (3)		
SEVERIN (2)		
Smeg (2)		

All the above values and assumptions need to be verified, preferably in a follow-up study dedicated to cold appliances, including wine storage appliances.

[87] Based upon: http://www.testbericht.de/de/productlist/kuehlen-gefrieren-Fweinkuehlschrank.html#filterHS (accessed February 2014)
[88] Based upon: www.cdiscount.com (accessed February 2014)
[89] Based upon: www.wineware.co.uk/wine-cabinets/ and www.currys.co.uk (accessed February 2014)

5.5.3 User analysis

It is assumed that wine storage appliances are mostly sold for household use, although there will be purchases by small commercial users as well. Large commercial users will probably use commercial refrigerated display cabinets or coolrooms for chilled wine storage and specially built insulated cellar rooms for ageing and maturation.

Wine coolers show a variety of forms, installation and technical features. As form factor one can discern built-in (undercounter coolers, or larger) and free-standing, with a single or two doors, with transparant doors or opaque. Important features are the number of climatised compartments (single, two, three or multi)[90].

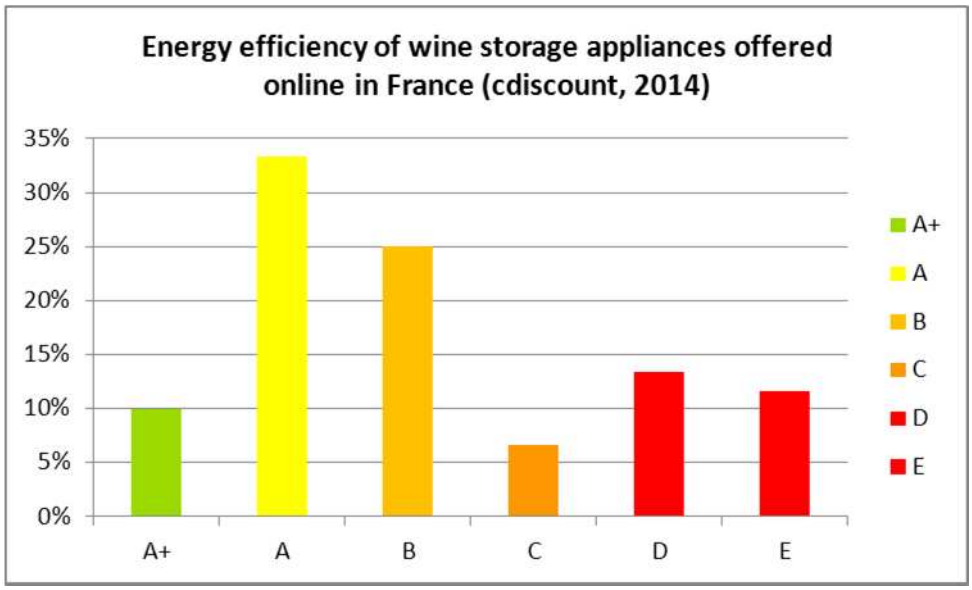
5.5.4 Technical analysis and saving potential

Energy efficiency of wine storage appliances are assessed in a manner similar to other cold appliances. Also the labelling scheme is shared with that of other cold appliances. As wine coolers have not been subject to years of energy labelling and minimum requirements like other cold appliances have, the range in energy efficiency found on the market is relatively wide.

A major cause for thsi is a technical divide between thermo-electric (Peltier)-cooled appliances and those using more conventional vapour compression cycles. Peltier elements are on average some 6-9 times less efficient than compressor driven appliances[85], but do not cause vibrations and are a relative simple technology to apply.

An internet survey of one of the largest online retailers of France[91] shows that some 156 models are on offer, of which over 40% is class A or better, and some 25% is class D or worse.

Figure 5-7 Energy efficiency of wine storage appliances on offer in France, Cdiscount 2014

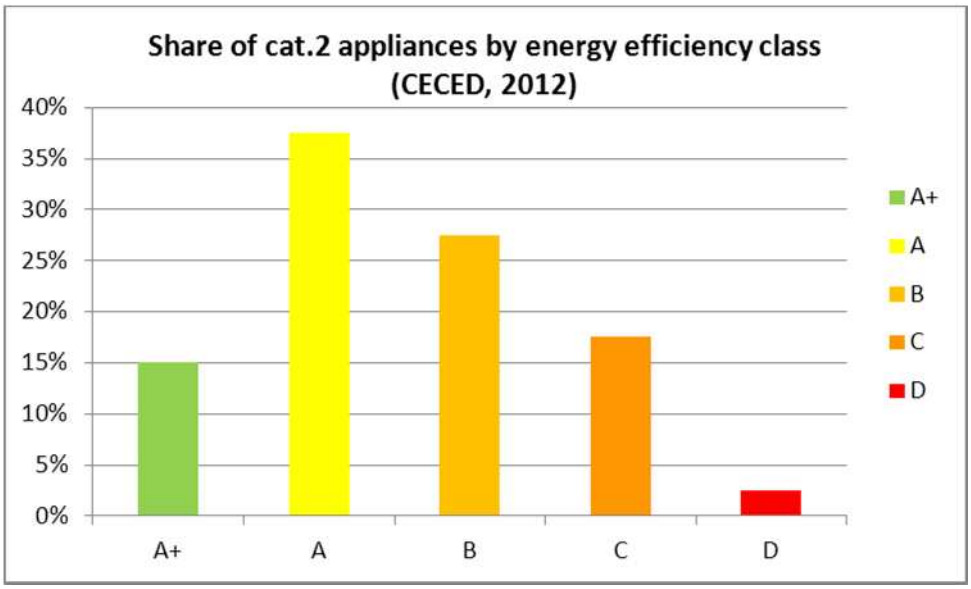


[90] Features based upon: http://www.wineware.co.uk/wine-cabinets/#sthash.HridyALG.dpuf
[91] Source: http://www.cdiscount.com/electromenager/cave-a-vin/toute-l-offre-cave-a-vin/l-1102111.html, accessed on 12-02-2014

The above data shows the best products on the market, class A+, has an efficiency of at least 44 (as of July 2014, the class A+ border shifts to 42). Class D has an efficiency index of at least 110.

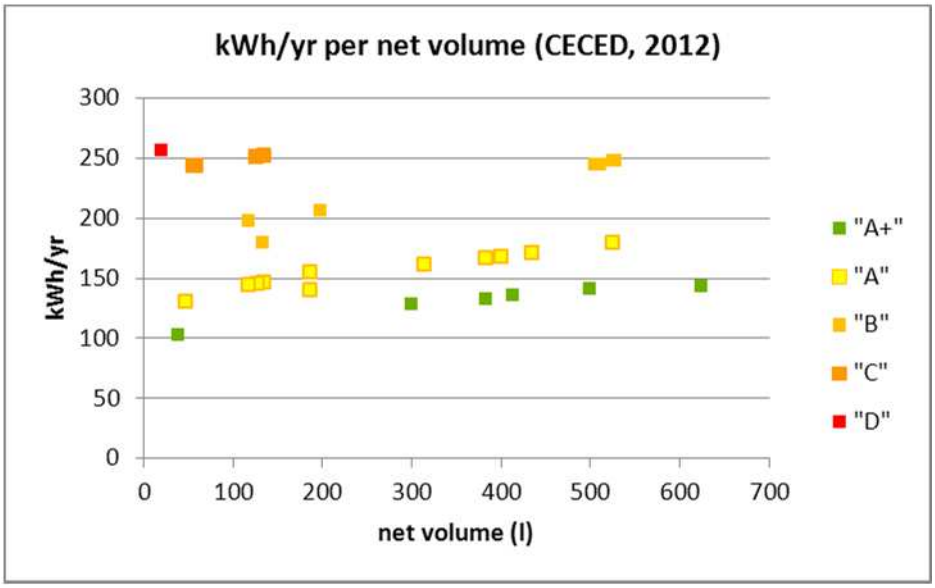
The 2012 CECED database for cold appliances includes 40 entries of cold appliances with only a wine/cellar compartment. The database does not give information whether these appliances fullfill other criteria of the definition for a wine compartment, but for the sake of analysis it is assumed these are primarily or solely wine storage appliances. The data shows that some 50% os class A or better, and some 20% is class C or worse.

Figure 5-8 Energy efficiency of "Category 2" (presumably mainly wine storage appliances), CECED 2012



Further analysis of the CECED data shows that class A+ (and A as well to a large degree) is available over the whole net volume range (from 39 up to 625 liter).

Figure 5-9 Annual energy consumption of "Category 2" (presumably mainly wine storage appliances), CECED 2012



Saving potential

A simple analysis shows that if the average wine storage appliance placed on the market between 2005 and 2030 consumes 225 kWh/yr (comparable to 300 liter net volume / 120 bottles, of energy efficiency class C), the total consumption is some 0.2 TWh/yr in 2010, increasing to almost 7 TWh/yr in 2030 (assuming stock and average consumption development as shown above) .

If, for example, from 2015 onwards the average new product placed on the market would carry energy efficiency class A, with an indicative consumption of 175 kWh/yr (same 300 ltr model), the consumption in 2030 would be reduced to over 5 TWh/yr (1.5 TWh saved).

If the new product placed on the market from 2015 onwards would be a class A+, of 125 kWh/yr (still a 300 ltr model), then the consumption in 2030 would be closer to 3.8 TWh/yr, a saving of 3 TWh in 2030.

Table 5-14 Saving potential (indicative) for wine storage appliances

		Stock energy consumption						unit
average consumption per unit		**2005**	**2010**	**2015**	**2020**	**2025**	**2030**	
average assumed to be class 'C'	225 kWh/yr	0,07	0,17	0,37	0,79	1,69	3,09	TWh/yr
new average: class 'A', as of 2015	175 kWh/yr	0,07	0,17	0,37	0,64	1,31	2,41	TWh/yr
new average: class 'A+', as of 2015	125 kWh/yr	0,07	0,17	0,37	0,49	0,94	1,72	TWh/yr
saved if new average is 'A'					0,2	0,4	0,7	TWh/yr
saved if new average is 'A+'					0,3	0,8	1,4	TWh/yr

Of course the above assumptions need to be verified/scrutinised by a more thorough follow-up study, involving more experts and stakeholders. The above results are indicative only.

Nonetheless, the analysis shows that, provided the assumptions on sales, stock, product life and average energy consumption are indeed representative, savings in the area of 0.5-1 TWh/yr by 2030 appear possible.

5.6 Conclusions

Eligibility of product group regarding Article 15 criteria

The most recent data shows the product group of domestic refrigerators/freezers is still economically significant. The high household penetration and the limited increase in average efficiency lead to the conclusion that the environmental impact will also be significant. A technical improvement potential exists as machines have been identified exceeding class A+++ limits.

According to GFK data in 2012, 2% of the products are sold in this highest A+++ energy class. CECED data showed that 1% of the models are offered in this label class. GfK data further reveals that models in this highest labelling class come at a high price premium.

The Ecodesign requirements ultimately allow only machines in the top three energy label classes. This gives room for differentiation of energy efficient machines, but it is rather limited when compared to Energy Labelling main purpose (labelling to apply in seven energy efficiency classes).

→Possibility for changing the labelling scheme has to be investigated related to improvement potential

→ The possibility for tightening the ecodesign requirements on energy efficiency has to be investigated with an economic assessment including lowest life cycle costs.

Changes in performance standard IEC 62552

The new global standard (IEC 623552-1-2-3 coming into force in 2014) introduces a way of testing with different ambient temperatures and reduces the target temperature of the fridge compartment. Such changes are expected to affect the energy consumption per cycle and hence the EEI.

→ Future revision of the energy label and ecodesign regulation should take into account the effects of a change in the standard.

Calculation of EEI

Here the preliminary study finds diverging views: On one hand a study recommends review, possible deletion or reduction of the correction factors. on the other hand, this is contested by industry, who state the current method can be used to drive energy efficiency in cold appliances.

The global standard being developed should be considered as well, which allegedly can be done by only a small change on the reference line for refrigerators, provided that the rest of the calculation is maintained. This of course needs to be subject of further analysis. ***Editorial issues***

Review necessity to address the contradiction in the ecodesign/labelling legislation between the scope of the measures and the definition of the household appliances

There is a contradiction between the scope of the measures ('*including those sold for non-household use*') and the definition of the household appliances ('appliances *used for non-professional purposes'*) in the current regulation. It would be consistent to remove "including those sold for non-household use" from the regulatory text.

Wine storage appliances

It appears the energy efficiency of wine storage appliances shows a relative large disparity, suggesting a potential for removing the least efficient from the market. Following the analysis in section 5.5 a saving potential between 0.5 and 1 TWh/yr by 2030 could be achieved if appliances of class B and less efficiency would be removed (the feasibility of which needs to be proven in a more thorough follow-up study).

→ Future revision of the energy label and ecodesign regulation should assess the possibility for setting ecodesign requirements for minimum energy efficiency.

6. Non-directional light sources

Main author & final editing: VHK, Rene Kemna

Summary

This section of the omnibus assignment entails a (first) review of Commission Regulation (EC) No 244/2009 regarding Ecodesign requirements for Non-Directional Light Sources (NDLS).

The structure of this review follows the general structure as described in the introductory section of the omnibus assignment. Related sections elsewhere in this omnibus study deal with Special Purpose Lamps (special report) and the review of Regulation (EC) No 245/2009 on tertiary sector lighting.

The main conclusions from this review are that:

- NDLS represent an economically and environmentally significant product group, with annual sales of 1.4 billion units (2010) and an electricity consumption that is currently 4% of total EU demand.
- The energy saving potential, beyond what will be realised through the existing regulation, is still an extra 20% (18 TWh/year) in the years 2020 and 2030.
- This saving is technically feasible through setting targets that are ultimately at the energy label level 'A+' in 2020/2021. This would phase out CFLs and halogen technology and implies that from 2020/2021 the NDLS-technology is to be based on LEDs (and possibly OLEDs at a later stage).
- If LED lamps meet current industry projections for 2020, the payback period of the average LED lamp with respect of cheaper alternative of a mains voltage halogen lamp will be around 1.5 years at the mentioned target level.
- There are considerable uncertainties when and how a revision of the existing regulation should be implemented in order to minimise possible negative impacts in terms of functionality, affordability and industry's competitiveness.
- Addressing these uncertainties, in consultation with stakeholders, would require a comprehensive follow-up study.
- Such a follow study could also look into the possibility of a holistic approach whereby the regulations for all lighting products (including 245/2009 and 1194/2012) are treated in a single piece of legislation.

The matter of special purpose incandescent lamp types and their misuse for general lighting purposes will be addressed in a separate section of the omnibus study.

6.1 Introduction

This is a review study of Commission Regulation (EC) No 244/2009 with regard to Ecodesign requirements for non-directional light sources[92] (hereafter 'the Regulation'), in the context of the Omnibus project.

[92] Commission Regulation (EC) No 244/2009 of 18 March 2009, implementing Directive 2005/32/EC of the European Parliament and of the Council with regard to ecodesign requirements for non-directional household lamps, OJ L76/3, 24.3.2009 *(entering into force 20 days after publication, i.e. 13 April 2009)*

6.1.1 Existing legislation

Commission Regulation (EC) No 244/2009, implementing Directive 2005/32/EC of the European Parliament and of the Council with regard to ecodesign requirements for non-directional household lamps (hereafter 'the Regulation') was published the 18tht of March 2009 and entered into force two weeks later.

The legal context is Article 7 (Revision) of Commission Regulation (EC) No 244/2009, stating that 'The *Commission shall review this Regulation in light of technological progress no later than five years after the entry into force and present the result of this review to the Consultation Forum*.' Five years after entry into force means by 13 April 2014.

Furthermore, recital (20) mentions *'A review of this measure should take particular note of the evolution of sales of special purpose lamp types so as to verify that they are not used for general lighting purposes, of the development of new technologies such as LEDs and of the feasibility of establishing energy efficiency requirements at the 'A' class level as defined in Commission Directive 98/11/EC of 27 January 1998 implementing Council Directive 92/75 with regard to energy labelling of household lamps.'*[93]

In Article 3 the Regulation sets requirements for Non-Directional Light Sources (NDLS), specified in Annex II of the Regulation, in 6 stages.

The first 4 stages, with requirements applying from the 1st of Sept. 2009, 2010, 2011 and 2012, eliminate low-efficacy ('incandescent') lamps in subsequently lower lumen output-levels[94]. At the moment all general purpose incandescent lamps with output >60 lm should have been phased-out from the EU market.

Stage 1 also sets minimum functionality requirements for Compact Fluorescent Lamps (CFLs) and –in one group– light sources that are neither CFLs nor Light Emitting Diodes (LEDs). This latter group of non-CFL/LED lamps mainly includes the NDLS halogen lamps. Stage 5, which applies from 1 Sept. 2013, sets more stringent minimum functionality requirements regarding minimum rated lamp lifetime/lamp survival factor at 6000 h, lumen maintenance, number of switching cycles, starting time, heat-up time to reach 60% of lumen output, premature failure rate, UVA+UVB radiation, UVC radiation, lamp power factor (LPF) and –for CFLs only– the colour rendering index (Ra). Most significantly, with respect to stage 1, stage 5 tightens the requirements for the service life and lifetime functionality.

Stage 6 is now foreseen to be applied from 1 Sept. 2016. It sets more stringent efficacy requirements for clear lamps, but requirements and timing of Stage 6 are currently revisited by the Commission in a separate context[95]. As it stands today, Stage 6 entails that instead of the maximum rated power P_{max} (in W) being 0.8 * (0.88√Φ+0.049Φ), where Φ is the rated luminous output (in lm), the rated power of clear lamps will then have to be less than a P_{max} of 0.6 * (0.88√Φ+0.049Φ), which equals the lower limit value of the 'B' energy label class.

There are a number of exemptions in the product scope of the regulation, as will be discussed extensively in the next chapter. The exemptions include not only the 'special purpose lamps', but also coloured (not 'white') lamps, directional light sources (DLS), commercial lamps that are covered by other legislation (LFLs, High Intensity Discharge HID lamps and non-integrated CFLs), lamps with lumen output below 60 or above 12000 lumen, low voltage incandescent lamps with E14/E27/B22/B15 caps. The exceptions to stage 6 requirements are clear lamps with type G9 and R7s cap.

[93] OJ L 71, 10.3.1998, p. 1.

[94] 'low-efficacy' intended here for lamps where the rated power P exceeds the maximum rated power Pmax (in W) at a given rated luminous flux (Φ, in lm) with for non-clear lamps Pmax=0.24√Φ+0,0103Φ and for clear lamps in stages 1 to 5 Pmax= 0.8 * (0,88√Φ+0.049Φ).

[95] VHK, Review study on the stage 6 requirements of Commission Regulation (EC) No 244/2009, draft report for the European Commission, April 2013.

6.1.2 Legislative developments in the EU

Since the publication of Ecodesign Regulation 244/2009, the following related legislation has been introduced in the EU:

- Ecodesign regulations for other light sources than NDLS were introduced, specifically these include Commission Regulation 245/2009[96] regarding linear fluorescent lamps (LFL) and high intensity discharge lamps (HID) as well as Commission Regulation 1194/2012 regarding directional light sources (DLS) and LEDs[97].
- A new Commission Delegated Regulation for energy labelling of luminaires and light sources has been published in 2012[98]. Contrary to the previous lamp energy label, regulated under Directive 98/11/EC, the new Regulation covers directional lamps, extra low voltage lamps, light-emitting diodes (LEDs), and lamps used predominantly in professional lighting, such as high-intensity discharge lamps. It informs consumers about the compatibility of the luminaire with energy-saving lamps and about the energy efficiency of the lamps included with the luminaire. The exclusions from the scope are similar to those intended in Regulation 244/2009.[99] The energy efficiency limits for classes A-G are similar to the ones in Directive 98/11/EC[100], but new 'A+', 'A++' and 'A+++' classes have been added to accommodate more efficient lighting technology (e.g. LED).
- The energy efficiency of lighting is explicitly addressed as a subject --mainly for the non-residential sector-- in the 2010 recast of the Energy Performance of Buildings Directive (EPBD)[101] . The EPBD recast also explicitly formulates that '*Member States should use, where available and appropriate, harmonised instruments, in particular testing and calculation methods and energy efficiency classes developed under measures implementing Directive 2009/125/EC*'. [102]
- An improved energy efficiency of lighting is one of the items that may be part of the National Energy Efficiency Action Plans required under the new Energy Efficiency Directive (EED)[103] and the carbon-abatement resulting from more efficient lighting may be part of policy measures such as the Emission Trading Scheme (ETS)[104].

[96] COMMISSION REGULATION (EC) No 245/2009 of 18 March 2009 implementing Directive 2005/32/EC of the European Parliament and of the Council with regard to ecodesign requirements for fluorescent lamps without integrated ballast, for high intensity discharge lamps, and for ballasts and luminaires able to operate such lamps, and repealing Directive 2000/55/EC of the European Parliament and of the Council. OJ L76/17, 24.3.2009.

[97] COMMISSION REGULATION (EU) No 1194/2012 of 12 December 2012 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for directional lamps, light emitting diode lamps and related equipment. OJ L342/1, 14.12.2012

[98] COMMISSION DELEGATED REGULATION (EU) No 874/2012 of 12 July 2012 supplementing Directive 2010/30/EU of the European Parliament and of the Council with regard to energy labelling of electrical lamps and luminaires. OJ L258/1, 26.9.2012.

[99] Excluded from the scope are lamps and LED packages with low-lumen output (<30 lm), made for battery operation, not intended for general lighting (where the emitted light is an agent in a chemical or biological process, used for image capture and –projection, used for heating or used for signalling), part of a luminaire, part of a product not used for lighting or not compliant with requirements in Ecodesign regulation that will be introduced in 2013 and 2014. Luminaires that are designed to operate exclusively with the lamps and LED modules with low-lumen output, battery operated or not intended for lighting, are also excluded from the scope.

[100] Except for the 1300 lm cap that has been introduced in the metric.

[101] DIRECTIVE 2010/31/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 19 May 2010 on the energy performance of buildings. OJ L153/13, 18.6.2010.

[102] Recital (12) of the EPBD recast.

[103] DIRECTIVE 2012/27/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC. OJ L315/1, 14.11.2012.

[104] Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC. OJ L 275, 25.10.2003, p. 32. Latest amendment: Directive 2009/29/EC of the European Parliament and of the Council of 23 April 2009. OJ L140/63, 5.6.2009.

- The 2011 recast of the Directive on the Restrictions of Hazardous Substances in Electrical and Electronic Equipment (RoHS 2)[105] formulates more stringent criteria for the mercury-content in (compact) fluorescent lamps.[106]
- Revised EU Ecolabel criteria for light sources were introduced in 2011[107]. For energy efficiency they require a minimum of 10% better than the 'A' class (as defined in the lamp energy label of Directive 98/11/EC) and require minimum lumen maintenance. They set minimum performance requirements for the number of switches, colour rendering and colour consistency. Environmental criteria relate to hazardous substances (e.g. mercury), substances regulated through REACH[108], marking of plastic parts and recycling of packaging.
- New EU Green Public Procurement (GPP) criteria for indoor lighting were introduced in 2012 [109]. They relate not only to minimum luminous efficacy of the light sources (in lm/W), but also to lighting levels (W/m²/100 lux), lighting controls, etc..

The 2011 Evaluation-study of the Ecodesign Directive by CSES[110] indicates that, in contrast to previous policy measures, the Regulation 244/2009 appears to be successful in phasing out the least efficient light sources from the market and concludes that *'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.'*

The European Commission continues to study various aspects of the regulation e.g. through a preceding review study that looked into possible effects of the 'Stage 6' requirements[111] and another study that has just been launched on a possible extension of the scope, in an Ecodesign or alternative context, towards lighting systems (including lay-out, luminaires, lamps, controls, etc.).

6.1.3 Extra-EU developments in legislation

The EU legislation on phasing out low efficacy (incandescent) lamps is in line with the current legislation on this issue around the globe. But there are signs in several countries that show a willingness to set more stringent requirements, although this has not been translated into legislation until now.

Japan, the largest LED producer in Asia[112], has explicitly announced that it aims for sales of only LED lamps (or lamps with similar efficacy) from 2020 onwards.

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[105] DIRECTIVE 2011/65/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment ('RoHS 2'). OJ L174/88, 1.7.2011.

[106] After 31 December 2012, the mercury-content in single capped (compact) fluorescent lamps may not exceed (per burner) 2,5 mg (<30W lamp), 3,5 mg (30-50W lamp), 5 mg (50-150 W lamp), 15 mg (>150W lamp)

[107] COMMISSION DECISION, of 6 June 2011 on establishing the ecological criteria for the award of the EU Ecolabel for light sources, (2011/331/EU). OJ L148/13, 7.6.2011.

[108] REGULATION (EC) No 1907/2006 of The European Parliament and of the Council of 18 December 2006 ('REACH'). OJ L 396/1, 30.12.2006. Relates to substances under Article 59(1).

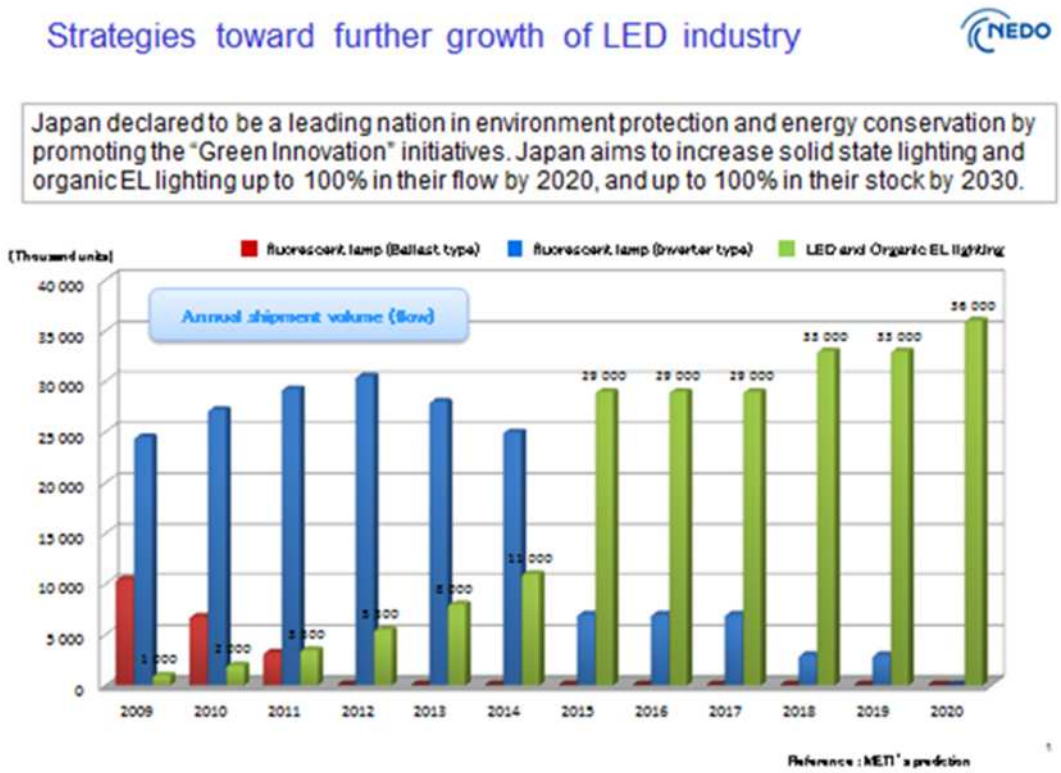
[109] http://ec.europa.eu/environment/gpp/pdf/criteria/indoor_lighting.pdf

[110] Centre for Strategy & Evaluation Services CSES, *Evaluation of the Ecodesign Directive (2009/125/EC)*, Final Report, March 2012. available at http://ec.europa.eu/enterprise/policies/sustainable-business/ecodesign/review/files/ecodesign_evaluation_report_part1_en.pdf

[111] VHK/VITO, *Review study on the stage 6 requirements of Commission Regulation (EC) No 244/2009*, Final report for the European Commission, September 2013.

[112] Digitimes, *Japan is still LED leader in Asia*, 4 Sept. 2013. Note that Digitimes considers a) Taiwan and mainland China as separate entities and b) looks at market value (not necessarily shipments) when stating Japan's leading position.

Figure 6-1. METI strategies towards further growth of LED industry.



(Source: Y Kudo, NEDO[113], at the Symposium on standardisation of LED, Tokyo, March 2012. Comm. P. Bennich)[114]

China (including Taiwan) is the worldwide leading manufacturing economy in CFLs and the runner-up in LED production. At the moment China seems not yet ready to announce a 'LED-only' strategy for the future; in 2012 only the 1st stage of the phasing out of incandescent bulbs, comparable in stringency to the EU's stage 1 in 2009, took effect.[115]

South-Korea, while following the same path as the EU in phasing out incandescent bulbs, does not foresee an overall 'LED only' before 2020. Until that time, there is a policy to promote LEDs through measures in suitable niche markets such as traffic lights.[116]

The US is committed to strong R&D support through its Solid State Lighting (SSL) program, but there is no sign of imminent legislation that would set more ambitious minimum requirements on efficacy than the ones already in place[117].

As far as timing is concerned, there seems to be a consensus between Japan, Korea and the US that 'LED only', at an efficacy of around 200 lm/W and without negative functional impacts, is expected to be possible in 2020.

Overall, most countries appear to be in a transitional phase as regards considering more stringent minimum efficacy requirements for light sources. LED-technology is considered not yet mature enough (see also negative impacts), to be the only NDLS alternative in the residential sector. On the other hand, most policy

[113] NEDO is a Japanese semi-governmental organization, founded in 1980 to promote the development and introduction of new energy technologies.

[114] LightingEurope comments that This graphic does not include Halogen ECO types and is misleading in its indication of market share for LED.

[115] LEDinside : *China's LED Lighting Market Demand Value May Reach $US 10 Billion in 2015; LED Lighting Sales from Online and Physical Channels to Gradually Increase*, April.24, 2013. Note that the 1st stage of the Chinese regulation addresses incandescent bulbs with a power of 100 W or higher.

[116] Ministry of Knowledge Economy and KEMCO, Performance Improvements during the First 19 years and a Vision for the Future, KOREA'S ENERGY STANDARDS & LABELING, 2011.

[117] US Dept. of Energy. Federal Register 10 *CFR Part 430. Energy Conservation Program for Consumer Products etc.*

makers seem convinced that the time for LED-only will come and thus –in the interim—are prudent in implementing intermediate solutions.

6.2 Evaluation of basic policy options

For the selection of the policy options as mentioned in the general section of the Omnibus project, the eligibility criteria formulated in the Ecodesign directive are relevant in order to decide whether or not the existing Ecodesign regulation should be terminated (option 2) and they are an important element in determining the expected performance when maintaining the existing regulation without any changes (option 1). Furthermore, the possibility of self-regulation (option 3) was investigated.

6.2.1 Economic significance

According to a recent CLASP analysis[118], which is based on the projections from the 2009 preparatory study as well as more recent market data from the European industry association Lighting Europe, around 1.5 billion NDLS were being sold in the EU-27 in 2010. CLASP estimates that around 4.4 billion lamps are being installed in that same year.

Over the period 2010-2030 the number of lamps per household can be expected to follow the usual upwards trend, but nonetheless the sales will decrease significantly as the incandescent bulbs with a short service life (1000 h) will be replaced by other lamp types with a (much) higher service life, such as halogens (2000h), compact fluorescents (6000h) and LEDs (>20 000h).

Although the CLASP analysis is approximate and can be improved, the order of magnitude is certainly enough to state that NDLS still represents –also in 2030-- an economically significant product group in the sense of Article 15 a) of the Ecodesign Directive.

6.2.2 Environmental significance

In the 2009 preparatory study and impact analysis, the most significant environmental impact of NDLS was found to be the energy use during operation. The mercury content of CFLs was mentioned as another relevant impact, but –as mentioned in the 2009 impact analysis—the total mercury balance of CFLs, weighing mercury content of the lamp versus diminished mercury emissions from lower electricity consumption, is also linked in a positive way to energy saving during operation.

CLASP developed a BAU ('Business-as-Usual') Scenario which shows a rapid decline in the remaining special-purpose incandescent lamp shipments, reaching zero by 2021. CLASP assumptions were that

- Halogen becomes a popular replacement for incandescent, however it starts to decline around 2015 and trends downward in response to Stage 6 in September 2016 which requires halogen lamps to achieve energy label B rating.
- CFLs peak in 2012 and then decline as the most suitable sockets for CFLs will then have long-life CFLs installed and consumers are expected not to fully embrace the technology due to warm-up time, mercury content and other issues.
- LEDs start to gain market-share, surpassing CFLs on a unit basis in 2015 and halogens in 2017.
- However, LEDs are very long life, thus once installed the socket is not available for replacement in the domestic setting for approximately 20 years – leading to peak in LED replacement lamp sales around 2020 and a gradual decline and levelling off by 2030 at around 200 million unit LED lamp sales per annum.

[118] CLASP, Estimating potential additional energy savings from upcoming revisions to existing regulations under the ecodesign and energy labelling directives -a contribution to the evidence base-, supported by eceee, 18 February 2013

The outcome of the analysis indicates that, in a baseline scenario with the existing legislation, the total electricity consumption would decrease from 112 TWh in 2010 to around 80 TWh in 2025-2030.

Table 6-1. Projected Sales, Stock and BAU Energy Consumption to 2030, Non-Directional Household Lamps

EU-27 projection	2010	2015	2020	2025	2030
Sales (million units)	1 485.0	1 036.7	883.0	522.3	380.7
Stock (million units)	4 377.0	4 580.2	4 927.7	5 201.7	5 556.2
Stock annual energy consumption BAU, (TWh)	111.92	106.82	89.07	81.49	79.56

In 2010 this means that NDLS constituted 4% of total final electricity demand in the EU27. This is comparable to the electricity consumption of a country like The Netherlands. In 2030, depending how the total electricity consumption in the EU develops, it will be slightly less –perhaps 3% (c.p.)-- but still very significant.

6.2.3 Saving potential

The energy savings scenarios developed by CLASP for non-directional household lamps all assume that new ecodesign regulations come into effect in two steps – a Tier 1 requirement with an EEI of 0.24 (energy label class A) and a Tier 2 requirement with an EEI of 0.17 (energy label class A+). The difference between the scenarios is essentially the timing of when the regulation becomes effective. These scenarios are based on the assumption that LED technology will be diverse, compatible and offer performance equivalent to products servicing these lighting applications today.

Table 6-2. Three Illustrative Policy Scenarios for Non-Directional Lamps (CLASP 2012)

Scenario	Ecodesign
1	Tier 1 at EEI ≤ 0.24 from 2019 Tier 2 at EEI ≤ 0.17 from 2022
2	Tier 1 at EEI ≤ 0.24 from 2018 Tier 2 at EEI ≤ 0.17 from 2021
3	Tier 1 at EEI ≤ 0.24 from 2017 Tier 2 at EEI ≤ 0.17 from 2020

Table 6-3. Table 3. Projected Annual Energy Savings to 2030, Scenarios 1-3, Non-Directional Household Lamps (CLASP 2012)

Scenario	2010 (TWh/yr)	2015 (TWh/yr)	2020 (TWh/yr)	2025 (TWh/yr)	2030 (TWh/yr)
Scenario 1	-	-	12.4	21.3	16.0
Scenario 2	-	0.1	18.6	22.9	17.4
Scenario 3	-	0.1	25.2	24.1	18.6

CLASP mentions that across the EU, non-directional household lamps are projected to consume 89.1 TWh of electricity in 2020. The energy savings estimate from Scenario 2 is **18.6 TWh** in that year, or approximately

21% of the baseline. By 2030, the baseline energy consumption is 79.6 TWh of electricity and the energy savings estimate from Scenario 2 is **17.4 TWh**, or 22% of the baseline.

On the technological progress CLASP states that halogen technology has some room for improvement through the use of infrared reflective coatings, low voltages and improvements to halogen capsules. CFLs are only expected to experience minor improvements in performance, as they are already a mature technology and are not the focus of any significant research and development investment. LED technology, on the other hand, is the subject of large research investments, on every aspect of an LED lamp, from chip and package-level improvements through to the LED driver and optical performance. However, CLASP mentions that *'LED technology.. currently relies on rare earths and other precious material, and future research should investigate the possibility of increasing material efficacy.'*

The table below combines the efficacy figures with the MV LED retrofit (500 lumen) price projections by lighting manufacturer's association LightingEurope up to 2020 and –estimated by VHK—a plausible extrapolation of these prices up to 2025.

Table 6-4Technological progress Mains-voltage LED retrofit lamp, efficacy and price projections EU

Year	2012	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2030
lm/W	58	93	99	105	112	118	125	130	134	138	142	169
price in €	18.0	10.0	9.0	8.5	8.0	7.5	7.0	6.5	6.0	5.5	5.0	2.5

(sources: for efficacy CLASP 2013, based on US DoE MYPP projections; for EU lamp consumer prices incl. VAT (500 lm lamp) up to 2020 LightingEurope; 2021-2030 prices, extrapolation VHK)

New technologies that should increase the LED efficacy include

- Improvement of diode source efficacy through new materials/alloys to increase initial lumen output. Especially, in the interest of producing high efficacy RGD LEDs, there is a new focus on the luminous efficacy of the Red (R) and Green (G) LEDs that reportedly are lagging behind the Blue/UV (B) LEDs. The losses of the colour mixing optics remain an important subject for optimisation. Latest R&D efforts show an increased effort in hybrid LEDs, a mix of both phosphor-converted and discrete monochromatic LEDs.
- Optimisation of phosphors and phosphor combinations in white and hybrid LEDs to lower optical and Planck losses, while improving colour rendering. Also the lay-out and geometry of the phosphor layer versus the diode is a subject of optimisation. At the same time there are attempts to get rid of the phosphors, and the rare earth materials contained therein, which have a significant environmental impact an constitute a risk in terms of security of supply. Start-up firms are looking into possible alternatives (e.g. silicon nanoparticles).
- Driver efficiency, longevity and provisions for dimmability (see par. 4.2.1). In this respect, one of the more interesting studies –although it is too early to tell whether this will ever become economical in a broad sense-- relate to the combination of LEDs and driver electronics on the same wafer.

These are just the a few new technologies in general purpose LED lighting that are currently explored. In a wider context, the combination of starting from laser light and phosphors –such as in the recent PHASER® technology used in image projection and light guidance—might in the long term be an interesting direction.

It is outside the limited scope of this omnibus-study to give a detailed technical discussion of all developments. For a more comprehensive review, available in the public domain, the authors refer to the publications of the US Department of Energy on Solid State Lighting.[119]

6.2.4 Self-regulation

As with all products discussed in this omnibus review self-regulation is the preferred option, if all criteria are met. However, as with other products, the industry has not offered, nor has it indicated any intention to offer in the near future, to engage in self-regulation that would meet the required criteria.

6.2.5 Preliminary conclusions

The conclusions from the three preceding paragraphs are that

a) The baseline projections show that over the period up to 2030 the current legislation (the BAU scenario) is effective in reaching another 32 TWh of energy saving and thus Option 2, termination of the existing legislation, can be discarded;

b) Industry has not taken any initiative regarding self-regulation; hence Option 3 can be discarded.

c) The preliminary energy scenarios show that an additional saving potential of around 20% of the baseline, around 18 TWh annually in 2020 and 2030, would still be feasible through more ambitious Ecodesign requirements. Hence it is worthwhile to investigate Option 4, i.e. determine whether revised requirements can be designed that meet the boundary conditions of the Ecodesign Directive regarding Least Life Cycle Costs, acceptable Payback Periods, no significant negative impacts and then still generate energy savings that will exceed those of the baseline (Option 1) .

6.3 Revision

As policy options 2 (termination) and 3 (self-regulation) were discarded in the previous chapter, the possibility of a review of the requirements, timing, etc. of the existing regulation (option 4) is explored and the possible savings against the baseline (option 1, no change) are calculated. This includes a first assessment, as far as available data allow, of the economic consequences of setting targets at a technically feasible level identified earlier. It also entails an assessment of whether a new regulation can be designed avoiding significant negative referenced in the Ecodesign Directive.

6.3.1 Target: Least Life Cycle Costs

The Ecodesign Directive aims to set the minimum requirements at the Least Life Cycle Costs of the products, i.e. the sum of the acquisition costs and the discounted accumulative running costs over product life. If, between 2012 and 2020, the luminous efficacy per unit (in lm/W) doubles and the unit price drops by almost 60% then there are good grounds to assume that an 'A' or 'A+' level will be economical.

The draft of the Stage 6 study illustrates the case of the payback period[120], using 2016 parameters for LED and mains voltage halogen ('MV-HL') retrofit lamps. Note that currently, after the phasing out of most incandescent bulbs, the MV-HL lamps constitute the product with the lowest purchase price.

[119] See US DoE/EERE website on Solid State Lighting program. Various annual publications on state of the art, US sponsored research projects. http://www1.eere.energy.gov/buildings/ssl/

[120] The Payback Period, in years, is an economic parameter in investment decision making and –simply put—calculates how long it takes before the discounted gain in running costs equals the extra investment costs of two (or more) alternative options. The application of this parameter in Ecodesign analysis is explained in MEErP 2011. In case the two options have the same product life, the payback period is the ratio between the extra investment and the total discounted gain in running costs over product life. If --as is currently the case-- the discount rate equals the escalation rate, then explicit discounting to Net Present Value can even be omitted. In

The MV-HL lamp has 36W power (500 lm, 14 lm/W, energy label Class C), 2000h product life and a list purchase price of € 3. The equivalent LED lamp is expected to have 5.4 W power (500 lm, 93 lm/W), 20 000 h product life and a list price of € 10. Both are assumed to have an operating time of 500h per year and thus the MV-HL uses 18 kWh/year (€ 3.96/year in electricity at a 2016 electricity rate of € 0.22/kWh) and the LED lamp uses 2.7 kWh/year (€ 0.60/year at the same rate). Both the discount rate and the escalation rate are 4% (Present Worth Factor PWF = Product Life).[121]

Table 6-5. Table 5. Calculation of 'payback period' of LED versus MV HL retrofit lamp, basis EU 2016*

(Numbers in constant 2016 Euro)

Description	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
LED price	€ 10.00					
LED accumulated running costs	€ 0.60	€ 1.20	€ 1.80	€ 2.40	€ 3.00	€ 3.60
LED total	€ 10.60	€ 11.20	€ 11.80	€ 12.40	€ 13.00	€ 13.60
MV-HL accumulated write off (price/4)	€ 0.75	€ 1.50	€ 2.25	€ 3.00	€ 3.75	€ 4.50
MV-HL accumulated running costs	€ 3.96	€ 7.92	€ 11.88	€ 15.84	€ 19.80	€ 23.76
MV-HL accumulated total	€ 4.71	€ 9.42	€ 14.13	€ 18.84	€ 23.55	€ 28.26
accumulated cash saving LED vs. MV HL	-€ 5.89	-€ 1.78	€ 2.33	€ 6.44	€ 10.55	€ 14.66

The table above illustrates that, using 2016 parameters and list prices, the expected 'payback period' of LED versus MV HL lamp is around 2.4 years at 500h/yr. At an operating time of 250h per year, instead of 500h per year, the payback period would be 4.2 years.

Using 2021, i.e. the median year of the 2016-2025 period, the parameters would change again considerably. The LED lamp would then cost € 7/unit, the electricity rate would be € 0.266/kWh [122] and LED efficacy will be 125 lm/W. The result is a payback period of 1.4 years at 500 h/yr and 2.4 years at 250h/yr. The table below summarizes the results for the years 2012, 2016 and 2021.

Table 6-6. Payback periods, in years, LED vs. MV-HL retrofit 2012-2016-2021

operation hours per year	investment year		
	2012	**2016**	**2021**
500 h/year	5.0	2.4	1.4
250 h/year	8.8	4.2	2.4

case the two options do not have the same product life, the discounting can still be omitted, but otherwise the above simple method is not valid. The calculation of a 'payback period' then entails the point period in time where the accumulated write-off of the shorter-lived product (e.g. MV HL) plus its running costs equals the purchase cost plus running costs of the longer-living product (e.g. LED).

[121] the effect of discounting of multiple MV-HLs purchased in the future, which works in favour of MV-HL in terms of payback, is small and therefore not taken into account.

[122] In constant 2016 euros

6.3.2 Avoiding significant negative impacts

Functionality

Commission Regulation 1194/2012 sets minimum functional requirements for directional and non- directional LED light sources. From the 1st of September 2013, minimum requirements apply for

- the number of switches before failure (half the product life in hours, with a maximum of 15 000 switches),
- starting time (< 0.5 s),
- lamp warm-up time (<2s to reach 95 % Φ), premature failure rate (≤ 5.0 % at 1 000 h),
- colour rendering (Ra) (≥ 80, if the lamp is intended for outdoor or industrial applications[123]),
- colour consistency (maximum variation of chromaticity coordinates within a six-step MacAdam ellipse[124] or less),
- lamp power factor (PF) for lamps with integrated control gear (P ≤ 2 W: no requirement; 2 W < P ≤ 5 W: PF > 0.4; 5 W < P ≤ 25 W: PF > 0.5 ;P > 25 W: PF > 0.9)

From the 1st of March 2014 additional minimum requirements will apply on

- the lamp survival rate (>90% at 6000h[125]) and
- lumen maintenance (>80% at 6000h).

These requirements cover large part of the functional concerns related to using LED light sources as the only type of NDLS allowed. Nonetheless, considering that all CFLs and halogen NDLS would be phased out, there are currently still concerns on:

- Dimmability. Not all LED lamps are dimmable, and those that are dimmable are not compatible with all types of dimmers. In particular for installations that are currently using filament (e.g. halogen) light sources this may mean that owners will have to replace much more than just the light source in order to obtain a roughly similar environmental performance.[126]
- High temperatures. As opposed to filament lamps, LED lamps suffer from high temperatures. This negatively influences longevity and/or limits the amount of lumen in applications such as traffic lights in hot climates[127] or luminaires that do not allow the light sources to get rid of the surplus heat. In a 'LED only' regulation, high-temperature applications (e.g. oven lamps, lighting in certain emergency situations) will probably have to be exempted.[128]
- Dimensions and lock-in effect. Retrofit LED lamps require a minimum geometry to house heat sink(s) and integrated driver (power supply). This poses a problem for retrofitting very small lamps like e.g. the G9 mains voltage halogen type. Furthermore, although the currently available LED lamps cover the most popular form factors and caps, not all types are yet covered. Due to this lock-in effect of current non-LED types there would be several situations where consumers would be forced to replace not only the lamp but also the luminaire.

[123] In accordance with point 3.1.3(l) of Annex III of Commission Regulation 1194/2012.

[124] Ellipse-shaped colour region in a chromaticity diagram where the human eye cannot see the difference with respect of the colour at the centre of the ellipse. MacAdam ellipses are used e.g. in standards for describing acceptable colour deviation between LED lamps/luminaires of the same model (1 step=1 ellipse area; 2step=2 concatenated ellipse areas, etc.)

[125] The intention is to ascertain a minimum product life (lumen maintenance >70%) of around 20 000 h. The period of 6000h at the mentioned parameters values was defined to limit costs for compliance testing.

[126] See ibid. 23.

[127] Especially in climates with large day-night temperature differences

[128] Lighting Europe comments that there are also problems in general lighting, e.g. the obligatory fire-rated type of down lights in the UK, in which LED retrofit operating temperatures are typically 30°C higher than ambient, and lamp lifetime is then typically reduced to about 15% of the declared value.

- Power supply compatibility. In principle, appropriate low voltage LED lamps can replace low-voltage halogens, using the existing power supplies, but the lower voltage and power demand reportedly may create some problems of the LEDs not working properly (e.g. flicker) or not at all.
- Driver longevity. Until recently, manufacturer's claims for LED lamp longevity could be found up to 100 000 operating hours. But now, not only due to temperature problems (see above), but also because of the limited longevity of the electronic (driver) circuitry, a product life of 20 000 to 25 000 hours is much more realistic and most manufacturers have adjusted their claims accordingly. Still, some technical experts suspect that 20 000 hours might still be problematic and further research is required.[129] This influences the monetary life cycle costs (current calculations in this report already start from 20 000 hours) and in particular the maintenance effort for premature replacement.
- Colour rendering remains a cause of concern. The question remains whether the minimum requirement of a CRI larger than 80 Ra is enough to gain universal consumer acceptance in general purpose lighting. Also, for special purpose professional applications 80 Ra may not be enough. Finally, in recent consultations[130], NGOs mentioned that the appropriateness of the current CRI-metric and testing is under debate. [131]
- Special purpose lamps. Although between 2009 and 2012 there has been considerable progress in lighting-related legislation on the definition of 'special purpose lamps', and thus exempted from requirements, it still remains an elusive subject. In order to not only avoid loopholes in legislation but also to certain functionally important lamp types are not phased out unintentionally, this subject needs to be thoroughly looked into (see also the special report on the subject in the underlying omnibus study).

All in all, the question if and when the above functional problems can be solved is vital in deciding whether in 2021 the 'minimum A+' ('LED only') strategy can be made mandatory through an Ecodesign regulation. The answer to this question is complex and most certainly requires a follow-up study.

In the (written comments following the) stakeholder meeting, several participants supported this position. In particular the consumer association ANEC/BEUC reported that its members have intensified their activities through international comparative tests of different lighting technologies such as halogens, CFLs and LEDs. So far, 36 halogen models, 86 LED models and 255 CFL models with E27 caps have been tested since 2011.

Regarding luminous efficacy, ANEC/BEUC confirms the considerable efficiency improvements in LED lamps to levels exceeding 80 lm/W, while 'eco' halogen bulbs that are stated to save 30-50% over conventional incandescent bulbs hardly reach a 15% improvement.

However, when it comes to functionality features, in terms of light quality, LEDs (and, as expected, also the CFL's) cannot provide equivalent quality of light to halogens. ANEC/BEUC members only found 10 models out of the 86 with a CRI higher than 90. No LED is capable of reaching a full colour spectrum. The consumer consortium expresses reservations about the correspondence of this good CRI performance to the light quality of the light bulb and fears that such a high CRI score stems from technical adjustments, which does not ensure LED light quality equivalent to halogens. We would therefore advocate in favour of the development of a light quality measurement that corresponds to the nature of the LED technology.

In order to justify the switch to LED technology, the available products must meet both the expected energy efficiency as well as lifetime expectations. ANEC/BEUC recognises that the prices of LEDs are rapidly

[129] Technical expert meeting regarding the study on the Stage 6 Review (ibid. 23) , April 2013.
[130] Ibid 36.
[131] Sylvania comments that In consideration of the fact that CRI 80 class linear fluorescents are specified as being the desired sources for the vast majority of new professional lighting installations, plus the fact that making e.g. Ra90 a minimum requirement for LED would lead to significant increases in cost per lumen for LEDs which may hinder rather than help LED sales, Sylvania would not welcome a strengthening of the minimum CRI requirements.
However Sylvania could appreciate the value of, for instance, requiring a minimum value for the red colour rendering of R9=Zero so as to exclude the lowest end of the current Ra80+ products.

decreasing over the past years but consumers must be able to trust that their investment in a more expensive technology will be returned through the long product lifetime. Three aspects associated with the durability of the product were investigated by ANEC/BEUC members: lumen maintenance, durability over a number of switching cycles and the lifetime of the product after certain burning hours. When it comes to light decrease and switching cycles, LEDs seem to perform very well even after 30.000 switching cycles. However, when it comes to burning hours, problems were encountered even after a restricted number of tested hours (13% failure rate before 5000h with 57 models tested in 2011). The proper heat dissipation in luminaires plays an important role in this respect. ANEC/BEUC recommends that the lamp lifetime information provided to consumers be truthful, i.e. indicates a lifetime reached by most samples of a same model.

The full text of the ANEC/BEUC input, including tables with test results, can be found in the annex with written stakeholder comments.

Environmental

The production of LEDs requires materials whose mining and manufacturing require significant amounts of energy and cause significant emissions. To address this concern, the US DoE commissioned Navigant to perform a life cycle energy analysis, looking into the overall energy life cycle energy impact especially for production and during operating life. [132] Based on literature sources, Navigant found the values for manufacturing energy of various lamp types as given in the table below.

Table 6-7. Manufacturing energy for lamp types, in MJ per 20 million lumen hours

Manufacturing Process	Incandescent			CFL			2011 LED (16 LED Packages)			Future 2015 LED (5 LED Packages)		
	Min.	**Avg.**	**Max.**	**Min.**	**Avg.**	**Max.**	**Min.**	**Max.**	**Avg.**	**Min.**	**Max.**	**Avg.**
Bulk Lamp Material	10.1	42.2	106	11.3	170	521	38	87.3	154	25.4	58.5	103
1 LED Package1	N/A	N/A	N/A	N/A	N/A	N/A	0.12	83.5	16	0.11	76.2	14.6
Total LED Packages contribution	N/A	N/A	N/A	N/A	N/A	N/A	1.9	256	1336	0.54	73	381
Total	**10.1**	**42.2**	**106**	**11.3**	**170**	**521**	**39.9**	**1490**	**343**	**25.9**	**132**	**484**
Source: Navigant for US DoE 2012.												

The table shows the significant impact of the current LED production. However, when set against the energy saving during product life, the influence of the manufacturing on the total energy balance is still very small, as is shown in figure 6-2.

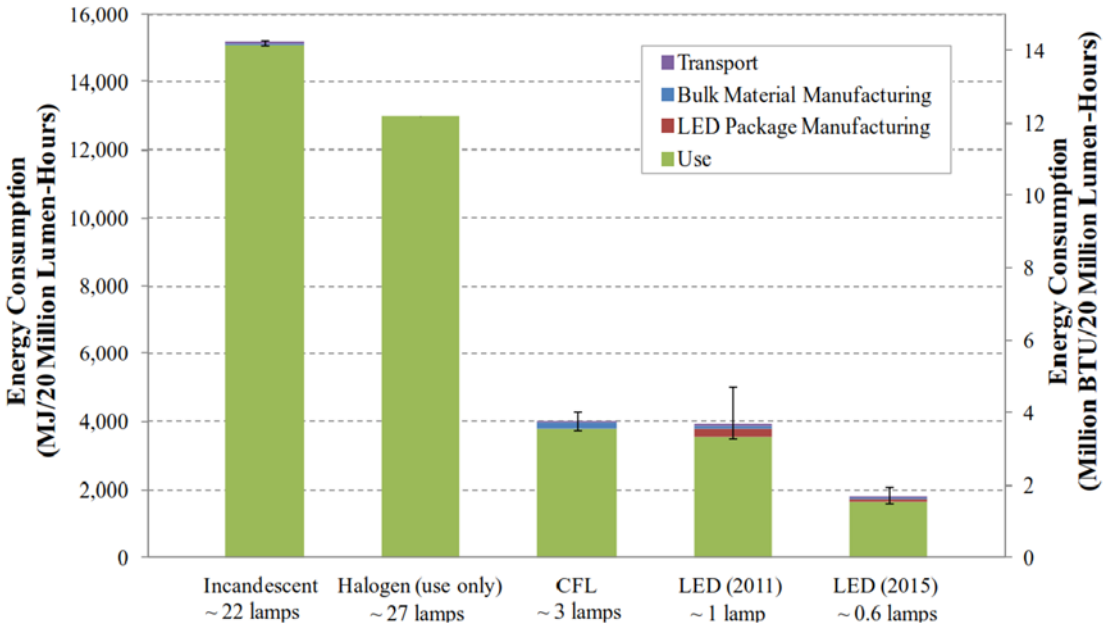
This is reassuring and it can be expected that also the emissions balance, weighing production emissions against the emissions of power plants, will largely show a similar balance.

On the other hand, given the significant material resources of LEDs, it may be worth investigating whether simple measures (e.g. information requirements), also weighed against the administrative burden, would allow policy makers to keep taps on this materials resources issue and would incentivise recyclers to make the

[132] US Department of Energy, Life-Cycle Assessment of Energy and Environmental Impacts of LED Lighting Products, Part I: Review of the Life-Cycle Energy Consumption of Incandescent, Compact Fluorescent, and LED Lamps, Navigant Consulting for US DoE, February 2012/Updated August 2012.

extra effort to recycle this product. Such an assessment can only be made with stakeholders and is outside the scope of the underlying omnibus study.

Figure 6-2. *Energy use of various lamp types in production, distribution and use* (source: Navigant 2012)



The consumer association ANEC/BEUC also looked into the environmental impacts. It found that energy efficiency is dominant (see also next paragraph), but thinks that the production impacts of a scenario where LEDs would replace CFLs should not be neglected when the durability of the light bulb does not correspond to the claim. The biggest difference is in the amount of metal used and on the electronic circuit as LEDs use much more aluminium, copper and zinc than CFLs. With regards to the use of lead, cadmium and chromium, LEDs are comparable to CFLs but use much less mercury. This is particularly important in the case of LEDs since they use a higher quantity of materials than CFL's and in order to really replace CFL's, from a global point of view, LEDs should be able to guarantee that they will indeed last as long as they claim and they will consume less energy than they currently do.

Affordability and Life Cycle Costs for the consumer

As indicated in par. 6.3.1, if the LED lamps will meet projections in terms of luminous efficacy, price and longevity, the payback period for replacing even the least used lamps in the household with LED lamps will not exceed 2.4 years and for lamps with an average use the payback period will be in the range of 1-1.5 years.

In terms of Life Cycle Cost and affordability this means there should not be a significant negative impact in the majority of cases. But in the cases mentioned in par. 6.3.2, where LED lamps cannot physically replace the existing filament or CFL lamps or cannot meet the functional requirement, the affordability may become an issue, because in those cases the user would have to replace the whole luminaire and perhaps even the control system (dimmers, sensors, etc.).

The affordability issue, in 2020, will thus be very much linked to the issue of functionality and, in case certain functional issues cannot be resolved in time, whether it will be possible to formulate clearly and without loopholes the specific case for exemptions. This is outside the scope of the assignment.

Consumer association ANEC/BEUC mentions that labelling regulation 874/2012 more or less adopted the EEI-curves from the old regulation and added A+/A++ classes. Nevertheless, the curves still refer to lighting properties of conventional light bulbs. As it is the case with other product groups, the escalation to A+ and A++ classes is not linear (A+ is not twice as good as A; A++ is not twice as good as A+) and the consumer association believes that this is not providing transparent information to consumers.

Industry competitiveness

As regards the competitiveness of the EU industry, it is relevant to know that

a) a 'LED only' strategy means that all CFLs and halogen lamps will have to be phased out and that therefore the remaining production plants would either have to be closed or converted, and

b) EU industry does not produce light emitting diodes for general lighting purposes. The existing LED plant in Regensburg (D) produces LEDs for special applications and is deemed, according to recent consultations, too expensive for general purpose LEDs. As regards LED-lamps (the manufacturer of the lamp from the diodes), Lighting Europe (LE) reports manufacturing in Treviso (OSRAM), Erlangen and Tienen (SLI[133]) as well as Nagykanisza (GE[134]). Luminaires are made in many Member States already, e.g. LED modules and systems are made in Pila, Poland (Philips). CLASP mentions that a significant number of small- and medium-sized enterprises (SMEs) are entering the LED-lamp market.

These issues require careful consideration regarding the social-economic impact of future measures, also from the perspective of how lateral EU and Member State initiatives in a wider context may contribute in avoiding as much as possible negative impacts. These are complex items that need to be investigated, in consultation with stakeholders, in a follow-up study.

Furthermore, in their written comments to the draft report the German Umweltbundesamt (UBA) raised the question of e.g. potential material supply problems for LED technology and stated that the analysis of potential risks of material supply shortages should be a vital part of a follow-up study.

Imposing proprietary technology

All companies involved in producing light sources, including their suppliers, are heavily investing in Research and Development (R&D) in the field of LEDs and they try to protect their progress –big or small—by taking patents. This is a normal situation and cannot be interpreted as a significant negative impact. What would be a significant impact, if the legislation were to prescribe implicitly or explicitly a technology or level of performance that is only achievable by using the patents by one or a restricted group of manufacturers.

This is not the case. The fact alone that all manufacturers are investing in R&D implies that they all see no legal barriers to be successful in the LED market.

Imposing excessive administrative burden

NDLS have been subject to mandatory measures since 1998 that require testing and labelling and it cannot be expected that with an 'LED only' strategy there will be any change in administrative burden for either manufacturers or Member States (and their institutes that check for compliance).

Of course, any new regulation will require some administrative effort, but this is minor and not excessive in the light of the expected savings and the administrative burden of alternative strategies to reach such savings.

In this context, there are two (minor) comments that can be made:

a) A 'LED only' strategy will probably require a review of the current definitions of exceptions (e.g. 'special purpose lamps'). This may take some getting used to (extra effort) in the beginning for authorised bodies checking compliance. Furthermore, if the EU considers following the US strategy, described by the recent CLASP report, of weighing their own estimates of shockproof and other special purpose incandescent lamps against industry reports, this would require an extra effort. The necessity of such a step (or similar measures) will be discussed in a special report.

b) Largely due to the continued technological progress in LED research also the test standards for LEDs continue to change and have becoming a 'moving target' for R&D. In the latest US reports on solid state lighting, several companies complained about the large administrative burden of this continuous

[133] Havells Sylvania
[134] General Electric (Lighting)

change in test standards. The reasoning was that, apart from the direct costs, the dynamics in test standard development stifled their efforts in reducing the production costs of the LED lamps.

As regards the second item, it is understandable that the industry wants to capitalise on R&D and production investments as soon as possible and that the continuous technical advancements do not create the stable conditions that are needed for production cost optimisation. On the other hand, given the considerable improvement potential still ahead, it does not (yet) seems appropriate to stifle innovation just for the sake of cost reductions. On the long term, and this may be in 2020, it can be expected that such a more stable and evolutionary environment for standardisation will exist.

6.4 Conclusions

The review of Commission Regulation 244/2009 in this omnibus study indicates that

- NDLS represent an economically and environmentally significant product group, with annual sales of 1.4 billion units (2010) and an electricity consumption that is currently 4% of EU demand.
- The energy saving potential, beyond what will be realised through the existing regulation, is still an extra 20% (18 TWh/year) in the years 2020 and 2030.
- This saving is technically feasible through setting targets that are at the energy label level 'A+' in 2020/2021. This would phase out CFLs and halogen technology and implies that all NDLS-technology is to be based on LEDs (and possibly OLEDs at a later stage).
- If LED lamps meet current projections for 2020, the payback period of the average LED lamp with respect of cheaper alternative of a mains voltage halogen lamp will be around 1.5 years at the above mentioned target level.
- However, there are considerable uncertainties when and how a revision of the existing regulation should be implemented in order to minimise possible negative impacts in terms of functionality, affordability and industry's competitiveness.
- Addressing these uncertainties, in consultation with stakeholders, would require a comprehensive follow-up study. Such a follow study could also look into the possibility of a holistic approach whereby the regulations for all lighting products (including 245/2009 and 1194/2012) are treated in a single piece of legislation.

The matter of special purpose lamp types, verifying that they are not used for general lighting purposes, will be addressed in a separate, special section of the omnibus study.

Acronyms

bn	billion (10^9)
CCT	Correlated Colour Temperature
CFL	Compact Fluorescent Lamp
CRI	Colour Rendering Index
DLS	Directional Light Sources
E14/E27/B22/B15	smaller and larger screw (E) and bayonet (B) lamp cap-types
EC	European Communities (legislation before Dec. 2009), European Commission
EED	Energy Efficiency Directive
EPBD	Energy Performance of Buildings Directive
EU	European Union (suffix for legislation after Dec. 2009)
G9	cap-type for a two-pin (9 mm apart, heart-on-heart), single ended, mains voltage halogen lamp cap
h	hour(s)
HID	High Intensity Discharge (lamp)
LCA	Life Cycle Analysis, environmental
LCC	Life Cycle Costs, monetary
LED	Light Emitting Diode
LFL	Linear Fluorescent Lamp
lm	lumen (unit of luminous flux Φ)
lm/W	lumen per Watt (unit of luminous efficacy)
LPF	Lamp Power Factor
NDLS	Non Directional Light Sources
OJ	Official Journal
Pmax	maximum rated power
R&D	Research and Development
R7s	cap-type double ended halogen lamp with length 7 cm length
RoHS	Restrictions of Hazardous Substances (Directive)
UV	Ultra-violet (types UVA, UVB, UVC)

7. Tertiary Lighting

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Summary

This section of the omnibus assignment entails a (first) review of Commission Regulation (EC) No 245/2009 on Tertiary Lighting with regard to ecodesign requirements for fluorescent lamps without integrated ballast, for high intensity discharge lamps, and for ballasts and luminaires able to operate such lamps.

The structure of this review follows the general structure as described in the introductory section of the omnibus assignment. This section deals with the review of Regulation (EC) No 245/2009 on tertiary sector lighting.

For Regulation (EC) No 245/2009 on Tertiary Lighting the level of ambition is assessed: in general targets of above 100 lm/W for new lamps[135] around the year 2020 are feasible (technical/economical) and appropriate (see general annex on scope and special purpose lamps). Thus savings as projected by CLASP[136] are realistic.

The main conclusions from this review are that:

- New T5 fluorescent lamps with higher efficacy came on the market compared to the existing legislation, especially for the least efficient HO lamps; therefore raising the minimum requirements has to be reconsidered.
- It is also recommended to verify these declared fluorescent lamp performances and in this context to check if and how the permissible tolerance of 10 % in annex IV is or is not used in practice.
- The current state of art of HID lamps, available from different manufacturers, is well above stage 3 requirements in Table 10 of the regulation. Savings of up to 25 % are realistic and raising the future HID lamp target in the regulation can therefore be considered.[137]
- In relation to HID lamps there is a risk of imposing proprietary technology. [138]This needs to be further investigated as many of these lamps came only recently on the market, more in particular the manufacturing of special shape ceramic arc tubes and MH combinations.
- The regulation does not address all improvement potential available at system level, e.g. luminaires, installation and LED technology retrofits.
- Much energy can be saved by only replacing the lamp ballast. However this is not as obvious as retrofitting a lamp. Therefore it is advisable that more specific and supporting requirements are elaborated for luminaires with respect to this.
- The aforementioned conclusions confirm that technical savings of +5% up to +20% compared to BAU are technical feasible, therefore additional savings in the order of magnitude of 18 TWh [139] in 2030 are feasible by increasing efficacy requirements.

[135] LightingEurope comments that an efficacy target 100 lm/W is not retrofit lamps, because it would require new systems of gears, lamps and luminaires, i.e. users would have to buy new luminaires.

[136] CLASP, 2/2013, 'Estimating potential additional energy savings from upcoming revisions to existing regulations under the ecodesign and energy labelling directives'

[137] Lighting Europe (LE) comments that for HID lamps >=400 W users need quartz-MH lamps because there are no suitable ceramic-MH alternatives. Thus LE believes quartz-MH should be kept.

[138] LightingEurope confirms that there is a danger of monopoly situations for new high efficiency stand-alone systems (proprietary technology) and no lamp retro fitting is possible (specific control gear needed)

- There are still uncertainties when and how a revision of the existing regulation should be implemented in order to minimise possible negative impacts in terms of affordability and industry's competitiveness functionality.
- Addressing these uncertainties, in consultation with stakeholders, would require a comprehensive follow-up study.
- Such a follow-up study could also look into the possibility of a holistic approach whereby the regulations for all lighting products (including 245/2009 and 1194/2012) are treated in a single piece of legislation. This was abandoned in 2009 due to lack of time but still makes sense. This allows also integrating other elements such as dimming requirements and luminaires that are currently not in the regulation.
- Important remark: All lamp efficiency values used in this review are declared values by manufacturers and published in their catalogues or on their public websites.

The matter of special purpose lamp types, verifying that they are not used for general lighting purposes, will be addressed in a separate, special section of the omnibus study.

7.1 Introduction

This is a review study of Commission Regulation (EC) 245/2009 on Tertiary Lighting with regard to ecodesign requirements for fluorescent lamps without integrated ballast, for high intensity discharge lamps, and for ballasts and luminaires able to operate such lamps, in the context of the Omnibus project.

7.1.1 Existing Regulation 245/2009

Commission Regulation (EC) No 245/2009, implementing Directive 2005/32/EC of the European Parliament and of the Council with regard to ecodesign requirements for fluorescent lamps without integrated ballast, for high intensity discharge lamps, and for ballasts and luminaires, was published the 18th of March 2009 and entered into force two weeks later.

Commission Regulation (EC) No 347/2010 is amending Commission Regulation (EC) No 245/2009(hereafter 'the Regulation').

The legal context is Article 8 (Revision) of Commission Regulation (EC) No 245/2009, stating that 'The *Commission shall review this Regulation in light of technological progress no later than five years after the entry into force and present the result of this review to the Consultation Forum*.' Five years after entry into force means by 13 April 2014.

The scope is defined in Article 1 and Annex 1 of the regulation, this also needs a review but is discussed in this OMNIBUS review in a separate annex together with regulation 244/2009 on household lamps.

In Article 3 the Regulation sets Ecodesign requirements that are specified in Annex III of the Regulation, in 3 stages with an intermediate stage.

The possible phasing out is based upon achieving performance criteria like:

- colour rendering (Ra)
- efficacy (lm/W)
- lamp lumen maintenance factor

[139] CLASP, 2/2013, 'Estimating potential additional energy savings from upcoming revisions to existing regulations under the ecodesign and energy labelling directives'

- lamp survival factor

For HID lamps only the lamps that have an E27, E40 or PGZ cap are within the scope of the directive.

In the first stage (2010):

- Halophosphate Fluorescent Lamps (T8 linear, U shaped, T9 circular, T4 linear) were phased out.
- Standby losses less or equal to 1 W per ballast
- Fluorescent ballasts for current lamps in the market shall fulfil at least EEI = B2
- The term ballast efficiency was introduced
- Also several information requirements were introduced such fluorescent lamp rated lamp efficacy at 25°C and 35°C(T5) at 50 Hz (where applicable) and High Frequency.
- Extract on lamp efficacy requirement: LFL T8-36 W requires 93 lm/W (25°C)
  LFL T5-28 W requires 93 lm/W (25°C)
  LFL T5-39 W requires 73 lm/W (25°C)
- Extract on fluorescent ballast efficiency requirement:
  - T8-36 W class B2 ≥ 79.3 %
  - T8-36 W class A2 ≥ 88.9 %
- Table 17 on ballasts for fluorescent lamps contains rated/typical wattage for 50 Hz and HF operation. This also reflects the typical efficacy gain found for HF operation compared to 50 Hz, e.g. for the same lumen output a T8 '36 Watt' lamp needs typically 36 W at 50 Hz and 32 W at HF. HF power supply can only be provided with electronic ballasts.

In the second stage (2012):

- Halophosphate Fluorescent Lamps (T10, T12) were phased out
- For High Pressure Sodium and HPS / Metal Halide MH Lamps (E27/E40/PGZ12):
  - Set up established performance criteria for MH E27/E40/PGZ12 lamps
  - Standard HPS E27/E40/PGZ12 were phased out, this means that HPS lamps need an enhanced Xenon.
- Extract on lamp efficacy requirement:
  - HPS 70 W clear ≥ 90 lm/W
  - HPS 70 W not clear lamp ≥ 80 lm/W
  - MH 70 W clear ≥ 75 lm/W
  - MH 70 W not clear lamp ≥ 70 lm/W
- Standby losses less or equal to 0.5 W per fluorescent ballast
- Minimum efficiency for HID ballast, e.g. a 70 W HID lamp requires 75 % efficiency.
- introduction of minimum HID ballast efficiency and the obligation to make them available

In an intermediate stage (2015) the following lamps:

- High pressure mercury lamps are expected to be phase out
- High Pressure Sodium-Plug-in/Retrofit lamps (HPM replacement) are expected to be phase out

Extract on lamp efficacy requirement: other HID 50 W ≥ 50 lm/W

Note: The regulation 244/2009 (TBC) on household lamps is much stronger for CFLi lamps, e.g. a 50 W requires about 64 lm/W and CRI≥80 in regulation 244/2009 while any other 50 W HID requires only 50 lm/W in regulation 245/2009.

In the third stage (2017):

- Low performing MH E27/E40/PGZ12 lamps are phased out; in practice this means that 'quartz' MH lamps are phased out in favour of 'ceramic' discharge tube MH lamps.
- Compact Fluorescent Lamps with 2 pin caps and integrated starter switch (Reason: These lamps are phased out in stage 3 as they in practice do not operate on A2 class ballasts) are phased out.

- Ballasts for fluorescent lamps without integrated ballast shall have the efficiency: ηballast ≥ EBbFL, wherein EBbFL = Plamp/(2*sqrt(Plamp/36)+38/36*Plamp +1) for lamps between 5 and 100 Watt.
  For example: a 36 W T8 lamp ballast should have ηballast ≥ 87.8 %. This is far above the minimum class B1 requirement (Table 17) from stage 1 and is likely to commercially phase out magnetic ballasts in low cost applications. A side effect of phasing out magnetic fluorescent ballasts is an increase in efficacy gain for those lamps on HF operation, as discussed later on. More efficient magnetic ballasts require more copper and are expected to become too expensive for the market.
- More strict minimum efficiency for HID ballast, e.g. 70 W HID lamp requires 85 % efficiency

7.1.2 Tertiary lighting and regulation EU No 874/2012 on energy labelling of electrical lamps and luminaires

Regulation EU No 874/2012 on energy labelling of electrical lamps and luminaires is applicable from 1 September 2013 (except for cases listed in Article 9). This new labelling regulation applies also to tertiary lighting lamps and luminaires.

7.2 The option for more ambitious targets around 2020

For the selection of the policy options as mentioned in the general section of the Omnibus project with regard to regulation 245/2009.

7.2.1 More ambitious 2020 targets on fluorescent lighting

Recent developments on fluorescent lamps

After entry into force of the 245/2009 regulation, an important improvement was introduced for the T5-lamps. Thanks to better gas fillings and improved fluorescent powders, the new ‘energy savers’ or ‘eco-types’ are offering efficacies up to 114 lm/W at 35°C (this means in luminaires designed for T5-lamps) (excl. ballast losses). Also mercury amalgam technology is used to have a larger temperature range for energy-efficient applications and increasing therefore their efficiency in dimming mode.

For the T8-lamps, the main investments were made to reduce mercury content and changes in gas filling; also small improvements in lifetime and lumen maintenance were announced. Although research can possibly result in some more improvements, the leading manufacturers of lamps prefer to invest in LED solutions.

Traditionally fluorescent lamps are filled to a very low pressure with a mixture of Krypton and/or Argon. The gas filling reduces the required starting voltage for the discharge, protects the electrodes and adjusts the balance of ionised mercury atoms and randomises free electron movement in the discharge.

A relatively recent development[140] is the addition of Xenon to the gas filling, to achieve an additional energy saving over the krypton-filled T8 tubes. This technique is employed in the latest generation of 'Eco' series T8 lamps. Xenon causes a reduction in the discharge voltage, thus decreasing the power consumed by the tube on electromagnetic ballasts. It does however not account for a significant improvement in lamp efficacy - that is achieved in the Eco tubes by phosphor improvements. One primary drawback that has been identified with Xenon-filled Eco tubes is their sensitivity to ambient temperature variations. When operated under ideal conditions they can indeed achieve approximately 10% increase in efficacy over Krypton T8 types, but in many installations the light level is reduced dramatically if the ambient temperature is not suitable.

[140] http://www.lamptech.co.uk/Documents/FL%20Gases.htm

Another development[141] is the introduction fluorescent lamps filled with Neon in cases where a very high power loading per unit length of the lamp is necessary. Contrary to Krypton, neon can be used to increase the tube voltage. It is used most frequently in the HO and VHO high output. Neon is particularly destructive towards lamp electrodes, and it is customary to employ additional anode wires or plates to take some of the load away from the cathode coil, and thus minimise the life time reduction when using this gas.

Table 7-1 Fluorescent lamp parameters

Wattage [W]	Type	CRI	Colour temp [K]	Efficiency [lm/W @ 35°]	Efficiency [lm/W @ 25°]
28	HE standard	>80	4000	104	**94**
28	*HE regulation*				***93***
25	HE eco/es	>80	4000	114 (116)	**103**
28	HE standard	>80	6500	97	**88**
25	HE eco/es	>80	6500	106	**96**
24	HO standard	>80	4000	87	**78**
20	HO eco/es	>80	4000	99	**83**
24	HO standard	>80	6500	81	**72?**
24	*HO regulation*				***73***
20	**HO eco/es**	**>80**	**6500**	**93**	**77**

As already mentioned in the preparatory study[142] a significant efficacy gain for fluorescent lamps can be obtained with HF electronic ballasts compared to 50 Hz magnetic ballasts. Changing the magnetic ballast for a high frequency electronic in an existing luminaire is not obvious and is discussed with system level improvement options in a later section. In the third stage it is expected that magnetic ballast are economically phased out for new luminaires brought on the market (see discussion on existing regulation).

Table 7-2 Ballast parameters

T8 36W	Magnetic ballast(50 Hz)		Electronic ballast(HF)	
	Lamp efficacy(50 Hz)	System efficacy	Lamp efficacy(HF)[143]	**System efficacy**
1 x 36W	93 lm/W	80 lm/W	104 lm/W	**93 lm/W**
3 x 36W	**93 lm/W**	**80 lm/W**	**104 lm/W**	**100 lm/W**

Conclusion on technical feasibility of more ambitious 2020 targets related to fluorescent lamps

New fluorescent lamps with higher efficacy came on the market compared to the existing legislation, especially for the least efficient HO lamps; therefore raising the minimum requirement has to be reconsidered.[144]

[141] http://www.lamptech.co.uk/Documents/FL%20Gases.htm
[142] www.eup4light.net,
[143] Calculated values using the lumen-ballast factor, e.g. 104 lm/W= 93 lm/W x 36/32
[144] Lighting Europe points out the need to consider the system efficacy, not just the lamp datasheet specs. They say that If HO types are phased out, no replacement lamp will be available for many luminaires (the similar-sized HE types cannot be dropped in as retrofits due to the different ballast requirements). So the luminaire will have to be changed for a type accepting higher efficacy tubes whose luminous flux per unit length is always lower. To compensate for this and maintain lux levels in the installation, more lamps will have to be used and that also means additional ballasts (more electrical losses) and a second optic for the second tube (again more optical losses).Lighting Europe is of the opinion that these extra system losses will effectively negate the saving to be had by elimination of HO tubes.

It is also recommended to verify these declared performances and in this context to check if and how the permissible tolerance of 10 % in annex IV is or is not used in practice.

A clear benefit is switching from magnetic ballasts to electronic ballasts, which is approximately equivalent with switching in Table 17 (245/2009) from 50 Hz to HF wattage for the same lumen output. It is expected that this switch will take place in stage 3 for economic reasons.

Economic feasibility of more ambitious 2020 targets related to fluorescent lamps

Expected impact on industry competitiveness

Phasing out magnetic ballasts has a negative impact on the mainly European manufacturers, but this is already an expected consequence of the existing regulation.

The supply of noble gas and Xenon in particular might need a further follow up[145], up to our knowledge no problems are reported so far (needs confirmation by industry).

A potential weakness for fluorescent and LED lamps is their dependence on rare earth materials. Recently industry reported concerns[146]. As mentioned later on, HID lamps do not rely on rare earth materials giving them a benefit on this point.

Risk of Imposing proprietary technology

Fluorescent lamps are a well-established technology and it is expected that fundamental patents are therefore expired (i.e. 20 years).

Affordability and Life Cycle Costs for the consumer

Raising targets for T5 HO lamps are not expected to have any significant impact on LCC because of the relative low price of the lamp (4-5 euro/lamp).

Avoiding significant negative impacts on functionality

When considering a phase out of the least efficient HO fluorescent lamps, the impact on temperature sensitivity and life time should be further investigated.

7.2.2 More ambitious 2020 targets on HID lighting

Recent developments on HID lamps

High Pressure Sodium (HPS)

No considerable lamp innovations were introduced since 2007. The improvements are mainly found in improving lifetime. At this moment, lamps with still higher xenon-pressure are offering lifetimes of 24.000 hours with LSF and LLMF > 90%.

More important changes are introduced on the ballast side. The electronic, dimmable ballast has proved its sustainability and is widely introduced on the market. High pressure sodium lamps can easily be dimmed to 50% of their power, resulting in about 30% of light. Because HPS-lamps are mostly used in street lighting and traffic density is higher in the evening than during the night, dimming during the hours with low traffic can yield considerable energy savings.

Although electronic ballast for HPS-lamps doesn't result in a higher lamp efficacy, he gives lower power losses than an electro-magnetic one and so the system efficacy rises. Electronic, dimmable ballast can even provide additional energy savings.

Metal Halide (MH)

[145] http://www.huffingtonpost.com/2012/10/11/xenon-noble-gas-missing-atmosphere-minerals_n_1959207.html

[146] http://www.gelighting.com/na/business_lighting/rare-earth-elements/downloads/GE_RareEarthPaper_7.20.11.pdf

The most important MH innovations and improvements in between 2007 and 2013 were realized by optimising the ceramic arc tube shape. Many lamps from different manufacturers and for different lighting solutions are now offering better performances than the stage 3 requirements as published in Commission Regulation (EC) No 245/2009, Annex III, table 10.
Currently a lamp efficacy of about 100 lm/W appears to be realistic. Depending on the colour rendering and the nominal wattage, efficacies between 90 lm/W and 120 lm/W are already feasible. This was also confirmed by CLASP[147]. As the main manufacturers put all their efforts in R&D to the development of solid state lighting, much higher efficacies cannot be expected. Possibly lumen maintenance and lamp lifetime can still be improved. Different lamps with different caps, colour rendering and different efficacies for specific purposes are already available.

Electronic ballasts for MH lamps are also widely introduced and so the ballast losses are reduced. It must also be stated that many of the newly introduced lamps were especially designed to work on specified, electronic ballasts. Also for metal halide lamps, the electronic, dimmable ballast can offer considerable energy savings. For these lamps the dimmability is limited to 60% of the power that results in 55% of light. Dimming at less than 60% of the power can result in colour shifting of the light.

Table 7-3 HID lamp parameters

Wattage [W]	CRI	Colour temp [K]	Efficiency [lm/W]
Reg W≤55			***≥ 70***
20 *(cap G8,5)*	87	3000	**102**
45	66	2800	**110**
50	89	2800	**104**
50	90	4200	**100**
Reg 55<W≤75			***≥ 80***
60	73	2700	**120**
60	81	4000	**107**
70	87	3000	**105**
70	87	4200	**101**
Reg 105<W≤155			***≥ 85***
140	66	2800	**118**
150	90	3000	**100**
Reg 255<W≤405			***≥ 90***
315	90	3100	**115**
315	**90**	**4200**	**109**

High pressure mercury (HPM) are still expected to be phased out in the intermediate stage, no improvements are reported so far.

Conclusion on technical feasibility of more ambitious 2020 targets related to HID lamps

The current state of art available from different manufacturers is well above stage 3 requirements in Table 10 of the regulation. Savings of up to 25 % are realistic and raising the future target in the regulation can therefore be considered.

Economic feasibility of more ambitious 2020 targets related to HID lamps

Several manufacturers already offer improved ceramic metal halide technology, so no problems are expected.

[147] CLASP, 2/2013, 'Estimating potential additional energy savings from upcoming revisions to existing regulations under the ecodesign and energy labelling directives'

Expected impact on industry competitiveness

As many manufacturers of ceramic MH lamps are located in the EU, a positive impact is expected on industry by raising the minimum quality standard.

Risk of Imposing proprietary technology

This needs to be further investigated as many of these lamps came only recently on the market, more in particular the manufacturing of special shape ceramic arc tubes and MH combinations thereof.

Affordability and Least Life Cycle Costs for the consumer

A typical 70 Watt ceramic MH lamp with performances well above stage 3 requirements currently cost about 25 euro (end user price incl. taxes). With an electricity price of 25 eurocent/kWh this is equivalent to the electricity cost of 1000 h of operation. This is substantially below the lamp life time and therefore the lamp cost is not significant in the entire LCC. Hence, no negative but rather a positive impact on LCC is expected.

Avoiding significant negative impacts on functionality

As far as could be investigated there seems to be rather a positive synergy with colour rendering, colour temperature and stability.

7.2.3 More ambitious 2020 targets related to system level improvements

Recent developments on LED retrofit lamps and lighting

As LED lighting is winning market share, also in tertiary lighting, and no requirements are included in regulations 245 and 347, these requirements should be included in the review. The German UBA supports this view, as do several other stakeholders.[148] UBA further comments that 'efficiency and quality are at least in line with best-available fluorescent / HID technology. A "technology-neutral" approach could be taken as far as possible. Attention should be paid to the IEA 4E developments in this area.'[149]

A broad range of LED retrofit tubes is available on the market today; in many cases they have equal lumen output but already provide larger system efficiency in cases where directional light is needed. It is also expected that they will outperform fluorescent lighting on efficacy in the near future[150].

LED luminaires and luminaire output ratio

New luminaires are unlikely to be sold with LED retrofit tubes as integrated 'LED luminaires' can provide a more optimised solution.

As mentioned in the preparatory studies[151], there are also benefits in luminaire optics but this is outside the scope of the current regulation.

Functional lumen and/or efficiency of the installation

Lumens are only 'functional' when they are directed to the application, which is the responsibility of the lighting designer and installer. For example, in outdoor lighting uncontrolled upwards light can cause light pollution[152]. Changing the luminaire could often provide the largest saving, but this is outside the scope of this review.[153]

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[148] See Annex with written stakeholder comments
[149] See http://ssl.iea-4e.org/task-1-qualityassurance.
[150] http://www.luxmagazine.co.uk/news/37/philips-claims-world-s-most-efficient-warm-white-lamp
[151] www.eup4light.net
[152] http://www.lightpollution.it/cinzano/papers.html
[153] LightingEurope comments that Inclusion of luminaire efficiency will lead to complicate requirements. There are lots of different photometric luminaire designs on the market related to the large variance of luminaire applications which implies different quality

Luminaire lock-in effect and option for retrofitting ballasts in existing luminaires

As mentioned before, much energy can be saved by only replacing the lamp ballast. However, this is not as obvious as retrofitting a lamp. Therefore it is advisable that more specific and supporting requirements for luminaires with respect to this are elaborated. For example, many older luminaires can easily be retrofitted with new electronic ballasts so that the performance is raised or better performing lamps can be used. However this practice is currently not supported by luminaire manufacturers because they would withdraw their responsibilities connected to the CE and ENEC marking.

In the review could possibly be foreseen that a retrofitted model can get a legal approval so that qualified personnel can make these changes and that in this case the retrofitted luminaire keeps his markings.

7.3 Saving potential and review of CLASP study

For assessing the EU27 2030 saving potential the recent CLASP[154] BAU reference scenario provides an appropriate basis, see also the next table:

Table 7-4 Stock energy consumption 2010-2030 (estimates)

EU-27 projection	2010	2015	2020	2025	2030
Stock annual energy consumption (TWh), BAU	219	218	214	193	166

CLASP assumed the following extra savings from +5 to +20 % Increase in Efficacy Relative to EC No 245/2009 potential which obviously can result in savings up to **18.3 TWh/y** in 2030.

Potential savings of up to +5 % to + 20 %(HID) are also confirmed in previous sections; hence potential savings in the order of magnitude of 10 to 20 TWh in 2030 seem realistic which is in line with the CLASP study.

General stakeholder comments on tertiary lighting are in agreement with the main points:

German UBA appreciates the holistic approach of treating all three regulations in one, because it gives a better consistency and clearer definitions. E.g. at the moment LEDs are treated slightly different in various regulations. Also the definition of limit values is done in efficacy (lm/W) in Regulation 245/2009, whereas the other two light source regulations use a different approach. UBA is in favour of the latter approach.[155]

The Dutch Agentschap NL remarks that the revision of the various regulations should be an opportunity to streamline and simplify the regulations as much as possible. Making more regulations ever more detailed is not the way to go to make ecodesign and energy labelling implementation future proof. Therefore we suggest that the study provides suggestions to streamline and simplify regulations, including opportunities to harmonize with legislation outside the EU.

The 'green NGOs' (Topten and ECOS) states that the combination and streamlining of all lighting regulations would be a logical way forward and is therefore welcome. In case the regulations in the scope of this omnibus review are combined as proposed, the following points should be considered, among others:

- Define more ambitious requirements for LED lamp switching cycles (1194/2012): Stiftung Warentest has shown that it is possible and lamps that are able to be rapidly switched allow for large energy savings.

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parameters. These different technical designs creates also different energy efficiencies. A possible solution should therefore take care on the achievable energy efficiency level of each relevant luminaire design class. Investigations from the former CELMA together with the DIAL institute have lead to 34 different interior luminaire classes and to 25 different exterior classes.

[154] CLASP, 2/2013, 'Estimating potential additional energy savings from upcoming revisions to existing regulations under the ecodesign and energy labelling directives'

[155] See Stakeholder comments in the annex for further details

- Clarify the declaration obligation for LED luminaires (1194/2012): today manufacturers declare the product information for the lamps only, even if integrated in a luminaire, since the formulation is not clear. The measured power is often twice as high. It should be stated clearly (in 1194/2012) that the product information should be declared for the luminaire as well, including standby power.
- Introduce an Energy Label for tertiary luminaires based on the Luminaire Efficiency Factor LEF (874/2012): the background conditions supporting such a measure are good, since the relevant data is measured and declared by the manufacturers.

In the minutes of the stakeholder meeting (see Annex) similar comments can be found.

8. Special purpose lamps

Main author& final editing: VHK, Rene Kemna

Summary

This section of the omnibus study deals with the problem of 'special purpose' ('shockproof') non-directional incandescent light sources being misused for general lighting.

As far as available information allows, it was concluded that:

- There is a realistic EU-market of 8 million shockproof lamps per year
- On top of that, there are around 16 million units/year that are abusively sold for general lighting services, mostly from extra-EU imports
- The energy saving that is lost through the abuse varies between 0.32 to 1.3 TWh/year, depending on the alternative that consumers would have bought instead (halogen or CFL).
- The projected savings from Commission Regulation (EC) 244/2009 were 32 TWh/year and thus the EU misses out on 1 to 4% of these projected savings.

The misuse of special purpose lamps is not insignificant and undermines the credibility of the measures. It is not considered large enough to warrant the administrative burden of an immediate change of the legislation for this purpose only, but should be tackled at a general review of the relevant legislation. In the meanwhile, a large part of the solution may be found by not changing the legislation but simply increasing the market surveillance by Member States.

Options for the review of the legislation include:

- Explicitly lift the exemption for rough service lamps, because there are enough compliant alternatives, or
- Restrict the distribution of these lamps only to the professional channels, e.g. password-protected on-line sales or sales through shops that are accessible only for professionals and not the general public.
- Require a specific declaration on the lamp packaging of the technical characteristics that would make a lamp 'special purpose'.

More in general, the definitions of special purpose lamps in lighting related Ecodesign and labelling legislation should be made clearer and more consistent. Within the restricted resources and timeframe of the Omnibus project it was not proven possible to make a comprehensive technical proposal on this subject.

This work would require a comprehensive follow-up study.

8.1 Introduction

8.1.1 General context

In the Commission Regulations (EC) 244/2009, (EC) 245/2009 and (EU) 1194/2012 on various types of light sources 'special purpose lamps' are exempted from requirements. In the Commission Regulation (EC)

244/2009, recital (20), it is mentioned that '*A review of this measure should take particular note of the evolution of sales of special purpose lamp types so as to verify that they are not used for general lighting purposes*'. But also Member States and the industry association Lighting Europe have voiced concerns over what they perceive as significant quantities of special purpose lamps, especially shockproof incandescent bulbs that are being sold for general purpose lighting.

A recent CLASP study cited several anecdotal sources such as the UK media[156] and UK market surveillance authorities[157] that are concerned that '*several companies across Europe have started looking for ways to undermine regulation (EC) No 244/2009 by capitalising on the fact that the regulation has excluded 'rough service' incandescent lamps from the regulatory requirements.'*

Rough service lamps have a reinforced filament and tougher glass in order to enable them to operate in specialist applications where they are exposed to vibration and other harsh conditions. The thicker filament causes these lamps to have a 30% lower efficacy than the standard incandescent lamp covered by the regulation.[158] CLASP concludes that promoting incandescent lamps for non-household applications to the residential market may be mainly a matter of enforcement at the member state level, but may also raise issues of scope and definitions in the implementing measure and the topic should be included as part of the review.

CLASP reports that in the United States, the phase-out of inefficient lighting was accompanied with a series of measures to try and ensure that the objective of the regulation was not undermined. The legislation required the US Department of Energy to prepare a shipment forecast of five exempted lamp types[159] based on historic shipment data for those lamps. Starting in 2012, DOE obtains actual shipment data from the manufacturers association (NEMA) and compares the actual shipments of these lamp types to the projected shipments. If the actual shipments exceed the projected by 100%, then that lamp type loses its regulatory exemption and requirements are established for that lamp type within one year.

During the kick-off meeting of 3 July 2013 with Commission and industrial stakeholders (Lighting Europe), it was agreed to distinguish two parts of the special study on possible misuse of special purpose lamps:

- How big is the problem? (sales, energy saving missed) and
- How can it be solved? (e.g. regulation or surveillance)

In the specific contract for the omnibus study the subject is incorporated with the review of Commission Regulation (EC) 244/2009 on NDLS. But given the limited resources for the product-studies and the recent concerns voiced by Member States on the issue, the Commission indicated that the focus of the review study should be on the special purpose lamps.

During the kick-off meeting it was also discussed that the subject of special purpose lamps is relevant not only for possible misuse of Regulation 244/2009/EC, but also in the context of the other two lighting regulations that are clearly struggling to get a grasp on the definition of ' special purpose' .

8.1.2 Tasks

The exact definition, if any, differs in each piece of lighting-related EU legislation since 2009. In the interest of both determining the size of the problem and a possible solution an overview of definitions and interpretations of the phenomenon in Commission Regulations 244/2009, 245/2009 and 1194/2012 is given (Chapter 2).

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[156] CLASP mentions "Beyond the ban" by Pennie Varvarides, Lux Magazine, p.72, October 2012, but there are many more publications on the subject in the Telegraph, Daily Mail or in Germany Der Spiegel or Die Welt.

[157] The UK National Measurement Office (NMO) issued a guidance document on Rough Service lamps in October 2011. http://www.bis.gov.uk/assets/nmo/docs/eup/legislation/guidance/nmo%20guidance%20special%20purpose.pdf

[158] Comparison between a 100W incandescent lamp at 1550 lumens with a rough-service incandescent lamp at 1100 lumens

[159] The five exempted lamp types from the US regulation are: rough service lamps, vibration service lamps, 3-way incandescent lamps, 2601–3300 lumen general service incandescent lamps, and shatter-resistant lamps.

The largest challenge is the determination of the size of problem. 'Special purpose' (SP) can be split-up in more than 100 market segments. No market data exists in the public domain (nor probably anywhere else). Detailed sales data, if they exist, are confidential.

The approach is to estimate SP lamp sales and energy use from both 'top-down' and 'bottom-up' sources, for the most recent year. 'Top-down' means that any sales data on a type of specific purpose lamp, whether at country level or even stemming from another continent, is initially welcomed and translated to EU27 level (e.g. weighted by population, GDP or otherwise). 'Bottom-up' means that the sales are estimated from the number of users per market segment, the type of lamps used (rough split-up), the estimated lamp operating hours per lamp-type and the lifetime of the lamp.

The timeline for this approach, discussed during the kick-off meeting, is as follows:

- Initial input from stakeholders (asap): Industry and –if they have the knowledge– Member State experts deliver latest sales statistics, especially since 1 Sept. 2012 (e.g. LightingEurope sales data)
- Contractor makes first rough estimate. Probably within 2-3 weeks, i.e. around 20 July.
- Industry and –if appropriate– Member State experts amend EU data (this largely avoids the confidentiality issue). Deadline: End of August 2013.
- List is finalized and can be incorporated in intermediate report of the Omnibus project. Deadline: End of Sept. (intermediate draft from contractor to EC policy officer)

The authors made a preliminary estimate of the data for special purpose lamp applications.

The manufacturer's association Lighting Europe agreed to supply the latest market data (up to Q1, 2013) and agreed to review the preliminary draft list according to the deadlines mentioned.

The stakeholders, including the industry, will have an opportunity to react in writing to the intermediate report, that will be issued the beginning of October 2013, at the stakeholder meeting that was foreseen for the end October 2013 and –in writing and/or through bilateral meeting—within approximately one month after the stakeholder meeting.

New written comments, if necessary, can be given by stakeholders after the draft final report in December 2013.

Paragraph 8.3 will report specifically on the size of the problem and possible solutions regarding misuse of rough service lamps, which is the immediate concern for the review of Commission Regulation (EC) 244/2009.

Paragraph 8.4 gives preliminary conclusions and possible options.

8.2 Special Purpose lamps, legal definitions

This chapter looks at the legal requirements for a lamp to be qualified as 'special purpose', i.e. as being exempted from the requirements in the regulation. This is done not only for the definition in the Commission Regulation (EC) 244/2009, but also for the other two light source regulations in order to get a better grasp on the guiding principles of the legislator in defining 'special purpose'.

8.2.1 Special purpose NDLS

Commission Regulation (EC) 244/2009 [160]mentions the special purpose lamps in recital number 5 and in Article 1 of the regulation (see box).

[160] COMMISSION REGULATION (EC) No 244/2009 of 18 March 2009 implementing Directive 2005/32/EC of the European Parliament and of the Council with regard to ecodesign requirements for non-directional household lamps OJ, 24.3.2009, L76/3

Recital
(5) Products subject to this Regulation are designed essentially for the full or partial illumination of a household room, by replacing or complementing natural light with artificial light, in order to enhance visibility within that space. Special purpose lamps designed essentially for other types of applications (such as traffic signals, terrarium lighting, or household appliances) and clearly indicated as such on accompanying product information should not be subject to the ecodesign requirements set out in this Regulation.

Article 1
Subject matter and scope
This Regulation establishes ecodesign requirements for the placing on the market of non-directional household lamps, including when they are marketed for non-household use or when they are integrated into other products. It also establishes product information requirements for special purpose lamps.
The requirements set out in this Regulation shall not apply to the following household and special purpose lamps:

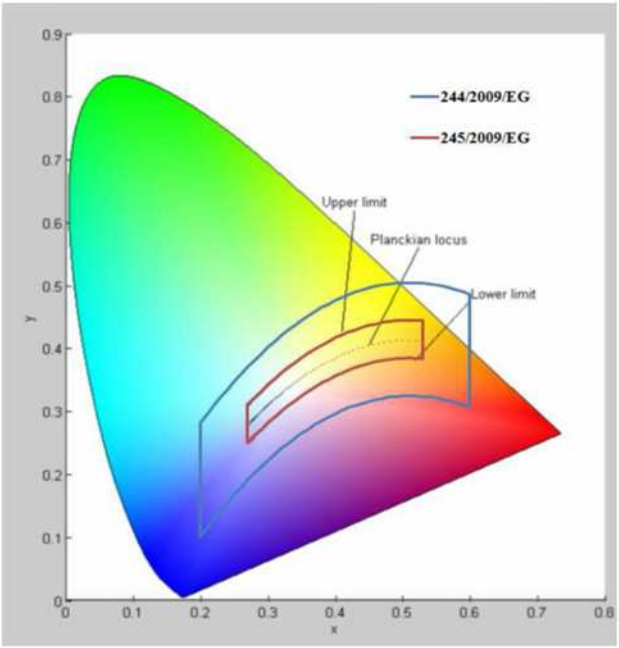
(a) lamps having the following chromaticity coordinates x and y:
— $x < 0{,}200$ or $x > 0{,}600$
— $y < -2{,}3172\ x^2 + 2{,}3653\ x - 0{,}2800$ or $y > -2{,}3172\ x^2 + 2{,}3653\ x - 0{,}1000$;
(b) directional lamps;
(c) lamps having a luminous flux below 60 lumens or above 12 000 lumens;
(d) lamps having:
— 6 % or more of total radiation of the range 250-780 nm in the range of 250-400 nm,
— the peak of the radiation between 315-400 nm (UVA) or 280-315 nm (UVB);
(e) fluorescent lamps without integrated ballast;
(f) high-intensity discharge lamps;
(g) incandescent lamps with E14/E27/B22/B15 caps, with a voltage equal to or below 60 volts and without integrated transformer in Stages 1-5 according to Article 3.

Article 2
Definitions
.
3. 'household lamp' means a lamp intended for household room illumination; it does not include special purpose lamps;
4. 'special purpose lamp' means a lamp not intended for household room illumination because of its technical parameters or because the related product information indicates that it is unsuitable for household room illumination;

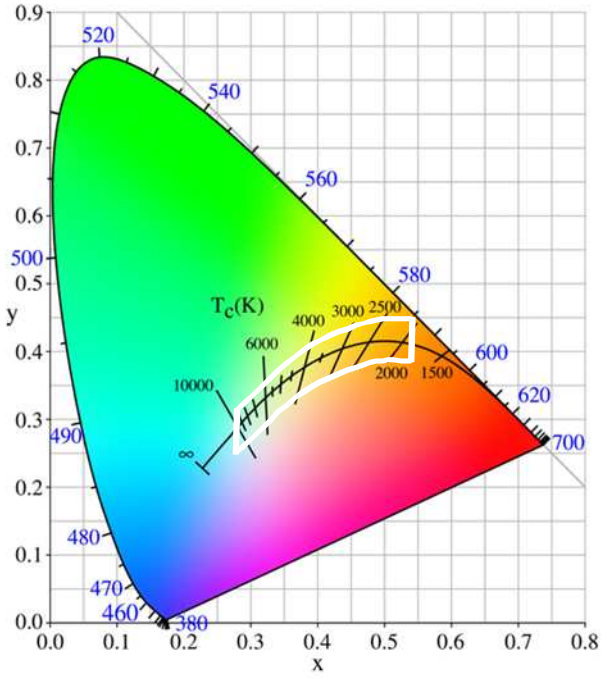
As regards special purpose lamps the regulation is not very clear, because it does not say anywhere directly that the regulation (or parts of the regulation) does not apply to special purpose lamps. This fact has to be deducted from the fact that the ecodesign requirements apply to 'household lamps' (Article 1) and that, following the definitions of Article 2, *'household lamps'* and *'special purpose lamps'* are mutually exclusive. This also explains the necessity to mention in Article 1 that the regulation *'also establishes product information requirements for special purpose lamps.'*

The criteria mentioned in Article 1 therefore do not serve to define 'special purpose lamps', but is just a list of criteria to exclude lamps in general from the application of the regulation. Nonetheless, when compared to the definitions in the other light source regulations, it does seem that Article 1 criteria a), c) and d) do relate to 'special purpose lamps'. For instance, the criterion a) relates to the so-called 'white light' (see figure below). Criterion c) allows certain low wattage (e.g. 11W incandescent), mainly decorative lamps with a light output less than 60 lumen and it also allows professional projection or spot (arc-) lamps with outputs of more than 12000 lumen. Criterion d) relates to UV (Ultra-Violet) lamps.

Figure 8-1. Chromaticity area in the scope of Commission Regulations on Light Sources



source: preparatory study lot 19; blue and red lines added by UBA



(Outside the white demarcation lines in the chromaticity.[161]

In contrast, Article 1 criteria b), e) and f) relate to lamps that are regulated elsewhere. The background of criterion g) is unclear: The typical lamps with these characteristics are (traffic) signalling lamps, but on the other hand there are also signalling lamps that operate at mains voltage (230 V) and they would then not be addressed.

[161] German UBA states that regulations 245/2009 and 1194/2012 should be adjusted to regulation 244/2009 in this respect. The EU industry sees it the other way around. This should be clarified in a follow-up study.

The conclusion of the above is, that, strictly speaking, the definition of what are special purpose lamps in practice is only hinted at in recital 5, which mentions the examples of traffic signals, terrarium lighting and (lamps in) household appliances.

The manufacturer's association previously known as ELC (now LightingEurope) issued a guidance document for its members, reflecting how they understood Recital number 5. This is given in the box below.

ELC Interpretation of Recital (5)

– special purpose lamps –
The list of special purpose lamps below shall serve as an interpretation and more profound specification of the stipulation in Recital 5 of the Regulation. It does by no means constitute any legal liability for ELC or its Member Companies and is given solely for informative purposes. ELC reserves the right to amend, update or delete this list without any prior notice.
Against this context, ELC regards the lamps types mentioned below as special purpose lamps in the application of Recital 5 of Commission Regulation 244/2009.

Petcare
o E.g. aquarium, terrarium
Anti-insect lamps
Disinfection
Tanning
Display optics lamps (< 12000 lumen) e.g.:
o Stage and studio lamps,
o Theatre lamps
o TV lamps
o Studio lamps
o Photo lamps – flash light of lamps or for the development of pictures
o Projection lamps
Heating lamps (infrared)
o Infrared Heat lamps Comfort Heating (outdoor and indoor).
o Infrared Heat lamps Industrial
o Infrared Heat lamps for Animal Rearing
o Infrared Heat for lamps for Health care
Traffic / signal lamps
o Signal lamps
o Aircraft lighting – for runways and planes, all exterior applications
o Train lighting, including signal lighting
o Water craft lighting, including signal lighting
o Automotive lighting/lamps
Household appliances
o Oven lamps
o Fridge lamps
o Sewing machine lamps
Other
o Temperature- and shock-proof lamps
o Mirror Lamps

8.2.2 Special purpose DLS/ LEDs

Commission Regulation (EU) No 1194/2012 [162] mentions special purpose lamps in recital 5 with the same text as in Regulation (EC) 244/2009 (see there), and in Articles 1 and 2 as well as Annex I (see boxes below).

Article 1
Subject matter and scope
This Regulation establishes ecodesign requirements for placing on the market the following electrical lighting products:
(a) directional lamps;
(b) light-emitting diode (LED) lamps;
(c) equipment designed for installation between the mains and the lamps, including lamp control gear, control devices and luminaires (other than ballasts and luminaires for fluorescent and high-intensity discharge lamps); including when they are integrated into other products.

Article 2
Definitions
In addition to the definitions set out in Article 2 of Directive 2009/125/EC, the following definitions shall apply for the purposes of this Regulation:
..
4. 'special purpose product' means a product that uses the technologies covered by this Regulation but is intended for use in special applications because of its technical parameters as described in the technical documentation. Special applications are those that require technical parameters not necessary for the purposes of lighting average scenes or objects in average circumstances. They are of the following types:

(a) applications where the primary purpose of the light is not lighting, such as:
  (i) emission of light as an agent in chemical or biological processes (such as polymerisation, ultraviolet light used for curing/drying/hardening, photodynamic therapy, horticulture, pet care, anti- insect products);
  (ii) image capture and image projection (such as camera flashlights, photocopiers, video projectors);
  (iii) heating (such as infrared lamps);
  (iv) signalling (such as traffic control or airfield lamps);
(b) lighting applications where:
  (i) the spectral distribution of the light is intended to change the appearance of the scene or object lit, in addition to making it visible (such as food display lighting or coloured lamps as defined in point 1 of Annex I), with the exception of variations in correlated colour temperature; or
  (ii) the spectral distribution of the light is adjusted to the specific needs of particular technical equipment, in addition to making the scene or object visible for humans (such as studio lighting, show effect lighting, theatre lighting); or
  (iii) the scene or object lit requires special protection from the negative effects of the light source (such as lighting with dedicated filtering for photosensitive patients or photosensitive museum exhibits); or
  (iv) lighting is required only for emergency situations (such as emergency lighting luminaires or control gears for emergency lighting); or
  (v) the lighting products have to withstand extreme physical conditions (such as vibrations or temperatures below – 20 °C or above 50 °C);
(c) products incorporating lighting products, where the primary purpose is not lighting and the product is dependent on energy input in fulfilling its primary purpose during use (such as refrigerators, sewing machines, endoscopes, blood analysers);

[162] Commission Regulation (EU) No 1194/2012 of 12 December 2012 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for directional lamps, light emitting diode lamps and related equipment. *OJ L 342, 14.12.2012, p. 1–22*

ANNEX I

Product information requirements for special purpose products

1. If the chromaticity coordinates of a lamp always fall within the following range:

— x < 0,270 or x > 0,530

— y < – 2,3172 x 2 + 2,3653 x — 0,2199 or y > – 2,3172 x 2 + 2,3653 x — 0,1595;

the chromaticity coordinates shall be stated in the technical documentation file drawn up for the purposes of conformity assessment in accordance with Article 8 of Directive 2009/125/EC, which shall indicate that these coordinates make them a special purpose product.

2. For all special purpose products, the intended purpose shall be stated in all forms of product information, together with the warning that they are not intended for use in other applications.

The technical documentation file drawn up for the purposes of conformity assessment in accordance with Article 8 of Directive 2009/125/EC shall list the technical parameters that make the product design specific for the stated intended purpose. If needed, the parameters may be listed in such a way as to avoid disclosing commercially sensitive information linked to the manufacturer's intellectual property rights.

If the product is placed on the market in a packaging containing information to be visibly displayed to the end-user prior to purchase, the following information shall be clearly and prominently indicated on the packaging and in all other forms of product information:

(a) the intended purpose; and

(b) that it is not suitable for household room illumination.

The definition of 'special purpose lamps' and other exemptions in this Directional Light Source (DLS) regulation is much more extensive and mature than in the Non-Directional Light Source regulation conceived three years earlier. Also the definitions extend to several areas, where DLS are actually very rare, hinting that this regulation in fact could be taken into account as a more general guidance as to what the legislator intends by 'special purpose lamps'.

8.2.3 Special purpose LFLs/HIDs

Commission Regulation (EC) 245/2009 [163] mentions the special purpose lamps in Article 1 of the regulation (see box). In 2010 this text was amended by Commission Regulation (EU) No 347/2010 of 21 April 2010.[164]

[163] COMMISSION REGULATION (EC) No 245/2009 of 18 March 2009 implementing Directive 2005/32/EC of the European Parliament and of the Council with regard to ecodesign requirements for fluorescent lamps without integrated ballast, for high intensity discharge lamps, and for ballasts and luminaires able to operate such lamps, and repealing Directive 2000/55/EC of the European Parliament and of the Council, OJ, 24.3.2009, L76/17

[164] Commission Regulation (EU) No 347/2010 of 21 April 2010, (OJ L 104, 24.4.2010, p.20), amending Commission Regulation (EC) No. 245/2009 of 18 March 2009 (OJ L 76, 24.3.2009, p. 17) implementing Directive 2005/32/EC of the European Parliament and of the Council with regard to ecodesign requirements for fluorescent lamps without integrated ballast, for high intensity discharge lamps, and for ballasts and luminaires able to operate such lamps, and repealing Directive 2000/55/EC of the European Parliament and of the Council.

Article 1.
This Regulation establishes ecodesign requirements for the placing on the market of fluorescent lamps without integrated ballast, of high intensity discharge lamps, and of ballasts and luminaires able to operate such lamps as defined in Article 2, even when they are integrated into other energy-using products. This Regulation also provides indicative benchmarks for products intended for use in office lighting and public street lighting. The products listed in Annex I shall be exempt from the requirements set out in this Regulation.

Article 2. sub 5.
'ballast' means a device which serves mainly to limit the current of the lamp(s) to the required value in case it is connected between the supply and one or more discharge lamps. A ballast may also include means for transforming the supply voltage, dimming the lamp, correcting the power factor and, either alone or in combination with a starting device, providing the necessary conditions for starting the lamp(s);

ANNEX I (Commission Regulation (EU) No 347/2010 of 21 April 2010, amending Commission Regulation (EC) No 245/2009)
Exemptions

1. The following lamps shall be exempt from the provisions of Annex III, provided that the technical documentation file drawn up for the purposes of conformity assessment pursuant to Article 8 of Directive 2009/125/EC states which of the technical parameters listed hereunder provide(s) a basis for their exemption:
(a) lamps that are not white light sources as defined in Annex II; this exemption does not apply to high pressure sodium lamps;
(b) lamps that are directional light sources as defined in Annex II;
(c) blended high intensity discharge lamps having:
- 6 % or more of total radiation of the range 250-780 nm in the range of 250-400 nm; and
- 11 % or more of total radiation of the range 250-780 nm in the range of 630-780 nm; and
- 5 % or more of total radiation of the range 250-780 nm in the range of 640-700 nm;
(d) blended high intensity discharge lamps having:
- the peak of the radiation between 315-400 nm (UVA) or 280-315 nm (UVB);
(e) double capped fluorescent lamps having:
- a diameter of 7 mm (T2) and less,
- a diameter of 16 mm (T5) and lamp power P ≤ 13 W or P > 80 W,
- a diameter of 38 mm (T12), lamp cap G-13 Medium BiPin base, +/– 5 m (+magenta, –green) colour compensating filter value limit (cc). CIE coordinates x=0,330 y=0,335 and x=0,415 y=0,377, and
- a diameter of 38 mm (T12) and equipped with an external ignition strip;
(f) single capped fluorescent lamps having a diameter of 16 mm (T5) 2G11 4 pin base, Tc = 3 200 K with chromaticity coordinates x=0,415 y=0,377 and Tc = 5 500 K with chromaticity coordinates x=0,330, y=0,335;
(g) high intensity discharge lamps with Tc > 7 000 K;
(h) high intensity discharge lamps having a specific effective UV output > 2 mW/klm; and
(i) high intensity discharge lamps not having lamp cap E27, E40, PGZ12.

2. The following products shall be exempt from the provisions of Annex III, provided that in all forms of product information it is stated that they are not intended for general lighting use within the meaning of this Regulation, or that they are intended for use in applications listed in points (b) to (e):
(a) products intended for use in applications other than general lighting and products incorporated into products which do not provide a general lighting function;
(b) lamps covered by the requirements of Directives 94/9/EC of the European Parliament and of the Council [(1)] or Directive 1999/92/EC of the European Parliament and of the Council [(2)];
(c) emergency lighting luminaires and emergency sign luminaires within the meaning of Directive 2006/95/EC of the European Parliament and of the Council [(3)];
(d) ballasts intended for use in luminaires defined in paragraph (c) and designed to operate lamps in emergency conditions;
(e) luminaires covered by the requirements of Directive 94/9/EC, Directive 1999/92/EC, Directive 2006/42/EC of the European Parliament and of the Council [(4)], Council Directive 93/42/EEC [(5)], Council Directive 88/378/EEC [(6)] and luminaires integrated into equipment covered by these requirements.

(1) Directive 94/9/EC of the European Parliament and of the Council of 23 March 1994 on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres (OJ L 100, 19.4.1994, p. 1).
(2) Directive 1999/92/EC of the European Parliament and of the Council of 16 December 1999 on minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmospheres (OJ L 23, 28.1.2000, p. 57).
(3) Directive 2006/95/EC of the European Parliament and of the Council of 12 December 2006 on the harmonisation of the laws of Member States relating to electrical equipment designed for use within certain voltage limits (codified version) (OJ L 374, 27.12.2006, p. 10).
(4) Directive 2006/42/EC of the European Parliament and of the Council of 17 May 2006 on machinery, and amending Directive 95/16/EC (recast) (OJ L 157, 9.6.2006, p. 24).
(5) Council Directive 93/42/EEC of 14 June 1993 concerning medical devices (OJ L 169, 12.7.1993, p. 1).
(6) Council Directive 88/378/EEC of 3 May 1988 on the approximation of the laws of the Member States concerning the safety of toys (OJ L 187, 16.7.1988, p. 1).

ANNEX II:
'White light source' means a light source having chromaticity coordinates that satisfy the following requirement:
— 0,270 < x < 0,530
— – 2,3172 x2 + 2,3653 x – 0,2199 < y < – 2,3172 x2 + 2,3653 x – 0,1595

The following pictures show samples of the lamps specifically mentioned in the regulation text.

Figure 8-2. PGZ12 lamp.

Philips MASTER CosmoWhite CPO-TW PGZ12 Discharge lamp, run by control gear in the fitting, 45-145W, 30000h. l=132, d=20, New-generation ceramic metal halide lamps used in outdoor offering efficient and pleasant white light. Price ca. € 60-70. Luminous efficacy 107-117 lm/W. Lamp base temperature 250-300 °C, Lamp temperature 380-550 °C.

Figure 8-3. G11 4 pin base

(PLL lamp; dimmable CFL)

Figure 8-4. Cold atmosphere lamp

Advertising text: offers highest light output at lower temperatures because of the insulation that is created by putting a TL-D (T8) lamp into a T10 or T12 tube. It can be used in existing luminaires for T8 lamps and is suitable for all applications in cold environments where re-lamping is costly and complex.

The regulation texts also mention varies spectrum ranges. To complete the picture the following terms are used for UV lamps:

- UVA (near UV-Black Light) 315-400 nm
- UVB (middle UV-Erythemal) 280-315 nm
- UVC (far UV-Germicidal) 100-280 nm

It has to be noted that Commission Regulation (EC) 245/2009 was conceived at the same time as the Commission Regulation (EC) 244/2009 and it shows that the legislator is still seeking the contours of what can be considered 'special purpose' lamps.

8.3 Size of the problem

This chapter investigates the size of the possible problem of misuse of special purpose lamps for general lighting services. The ingredients of this investigation consist of a summary of anecdotal incidents of misuse as reported by the media (par. 3.1), market statistics from EU industry on the size and trends in special purpose lamp sales at the lowest aggregation level (par. 3.2), US data on trends and sales of special purpose lamps (par. 3.3), estimates of the study team on the sales of special purpose lamps based on indirect market parameters (par. 3.4).

8.3.1 Anecdotal data on misuse of the 'special purpose' lamps

UK

The misuse of special purpose lamps for general lighting services has been reported not only in the sources mentioned by CLASP[165]. The study team found UK publications by newspapers Daily Mail[166] and Telegraph reporting on 'at least two British manufacturers', in reality (internet) retailers 'The Lamp Company' and 'Lamps2udirect', which are reported to have said that 'bucket loads' of rough-service loads are 'being produced'. Furthermore, one anonymous manufacturer was reported to have said that he sold 'over 5 million' rough-service lamps to suppliers.

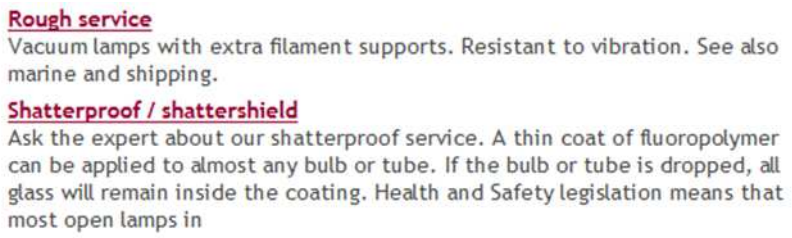
Germany

In Germany, Der Tagesspiegel[167] reports on DIY-outlets (Toom, Manufactum) that advertise shockproof lamps in a way that suggests that directly or indirectly that they can used as a replacement for the phased-out incandescent lamps for general lighting purposes. The same source also mentions that consumer-sites like amazon.de sell these shockproof lamps.

The 'scoop' of the articles above appears to be not the fact that the shock-proof lamps are sold, which is allowed, but that the retailers suggest that they could be used for general lighting purposes.

As a follow-up, the study team checked the website of the (internet) retailers and found the following on the website of The Lamp Company:

Figure 8-5. The Lamp Company website **(extract 17.7.2013), description of 'Rough service' lamps.**



(Source: www.lampco.co.uk)

[165] CLASP, Estimating potential additional energy savings from upcoming revisions to existing regulations under the ecodesign and energy labelling directives -a contribution to the evidence base-, supported by eceee, 18 February 2013

[166] Daniel Martin, *Old-fashioned light bulbs banned by EU directive can still be sold after traders find loophole allowing them to be renamed*, Daily Mail, 26 August 2012. http://www.dailymail.co.uk/news/article-2193792/Old-fashioned-lightbulbs-banned-EU-directive-sold-traders-loophole-allowing-renamed.html#ixzz2XLNJXdxv

[167] Markus Fischer, Trennungsschmerz im Lampenladen, Tagesspiegel, 19.08.2012. http://www.tagesspiegel.de/wirtschaft/eu-verbot-der-gluehbirne-stossfeste-lampen-sind-fuer-handwerker-oder-grubenarbeiter-gedacht-/7017264-2.html

On the www.amazon.de website, when sorting the category 'Beleuchtung/Leuchtmittel/ Speziallampen' (lighting/lamps/special lamps) on popularity, no shockproof lamps were found in the top-100. When using the key words several shock-proof globe lamps (not classic A-shape) were found, advertised with a neutral text.

Figure 8-6. Amazon.de (extract 17.7.2013), description of 'Rough service' lamps

Globe-Lampe stoßfest 100W 80mm opal E27 3603501
EUR 10,26
Nur noch 11 Stück auf Lager - jetzt bestellen.
Andere Angebote
EUR 6,90 neu (3 Angebote)

(no special mentioning of being appropriate for general lighting).

On the website of the German DIY-chain *Manufactum*, shock-proof lamps were also not found in the most popular section, but keyword-search found a shockproof lamp with suggestive texts.

Figure 8-7. Shock-proof lamp text on Manufactum website.[168]

Produktinformation – Glühlampe stoßfest

Matt. Sockel E 27. Mittlere Nennlebensdauer 2.000 h.

40 W, Höhe 10,5 cm, Ø 6 cm, Energieeffizienzklasse F. Lichtstrom 340 Lumen.
60 W, Höhe 10,5 cm, Ø 6 cm, Energieeffizienzklasse G. Lichtstrom 515 Lumen.

100 W, Höhe 11,5 cm, Ø 6,5 cm, Energieeffizienzklasse G. Lichtstrom 990 Lumen.

Gibt's doch noch: matte Glühlampen.

Etliche auf Geheiß der EU seit 2009 aus dem Verkehr gezogenen Leuchtmittel reüssieren derzeit, indem sie gewandt die einschlägige Verordnung umschiffen. Die klassische Glühlampe wird etwa als „Heizlampe" wieder angeboten. Ein ähnlicher Fall sind stoßfeste Lampen, die dort zur Anwendung kommen, wo Leuchten bewegt werden oder Erschütterungen ausgesetzt sind, also in Industrie, Bergbau oder Schiffahrt. Für den Haushalt sind sie obwohl der alten Haushaltsglühlampe erstgradig verwandt, nicht vorgesehen (und auf der Packung dementsprechend deklariert). Bei Leuchten, die sich zumeist draußen aufhalten, wo es rauher zugeht als drinnen, sind sie dagegen – obwohl knapp 30% lichtschwächer als konventionelle Typen – ein probater Nachfolger der klassischen Glühlampen.

Licht aus. Spot an.

Seit 2009 gilt sie nun, die landläufig als „Glühbirnenverbot" bekannte, nicht uneingeschränkt populäre und uns unvermindert suspekte Verordnung der Europäischen Union. Und auch der beleuchtungstechnisch nur am Rande Interessierte hat inzwischen bemerken müssen, daß an gleichwertigen Ersatz für eine durchgebrannte Glühbirne, sofern mattiert, nicht mehr heranzukommen ist. Aus den Bau- und Supermärkten sind die Restbestände weitestgehend verschwunden (wir haben zumindest in den letzten Wochen keine mehr entdecken können), und

The text reads '*They are still there: Frosted incandescent bulbs'*. The text suggests that several lamp-types phased out by the EU since 2009 are now re-edited finding loopholes in the regulation. The example of classic bulbs being offered as "heat lamps" is mentioned and shockproof lamps constitute a '*similar case'*. The text mentions that they are '*related in the first degree to'* the old domestic bulb, but not foreseen for indoor

[168] http://www.manufactum.de/gluehlampe-stossfest-p1448935/

applications. But for outdoor luminaires, where conditions are *'rougher'* they are –although 30% weaker in light output than the classic types—a good successor of classic incandescent bulbs.

On the website of the German DIY-chain *Toom* no shockproof lamps could be found.

Hungary

Lighting Europe estimates that "misused" lamps sales amount to 300 000 rough service/reinforced construction lamps per month (3.6 m per year) with an average wattage of 50W.

Figure 8-8. Shockproof lamp advertising and package in Hungary [169]

Poland

In Poland, as in most Eastern EU Member States, Lighting Europe signals large imports of standard incandescent lamps from outside the EU at prices as low as € 0.16/unit, offered for regular sales in consumer distribution channels. A part of these lamps are packaged in a box with the label 'special', suggesting that they are special purpose lamps (e.g. shockproof). A small fraction of these lamps are actually shockproof.

Figure 8-9. 'Special' lamps on the shelf in Poland (source: LE, Sept. 2013)

8.3.2 Industry sales statistics

The European manufacturer's association LightingEurope (LE) gathers sales data from its members (including Philips, Osram, GE, Havells-Sylvania, etc.). As regards incandescent lamps, these manufacturers represent

[169] LightingEurope, Incandescent/LFL situation in CEE, Presentation by Zoltan Pilter, Meeting with Hungarian National Consumer Protection Agency, 2013. July 30

almost the entire EU27 market. The data are confidential, but LE has made these sales data available to the study team for analysis and allows the publication of aggregated data.

At this moment, the special purpose and other lamps exempted from the application of Commission Regulation (EC) 244/2009 are all contained in the group of incandescent lamps, with sales as shown in the table below.

Table 8-1 Lighting Europe (LE): Incandescent bulb sales of members (in m units), including share of 'shockproof' bulbs.[170]**

	NDLS		
	GLS	***of which shockproof***	
	m units	***m units***	%
2008*	*ca. 1100*	6.2	0.6%
2009	973	6.5	0.7%
2010	628	7.5	1.2%
2011	534	7.3	1.4%
2012	345	7.1	2.1%
2013*	50	*ca. 7*	14.0%
***= *italic figures* are estimates VHK (not LE figures)**			
****= LE mentions that the situation may show large differences per country**			
*****= incandescent lamps / reinforced construction incandescent lamps including traffic signal incandescent lamps**			

The prognosis for 2013, which is in fact the first full year that Stage 4 of the regulation is implemented and thus sales should only relate to lamps that are special purpose or otherwise exempted, is based on the actual sales of 14 million units in the 1st quarter of 2013. Corrected for seasonal effects, this would come down to around 50 million units for the whole year 2013.

Shockproof lamps sold by LE members reportedly would amount to around 14% of this total.

8.3.3 Regulation of special purpose lamps in the US

As mentioned in the CLASP paper, the US Department of Energy employs a market surveillance method whereby it checks whether special purpose lamps are not misused for general lighting purposes. If the actual sales of these lamps, reported annually by the US manufacturer's association NEMA, exceeds the US DoE projections by 100% regulatory action will be taken.

The first NEMA report has been filed and checked in March 2013. The table below gives the outcome.

[170] pers. comm. LE, Sept. 2013

Table 8-2. US special purpose lamps check [171]

Lamp type	Sales Forecast (DoE), in m units	Actual Sales (NEMA) in m units	%	Regulatory action
Rough service lamps	5.78	6.05	104.6%	No
Vibration service lamps	3.02	1.08	35.7%	No
3-way incandescent lamps	50.13	28.85	57.6%	No
2,601-3,300 lumen general service incandescent lamps	33.98	12.37	36.4%	No
Shatter-resistant lamps	1.66	1.46	87.5%	No

DoE will continue to monitor sales data of these lamp types. Next publication is foreseen for March 2014. The figure below shows the DoE projections that will be used as a comparison check.

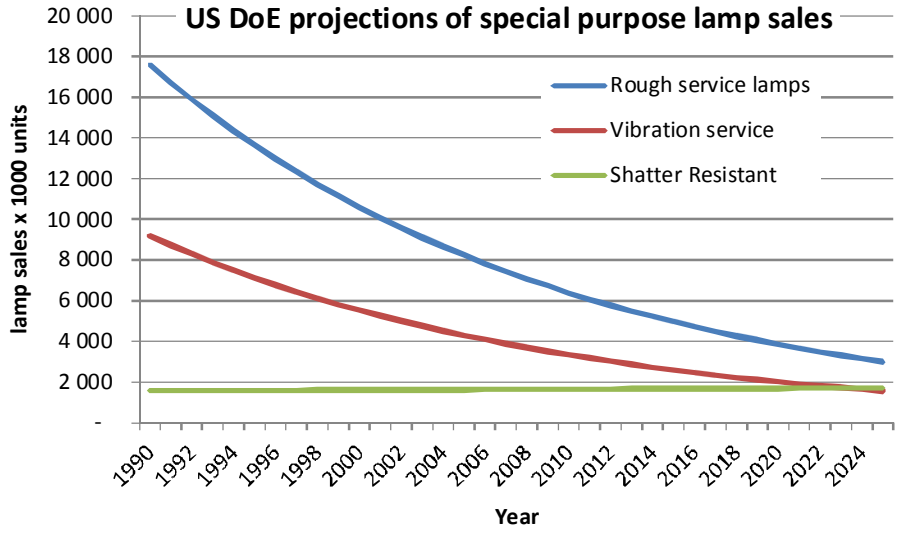


Figure 8-10. US DoE sales projections of special purpose lamps

The definition of 'special purpose lamps' is more limited than the one employed in the EU in the sense that only special incandescent lamps are mentioned. On the other hand, several of the US 'special purpose' incandescent lamps are not common in the EU such as 3-way incandescent lamps or shatter resistant lamps.

[171] http://www.regulations.gov/#!documentDetail;D=EERE-2011-BT-NOA-0013-0012. *Notice of Data Availability 2013-03-13 Energy Conservation Program: Data Collection and Comparison With Forecasted Unit Sales of Five Lamp Types*

Also the category of '2601-3300 lumen general service incandescent lamps' would be inside the normal scope of the EU regulations.

The box below gives the US definitions of the 'special purpose lamps'.

'Rough service lamp' means a lamp that has a minimum of 5 filament support wires (not counting the two connecting leads at the beginning and end of the filament), and must be designated and marketed for "rough service" applications. This type of incandescent lamp is typically used in applications where the lamp would be subject to mechanical shock or vibration while it is operating. Standard incandescent lamps have only two support wires (which also serve as conductors), one at each end of the filament coil. Typical applications for these rough service lamps might include commercial hallways and stairwells, gyms, storage areas, and security areas.

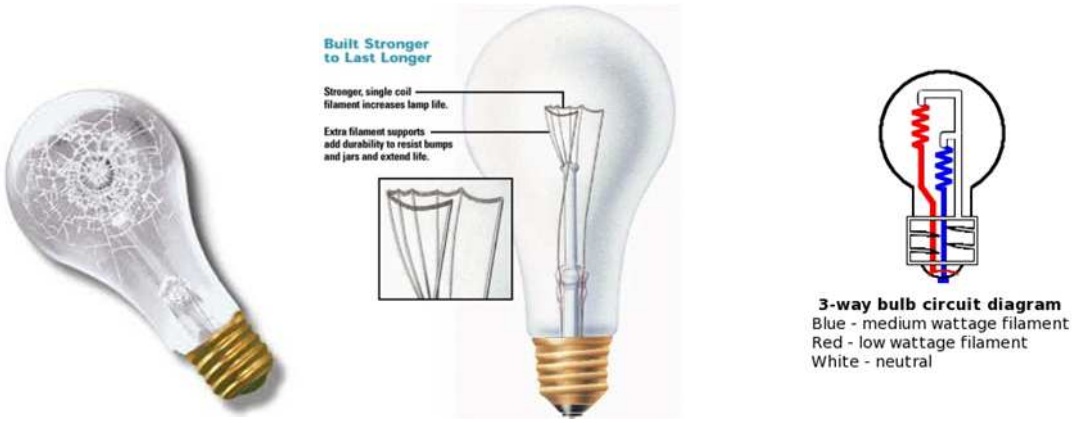
Vibration service lamp means a lamp that—(i) has filament configurations that are C-5, C-7A, or C-9, as listed in Figure 6-12 of the 9th Edition of the IESNA Lighting Handbook or similar configurations; (ii) has a maximum wattage of 60 watts; (iii) is sold at retail in packages of 2 lamps or less; and (iv) is designated and marketed specifically for vibration service or vibration-resistant applications. As the name suggests, this type of incandescent lamp is generally used in applications where the incandescent lamp would be subject to a continuous low level of vibration, such as in a ceiling fan light kit. To address this problem, lamp manufacturers typically use a more malleable tungsten filament to avoid damage and short circuits between coils.

The *`3-way incandescent lamp'* is an incandescent lamp that employs 2 filaments, operated separately and in combination, to provide 3 light levels and is designated on the lamp packaging and marketing materials as being a 3-way incandescent lamp. Three-way lamps are commonly found in wattage combinations such as 50, 100, and 150 watts or 30, 70, and 100 watts.

The *'2,601-3,300 Lumen General Service Incandescent Lamp'* is a general service incandescent lamp that emits light between 2601 and 3300 lumens.

Shatter-resistant lamps incorporate a special coating designed to prevent glass shards from being dispersed if a lamp's glass envelope breaks. The coating is compliant with industry standard NSF/ANSI 51 "Food Equipment Materials," and are labeled and marketed as shatter-resistant, shatter-proof, or shatter-protected. Some types of the coatings can also protect the lamp from breakage in applications subject to heat and thermal shock that may occur from water, sleet, snow, soldering, or welding.

Figure 8-11. US 'special purpose' incandescent bulbs.



From left to right: Shatter-proof, shockproof, 3-way bulb

8.3.4 Sales and energy data from indirect parameters

Top-down approach

The US data suggest that 2012 sales of approx. 6 million rough-service lamps is ' normal' for actual special purpose use. Shatter-proof and vibration resistant lamps are less common in the EU but could their equivalent could be sold as 'shockproof'. Thus for a country as the US, with 316 million inhabitants (Sept. 2013), a range of 6-8 million units shock-proof lamps can be considered as a reference. When weighted for population (EU ca. 500 million inhabitants), this would mean that in the EU sales of 10-12 million units for actual special purpose use could be deemed 'normal'.

The industry association Lighting Europe estimates, amongst others based on the situation in Hungary, that the actual EU sales of shockproof lamps 'misused' for general lighting purposes amounts to 14.4 to 18 million units. Main source of these lamps would be extra-EU imports, on top of the 50 million special purpose lamps (including 7 million 'shockproof' lamps) sold in the EU by LE members. With respect to the total EU population of installed non-directional light sources (approximately 1 billion units) the misused special purpose lamps constitute 1.4-1.8% of sales.

In terms of energy this means that approximately 16 million lamps (mid value of 14.4 and 18) are sold with wattage of 50W, whereas actually it should have been at least a 40W mains-voltage halogens or perhaps even 10W CFLs. In a worst case scenario, i.e. if consumers would have chosen CFLs instead of the rough-service incandescent bulbs, the EU would miss out on an energy saving of 40 W per lamp. At 500 operating hours per year this comes down to 20 kWh/year per lamp. At sales of 16 million units this comes down to 0.32 TWh per year in missed savings. Compared to the total electricity consumption of NDLS of around 100 TWh per year, this constitutes a missed saving of 0.3% annually.

If, again in the worst case, the 16 million annual unit sales of shockproof lamps for general lighting are a persistent phenomenon, the impact builds up, because the average shockproof lamps last around 4 years (2000h product life, 500h annual use). This would mean that 64 million shockproof lamps are installed in the EU that are used for general lighting. Thus the EU27 would miss out on 1.3 TWh/year or approximately around 1.3% of the total NDLS energy consumption. When compared to the projected energy savings from Commission Regulation (EC) 244/2009, calculated at 32 TWh in 2020, the 1.3 TWh constitutes 4%.

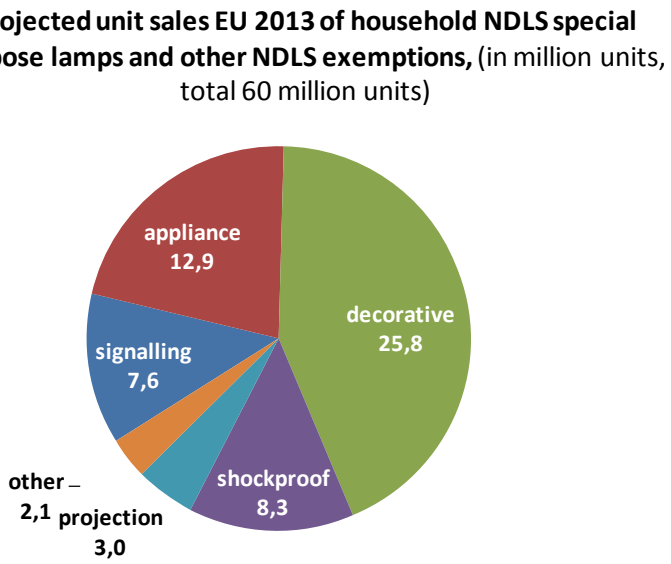
This is the worst case scenario. In reality, many of the consumers that now buy shockproof lamps are probably (also) motivated by the low price and –if they cannot buy a shockproof lamp would probably buy a mains-voltage halogen look-a-like bulb. In that case, the missed savings are only a quarter of the above figures.

Bottom-up approach

VHK has tried, using indirect market data, to establish the unit sales of incandescent bulbs that are exempted from the measures either through the definition of the scope or because they are interpreted as 'special purpose'.

The results are shown in figure 13.

Figure 8-12. Projected unit sales NDLS 2013



As an illustration of the methodology, the table below shows the case of shockproof lamps:

Table 8-3. . Calculation of shock-proof lamp sales for special purpose lighting, from underlying user/buyer characteristics

Shock-proof lamps and similar (incandescent)	units stock	lamp power	operation	energy	lamp life	total lamp sales	o/w new sales	o/w incandescent
	m #	W	h/yr	TWh/yr	h	m #/yr	m #/yr	m #/yr
shockproof-lamps car repair shop, inspection, mining, etc.	5.00	60	2000	0.600	2000	5.0	0.5	5.0
shockproof-lamps for trouble light at home	100.00	60	5	0.030	1000	0.5	0.4	0.3
temperature/ shatter/ vibration proof lamps	3.00	60	2000	0.36	1500	4.3	0.3	3.0
	108.00			*0.99*		*9.80*	*1.20*	*8.30*

The segment is sub-divided into 3 typical areas:

- Mobile professional applications, where the lamp may be subject to rough handling (bumps, falls, etc.). Examples are car repair shops (in car pits), inspection applications (e.g. construction sector, heavy metal industry) and mining.
- Mobile consumer applications, such as in trouble lights.

- Stationary professional applications, such as task lights in industrial machinery (vibration-proof), industrial ovens and similar (temperature- and shock-proof), hazardous industrial environments (shatter-proof).

In the US, the main area of application for vibration-proof is in lamps that are mounted on ceiling fans, but for the EU this segment is considered too small to take into account.

Figure 8-13. Examples of shock-proof lamps in mobile applications (left) and stationary applications (right)

The EU27 has around 0.6 m car and motorcycle repair shops where shockproof lamps can be used. They employ around 3.5 m people[172], of which probably 2 m mechanics that typically have a mobile inspection lamp as a standard item in their toolbox. Average annual use is estimated at around 2000h. Also in the repair and maintenance of other means of transport (trains, aeroplanes, boats), construction, mining, etc. mobile lamps are used as mobile or temporary light source. Clear statistics are not available, but given the size of e.g. the construction industry it is estimated that the number of mobile lamps, of the type that could use shockproof bulbs, would be at least as high as those in car repair. Technically there are plenty of alternatives for incandescent lamps --most standard CFLs, LEDs and even halogens would be more shockproof than a 'shockproof' incandescent bulb—but the sector is conservative and the tendency to replace like-for-like is strong. Thus, although a high estimate, a number of 5 m installed shockproof lamps in mobile professional applications is estimated.

In mobile consumer applications the shock-proof lamps are used in legacy 'trouble lights', i.e. technically similar to mobile professional version but usually in a low-cost and less robust version. They are used not only in home car repair, but in all sorts of Do-It-Yourself situations. The main reason for still using (shockproof) incandescent bulbs in those applications is the low price, given that a 'trouble light' is an item that is hardly used. Estimated use is 5h per year and it is estimated that roughly half of EU households, i.e. around 100 million, would own such a lamp. The wattage for such an application is higher than average and estimated at 60 W. The product life is only estimated at 1000h, because –given the low frequency of use—most trouble lights will break or be discarded before the end of the technical life of the light source.

For stationary applications, i.e. where the luminaire/ lamp-holder is fixed in a space or part of an appliance, the possibility of bumps and falls of the lamp-holder is minimal. Hence, these will be applications near machinery or in professional ovens as mentioned above. Amongst others through Ecodesign preparatory studies there are market data on these market segments, but –in contrast to mobile applications— shock-proof incandescent lamps only have a modest market share (most replacements in legacy machinery) and are overtaken by standard halogens (preferably low-voltage for safety reasons when liquids are involved), LFLs and –in power tools—by the more compact LEDs.

Hence, the rough estimate of around 3 million installed units that are mentioned in the table, constitute only a fraction of this market segment, mainly due to like-for-like replacements in legacy machinery. Where they are still used, they will operate around 2000h/year.

[172] Library of the European Parliament, *A picture of the EU car industry*, Library Briefing, 28/02/2013.

Based on the above, it is estimated that a maximum of 8 million shockproof or similar incandescent bulbs are sold for the right reasons. This is 2-3 million less than what was estimated on the basis of translating US data to the EU, weighted for population.

8.4 Conclusions and options

In this study, all publicly available information sources were tapped to estimate the size of the problem of 'special purpose' ('shockproof') non-directional incandescent light sources being misused for general lighting.

Information comes from anecdotal data (par. 3.1), EU industry statistics (par. 3.2), proportionality estimate from US sales data (par. 3.3) and an estimate from indirect market data (par. 3.4). Given the modest size of the market segment being investigated, the accuracy of the estimates is limited, but as far as the available data sources allow it can be concluded that:

- There is a realistic EU-market of 8 million shockproof lamps per year
- On top of that, there are around 16 million units/year that are abusively sold for general lighting services, mostly from extra-EU imports[173]
- The energy saving that is lost through the misuse varies between 0.32 to 1.3 TWh/year, depending on the alternative that consumers would have bought instead (halogen or CFL).
- The projected savings from Commission Regulation (EC) 244/2009 were 32 TWh/year and thus the EU misses out on 1 to 4% of these projected savings.

In view of earlier decisions of the Commission, the problem should be tackled at the next revision of the legislation but does not warrant the administrative burden for a revision of its own.

Furthermore, a large part of the solution may be found by not changing the legislation but simply increasing the market surveillance by Member States.

Having said that, the misuse of special purpose lamps in general undermines the credibility of the measures and if the legislation is changed for other reasons, this is an area to look into. Possible changes could entail either to

- Explicitly lift the exemption for rough service lamps, because there are enough compliant alternatives, or
- Restrict the distribution of Limit the visible presentation on the shop-shelves and on websites of these lamps only to the professional channels, e.g. password-protected on-line sales or sales through shops that are accessible only for professionals and not the general public.
- Require a specific declaration on the lamp packaging of the technical characteristics that would make a lamp 'special purpose'.

At the moment, the first option is relatively unproblematic: Halogen lamps are sold as signalling lamps (traffic lights), task-lights of sewing machines and industrial equipment, oven lamps, sewing machine lights and other applications where they are subject to vibration from traffic and machinery.[174] CFLs, although the mechanical load on the electronics in an integrated CFL may be more critical, could be an alternative in many cases. In any case, CFLs are now fairly common in certain builder-lights where they are an alternative to the R7s halogen lamps. Retrofit LED lamps are also a good alternative but with currently a higher price tag. Nonetheless, the lower running and maintenance costs should convince many professional buyers. A more serious restriction

[173] LightingEurope thinks the estimate is too low, but has no clear evidence for the real figure.

[174] LightingEurope remarks that 'shockproof' incandescent lamps are much more shockproof than halogens. LE further states that 'CFLi, LEDi and Halogen Eco types are not generally resistant to vibration. LED emitters themselves are OK, but the construction of LED retrofit lamps is generally NOK for vibration service.' (see Annex with stakeholder comments.

on LEDs and CFLs occurs when shockproof lamps should also be temperature proof, e.g. for ambient temperatures of 50- 60°C or above. For those cases, if the legislator decides to phase out halogen lamps, a solution (e.g. a specific exemption) must be found.

The second option is a compromise when some unexpected compelling arguments are brought forward to maintain the exemption for rough service lamps. There is no experience with the implementation or market surveillance of this option, but it might be worth investigating whether this would not make compliance checks and giving fines easier, i.e. if a rough service lamp is found for sale in a supermarket or DIY shop there is no doubt about non-compliance.

The third option is suggested by industry and entails an amendment to the 244/2009 Regulation by deleting *"if any"* from the article 3(2) (see box):

> For special purpose lamps, the following information shall be clearly and prominently indicated on their packaging and in all forms of product information accompanying the lamp when it is placed on the market:
>
> (a) their intended purpose; and
>
> (b) that they are not suitable for household room illumination.
>
> The technical documentation file drawn up for the purposes of conformity assessment pursuant to Article 8 of Directive 2005/32/EC shall list the technical parameters (if any) that make the lamp design specific for the special purpose indicated on the packaging.

Alternatively, the industry suggests and would support a specific mandatory declaration on the packaging, of the technical characteristics that would make a lamp special purpose, like definitions which amongst others specifically demands technical characteristics of the lamp.

More in general, the definitions of special purpose lamps in lighting related Ecodesign and labelling legislation should be made clearer and more consistent. Within the restricted resources and timeframe of the Omnibus project it was not proven possible to make a comprehensive technical proposal on this subject. This work should be done in a follow-up study.

The stakeholder opinions on the above subjects are given in detail in the Annex, but in short:

Although market surveillance is of course a necessary ingredient, most stakeholders are sceptic that more and better surveillance will be the ideal solution, given the current state of definitions especially in Commission Regulation (EC) 244/2009.

As regards limitations in the distribution channels many stakeholders point out that this is not feasible under the Ecodesign Directive, but no opinion was voiced as regards possibilities of enforcing appropriate measures on exemptions under the Energy Labelling Directive.

As regards the necessity of clearer definitions there is a broad consensus amongst stakeholders that they should be improved. As was also discussed in the Consultation Forum of 25 November 2013, there is a favourable opinion on using the clearer definitions of Commission Regulation (EU) 1194/2012 as a general template also for NDLS. Having said that, this would still require –at the level of legislation and/or through guidelines for surveillance authorities (e.g. in the AdCo)—to define one or more verifiable and distinguishing technical characteristics (spectrum, radiance, etc.) to find the right balance between not stifling innovation and avoiding loopholes.

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9. Simple set top boxes

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Summary

This document addresses "Commission Regulation (EC) No 107/2009 of 5th February 2009 with regard to ecodesign requirements for simple set-top boxes".

A review of this regulation is due in February 2014 and it is scheduled for discussion at the Consultation Forum to be held in Spring 2014 (to be confirmed by Commission). This review study evaluates the need for a formal redrafting of the regulation, taking into account technological progress, necessity for changes in product scope, potential to further improve energy and information requirements and wider environmental considerations, following a request of the European Commission during the kick-off meeting to consider this aspect as well.

Review study methodology

Data collection and model creation in this review study was based on a study and data set conducted by CLASP, expert interviews, modelling of data in spread sheets and consultation of industry upon assumptions and calculation methods.

Assumptions and data sources are noted alongside presentation of the analysis.

Results of review study

This analysis highlights that there are still further energy savings available through a very basic revision of the SSTB regulation - updating definitions based upon those in the EU Code of Conduct on Digital TV and CSTB Voluntary Agreement. It further highlights that there is also an opportunity to increase both energy and material savings by defining requirements that address wider lifecycle impacts through information requirements on installation, and the potential to place a maximum limit on the weight of SSTBs.

The analysis results are summarised in the table below:

Table 9-1 Results of options analysed in this review. More information on reduced environmental impact summarised in Chapter 6.

Scope	Options analysed	Energy savings	Reduced hazardous waste	Assessment of feasibility
Energy aspects (use phase)	1 No change	None	N/A	Easy
	2 Light revision of regulation (scope and energy)	0.25 TWh yearly in 2020	N/A	Relatively easy
	3 Revise scope	0.27 TWh yearly in 2020	N/A	Negotiation needed
Wider resource aspects (other phases than use phase)	4 Improved lifetime	1.70 TWh (indirect energy) from 2016-2020	10,641 tonnes from 2016-2020	Requires better use (ventilation), memory management, etc.
	5 Reduced footprint	0.97 TWh (indirect energy) yearly in 2020	826 tonnes yearly in 2020	Negotiation needed

	6 Design for recyclability	4.66 TWh (indirect energy) yearly in 2020	3,746 tonnes yearly in 2020	Negotiation needed
	7 Reduced hazardous materials	Not modelled	Not modelled	Negotiation needed

In Table 9-1, the options 4-7 of addressing the wider resource aspects, deals with lifecycle phases other than the use phase of the product, in other words; the indirect or 'embodied' energy consumption of the product. The options considered should not be seen as stand-alone options, but rather options that could be combined.

Conclusions and recommendations

The analysis of sales and resulting energy consumption of stock show a rapid decline, due to obsolescence of the technology (market shift towards 'complex' technology expected). By 2030 the resulting energy consumption of the stock would be less than 1/10th of that of 2015, regardless of which scenario is chosen (BAU or option 2 or 3).

Scenario 2 and 3 show small numerical energy saving potentials for the years 2015-2025, with most of savings occuring around year 2020,, and it could be classified as low priority in regulation revision. However, if no change is made to update the regulation, there would be unregulated products of the EU STB market. This leaves open the risk that very poorly performing products could enter the EU market if not corrected.

In view of this, revising the regulation is beneficial compared to doing nothing, especially with implementation assessed to be cost-effective. If a revision is called for, it is recommended to:

- Include unregulated products in the SSTB regulation and tighten the energy requirements by implementing Scenario 2 (stated in Appendix B).

Where savings as a result of a revision are relatively low, there is an opportunity to increase savings by defining requirements that address wider lifecycle impacts. The assessment undertaken in this review of describes the inclusion of information requirements on installation (Scenario 4), and the potential to place a maximum limit on the weight of SSTBs (Scenario 5). In case of a revision, options could consider:

- achieving wider energy and resource savings throughout the products' lifecycle by implementing Scenario 4 of extended product lifetime obtained by information requirements

- achieving wider energy and resource savings throughout the products' lifecycle by implementing Scenario 5 of introducing requirements around weight (based upon kg per Watt)

Whilst requirements on wider lifecycle impacts could be difficult to incorporate in a basic review, information requirements around these considerations could provide the data necessary to include requirements on these areas in the subsequent revision, providing the potential for further savings in the longer term. We recommend to:

- Include information requirements on modal power demand, TEC, APD availability and resource efficiency considerations such as weight, volume, and hazardous material content regardless of Scenario 4 being implemented or not

Stakeholders have questioned the need for a revision of the current regulation, given the limited significance for future energy savings.

This review study was carried out by VMAS from June to October 2013 as a part of the Omnibus review study for several products launched by the EU Commission.

9.1 Legislation & standards

9.1.1 Revision articles

A review of Regulation 107/2009 is due no later than five years after entry into force (2015), and a Consultation Forum will be scheduled to discuss this regulation. The regulation does not state any specific issue to address in the review besides "technological progress".

9.1.2 Subject matter and scope

This section focuses on the Commission Regulation (EC) No 107/2009 with regard to ecodesign requirements for simple set-top boxes.

A discussion on the scope of the current and possibly reviewed Regulation is presented in section 9.5

9.1.3 Regulation 107/2009 for simple set-top boxes (SSTB)

The regulation on ecodesign requirements for simple set-top boxes (SSTB) entered into force on 25 February 2009. There were two tiers to the ecodesign requirements; Tier 1 came into place one year after the regulation came into force, Tier 2 came into force three years after the regulation came into force. The current (Tier 2) requirements for new SSTBs placed on the market require that they must be equipped with auto power-down or similar function, and do not exceed the following power consumption limits:

Table 9-2 Ecodesign regulation No 107/2009 power consumption limit

	Standby mode	Active mode
Simple STB	0.50W	5.00W
Allowance for display function in standby	+0.50W	-
Allowance for hard disk	-	+6.00W
Allowance for second tuner	-	+1.00W
Allowance for decoding HD signals	-	+1.00W

Regulation (EC) No 107/2009 transformed the SSTB market at a critical time. From around 2006 the SSTB market had been undergoing substantial growth in countries such as the UK where the majority of the market was terrestrial (many other countries were mainly cable based services) and there was a planned switchover from analogue to digital television signals. At the time of the regulation being introduced, there were many very poorly performing products on the market. In some products the power demand was the same (around 15 W) in both active and standby mode. Better products on the market were consuming 5 to 6 W in standby and 12 W in active mode. The regulation limited active mode to only 5 W (8 W with HD) and standby mode to 2 W, reducing to maximum 1 W in standby mode after three years[175]. These levels were challenging for many products to meet (although there were best available products that performed better than that level)[176].

The introduction of the regulation removed the poor performing products from the market and ensured that the process of digital switchover continued with the most efficient products.

There is currently neither an energy labelling regulation nor non-energy requirements in the ecodesign regulation for SSTB.

Other relevant European legislation for SSTB includes:

[175] The second tier also provided additional allowances for hard disks and second tuners
[176] Historical market information courtesy of Robert Harrison, July 2013

- Directive 2002/96EC on waste electrical and electronic equipment (WEEE)
- Directive 2002/95/EC on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS)
- Low Voltage Directive (LVD) 73/23/EEC
- Electromagnetic (EMC) Directive 89/336/EEC, amended by Directive 92/31/EEC
- Mandate to ESO's M/451 EN – Mandate to CEN, CENELEC and ETSI for Standardization in the field of power consumption measurement of simple set-top boxes in active and standby modes

Other initiatives include[177]:

- UK's Energy Saving Trust Recommended Scheme for Simple Terrestrial Set Top Boxes, currently under consideration for revision.
- USA's voluntary ENERGY STAR criteria "Set-top Box Specification Version 3.0", in effect since 1 September 2011.
- USA's voluntary ENERGY STAR criteria "Set-top Box Specification Version 4.1", currently under revision.
- Energy Conservation Standards for Set-Top Boxes by U.S Department of Energy (DOE), currently under study (although the process appears to be currently stalled pending completion of the review of IEC 62087).
- Secretary of Energy in Argentina has completed the development a mandatory legislation for SSTBs; IRAM 6241. Current status states pending implementation.
- A voluntary label by Bureau of Energy Efficiency (BEE) of India for set top boxes and TV receivers is under consideration for development.
- Jordan is currently developing a mandatory Minimum Energy Performance Standard "Draft Technical Regulation on Eco-design requirements for simple set-top boxes" (transposition of 107/2009/EC); it is due to effect in 2014.
- Vietnam's Viet Energy Star is currently considering the development of a voluntary label scheme for "receivers".

9.1.4 Voluntary Agreement Complex set-top boxes (CSTB)

There is currently no ecodesign or energy labelling regulation for complex set-top boxes (CSTB). A Voluntary Agreement (VA) for complex set-top boxes entered into force in 1 July 2010. The Tier 2 energy consumption targets became effective 1 July 2013; see Appendix C for CSTB definitions and for details of the energy allowances.

In parallel, the voluntary EU Code of Conduct (CoC) for Digital TV service specifies targets for CSTBs. CoC is more ambitious than VA in terms of the energy consumption allowances and additional function allowances. Tier 1 targets came into force 1 July 2013, and Tier 2 will become effective 1 July 2015, see Appendix C for detailed energy allowances.

9.1.5 Test standards for SSTB and CSTB

The overview in this paragraph is based on expert interview[178]. The current standard that is usually referenced for SSTB testing is IEC / EN 62087 Edition 3. Whilst this adequately covers SSTBs, it does not include a "Z annexe" for information reporting, and so could not be directly referenced in the current regulation as a

[177] CLASP online, http://www.clasponline.org/
[178] Insight courtesy of Robert Harrison, July 2013

harmonised standard. This test standard is currently under revision and will be updated with the latest information necessary for CSTB and SSTB testing, including for example 3D testing patterns and the aforementioned "Z annexe". The revision should be completed toward the end of 2014 and could then be referenced directly in any regulation.

It is possible that with the timing of a revision to the SSTB regulation, a general reference to harmonised standards would need to be maintained, as Edition 4 of EN 62087 may not yet be available.

Under the US Department of Energy (DOE) rulemaking analysis, definition of a specific test method was considered, but activity in this area is on hold until the final results of the IEC / EN 62087 revision are known. The CSTB VA does not require a supporting harmonised standard since, as with the CoC, the VA administrators publish their own testing methodology.

9.2 Market Analysis

9.2.1 Market and stock

The CLASP report[179] states the global total shipment of set-top boxes (including CSTB and SSTB) to be 250 million units in 2012[180]. A recent report from IHS[181] indicates the global shipments of STB used for cable, satellite, terrestrial and IPTV digital TV services will increase 8 % to a total of 269 million units in 2013. IHS anticipates a further 6 % growth to 286 million units in 2014 and 1 % growth to 290 million in 2015, followed by decline thereafter.

However, CLASP shipment predictions for EU-27 Member States assume the sales of SSTBs stagnating from 2011 to 2015 and steadily decreasing from that time toward zero in 2025. The European market trend is predicted to differ from global market, because while the shipment of STBs is rapidly increasing in other parts of the world, such as China, the demand for STBs and particularly SSTBs in Europe is declining due to DTT broadcasting roll-out.

As detailed in the CLASP report, the market for SSTBs in Europe is in decline, with the exceptions of a number of eastern European countries. Bulgaria intended to switch off analogue signals in September 2013; switch off in Poland was scheduled for 31 July 2013; Romania plans to switch off in 2015; switch off in Hungary is currently in progress and should be completed by 2014[182]. CLASP predictions for stock and sales in Europe are shown in the table below:

Table 9-3 CLASP projected sales and stock to 2030 for Simple Set-top Boxes under current scope

EU-27 Projection	2010	2015	2020	2025	2030
Sales, million units	26.5	12.3	10.0	0.0	0.0
Stock, million units	132.7	107.4	74.5	37.3	4.7

Our own evaluation of the CLASP stock estimates suggests that these figures cover all cable, satellite, IP and terrestrial SSTBs as would be defined under revised scope/definitions, excluding any products with record to removable media functionality.

[179] Estimating potential additional energy savings from upcoming revision, by CLASP, 2013
[180] Page G-8, Estimating potential additional energy savings from upcoming revision, by CLASP, 2013
[181] IHS Defying Multiscreen Challenge, Set-Top Box Market to Achieve Record Shipments in 2013 http://press.ihs.com/press-release/design-supply-chain/defying-multiscreen-challenge-set-top-box-market-achieve-record-sh
[182] http://mavise.obs.coe.int/

9.2.2 Chapter conclusions

Referring to the analysis of product scope and the review of the CLASP model of sales and stocks, we decided to use the CLASP model as a foundation for our own scenario modelling in this review. The scenarios will be presented in the following chapter.

9.3 Technical Analysis of Energy Requirements

9.3.1 Usage profile

Consumer behaviour in terms of use of set top boxes is likely to be very varied. There is little data on actual use, but a usage profile assumption is required for calculating TEC (Total Energy Consumption) for CSTBs, which is used by the CSTB VA and EU Code of Conduct.

The CSTB VA assumes that a CSTB with no auto power down (APD) function is ON for 9 hours daily and 15 hours on standby; and that the CSTB with APD function is ON 4.5 hours daily, 4.5 hours to switch from ON mode to standby mode and the rest 15 hours on standby. Some manufacturers of SSTBs view the assumptions for cycle durations from CSTB VA to be unrealistic. An alternative duty cycle of 3 hours duration of ON mode and 21 hours of standby was proposed by manufacturers[183].

The VA usage profile assumes that an STB is never turned off. However, an Intertek study from 2012 found that yearly 42 % of the time a STB is in ON mode, 38 % in standby mode and 20 % in OFF mode[184]. This is equivalent to approximately 10 hours ON mode, 9 hours in standby and 5 hours in OFF mode. The U.S. Department of Energy (US DOE) life cycle cost analysis used an average household sample, in which a STB is in ON mode for 9.56 hours, standby for 14.44 hours, and the remainder of the time (4.01 hours) in APD mode. The US DOE study also shows that the average usage profile of different types of STB varies tremendously, e.g. ON mode usage can range between 12.43 hours and 3.62 hours depending on the type of STB and its additional functions[185]. A summary of these assumptions is shown in the table below:

Table 9-4 Usage profile from CSTB VA, Intertek study and US DOE analysis

	ON mode, hours	OFF mode, hours	Standby mode, hours	APD, hours
CSTB VA	4.5	-	15	4.5
Survey study	10	5	9	-
US DOE	9.56	-	10.03	4.01

In reality, expert opinion suggests that SSTBs are often left on for long durations due to the fact that separate remote controls are used for SSTBs and TVs – consumers often forget to turn SSTBs to standby mode[186].

For the purposes of this study, and for clear comparison with other European measures, the CSTB VA usage profile, which is also in line with an EU CoC usage profile, is chosen for modelling potential energy saving in this study as presented later in this chapter.

9.3.2 Product lifetime

In the CLASP analysis, product lifetime is assumed to be 6 years, based on the fact that analogue TVs has an average lifetime of 7 years[187]. In the US DOE rule making analysis, product lifetime is assumed to be 7 years,

[183] Insights courtesy of Mr Michael Auer, Kathrein, August 2013.
[184] R66141 Household Energy Survey Final Report March 2012, Intertek.
[185] US DOE Life Cycle Cost analysis for set top boxes.
[186] Insight courtesy of Robert Harrison, August 2013.
[187] CLASP Simple Set-top Boxes shipment/stock model, 2013

based on expert opinion; the consensus among 5 technical experts was that the mean STB lifetime was between 5-7 years, and the maximum STB lifetime was approx. 11 years. The product lifetime is predicted for both CSTBs and SSTBs in rulemaking analysis, however our analysis shows that there may be differences in lifetime between the two categories.

Some experts consulted as part of this study stated that the lifetime of SSTBs is generally much shorter than 5-7 years in reality. Consultation with industry has suggested that the typical lifetime of a SSTB is approximately 2 years nowadays; due to rapid product obsolescence (consumers may replace their STB more frequently to obtain the newest functions - see discussion around extending product lifetimes in Chapter 6 of this report). Therefore the retirement rate may be underestimated in both CLASP and US DOE analyses.

As our analysis model is built on CLASP's (which did not present the potential for a variation in lifetime assumptions), we have assumed a product lifetime of 6 years – also in line with US DOE analysis.

It was not possible to carry out an overall sensitivity assessment of the lifetime chosen for modelling, but it is likely that for the modelling of direct energy savings in the use phases of products, a variation in the lifetime would not change the results considerably. The reasoning is that a shorter life time, e.g. from 6 to 2 years, would lead to more rapid replacements of products, but this would probably not influence the efficiency of the stock, as the product development in terms of efficiency is stagnated. However, when speaking of indirect energy and material use for production and transport of demanding more products, shorter lifetimes would naturally lead to higher environmental impact due to higher demand on resources and transport. Therefore, a scenario assessing shorter life times is presented in Chapter 6 addressing wider resource efficiency requirements.

9.3.3 Best Available Technology (BAT)

In terms of potential step changes in technology expected within the next 3 to 4 years that could impact the energy consumption of STB products, most of the following changes are currently available but not necessarily adopted yet by all manufacturers[188]:

1. The digital TV tuner component of the STB can now run at less than 0.5 W in ON mode
2. Multicore processors with built in standby architecture enable reduction of core powering to one core processor in standby – technology transitioned from mobile phones.
3. For HDD (PVR) SSTB, hard drives will be replaced by NVRAM with a significant reduction in power demand.

Latest testing indicates that some of the SSTBs have well surpassed the ecodesign regulation requirement. For example, ENERGY STAR's most recent testing data indicates that Apple TV has an ON mode energy consumption of 1.99 W, which is 1.01 W lower than the SSTB regulation[189]. Intertek testing data indicates that Grundig and BUSH FTA Terrestrial STB have an ON mode energy consumption of 1.4 W and 0.3 W in standby mode[190].

9.4 Policy options related to energy

9.4.1 Analysis of Product Scope

Analysis of product definition and scope for SSTB

A simple set-top box (SSTB) is defined in the current ecodesign regulation as "a stand-alone device which, irrespectively of the interfaces used,

[188] Insight courtesy of Robert Harrison, July 2013
[189] ENERGY STAR June 2013-Draft 2 Version 4.1 Set top Box Dataset
[190] Intertek / Robert Harrison Associates STB testing 2012.

a) Has the primary function of converting standard-definition (SD) or high-definition (HD), free-to-air digital broadcast signals to analogue broadcast signals suitable for analogue television or radio;

b) Has no 'conditional access' (CA) function;

c) Offers no recording function based on removable media in a standard library format.

A SSTB can be equipped with the following additional functions or components:

a) Time-shift and recording functions using an integrated hard disk;

b) Conversion of HD broadcast signal reception to HD or SD video output;

c) Second tuner."

Comparing the definition to current products on the market it appears that the current definition is out-dated due to development since the original definition was made. The reasons for the definition appearing out-dated are explained below.

- **Primary function to convert digital to analogue signals for analogue TV:** This is out-dated due to the process of digital switchover being largely completed and likely to be less onerous in the Eastern European countries that have yet to convert (Bulgaria, Poland, Romania and Hungary[191]) as there will already be digital televisions in many homes without the need for SSTB signal conversion. Therefore the primary purpose of analogue to digital conversion is no longer likely to relate to any significant volume of products.
- **Conditional access (CA):** Whilst conditional access still remains a valid means of distinguishing between simple and complex set top boxes, the definitions of conditional access could be improved using text from the Complex Set Top Box (CSTB) industry Voluntary Agreement.
    - SSTB regulation: "'Conditional access' is specified in the SSTB regulation as "a provider-controlled broad-casting service requiring a market subscription television service." This means that it needs to be supplied by a television provider. Whilst the CSTB VA use
    - CSTB VA: "Conditional access" is specified as "the encryption, decryption and authorization techniques employed to make access to content conditional upon authorization using a key that is dynamically allocated by a Conditional Access (CA) OR Digital Rights Management (DRM) system." This definition differs from the above because it does not necessarily mean that it should be supplied by a television service.

An interesting market development to be considered in the revision of legislation is that products can now be sold as SSTBs with no conditional access, but upgraded to CSTBs via software downloads that enable conditional access.

- **Recording to removable media:** The other stipulation in the current SSTB regulation definition refers to a SSTB not offering recording capability via "removable media in a standard library format". This definition means that the products considered as "video recorders" in the Sound and Imaging preparatory study (ENTR Lot 3) and impact assessment would not be in scope of the SSTB regulation, although they have many similarities to SSTB products[192]. Another market development for consideration in this aspect of the definition is that "removable media in a standard library format" could come to be thought of as camera-style memory cards or similar, potentially providing an unintended loophole for some products. If there are video players with SSTB functionality on the

[191] MAVISE database http://mavise.obs.coe.int/

[192] However, the EC impact assessment into these products suggested that high end video recorder products, which required greater energy consumption due to the niche high-performance nature and electronic (multi chip) design would find any regulatory requirements difficult to meet.

market, these are assumed by experts to still be under the scope of the current measure, as they offer only playback functionality, not recording to removable media[193].

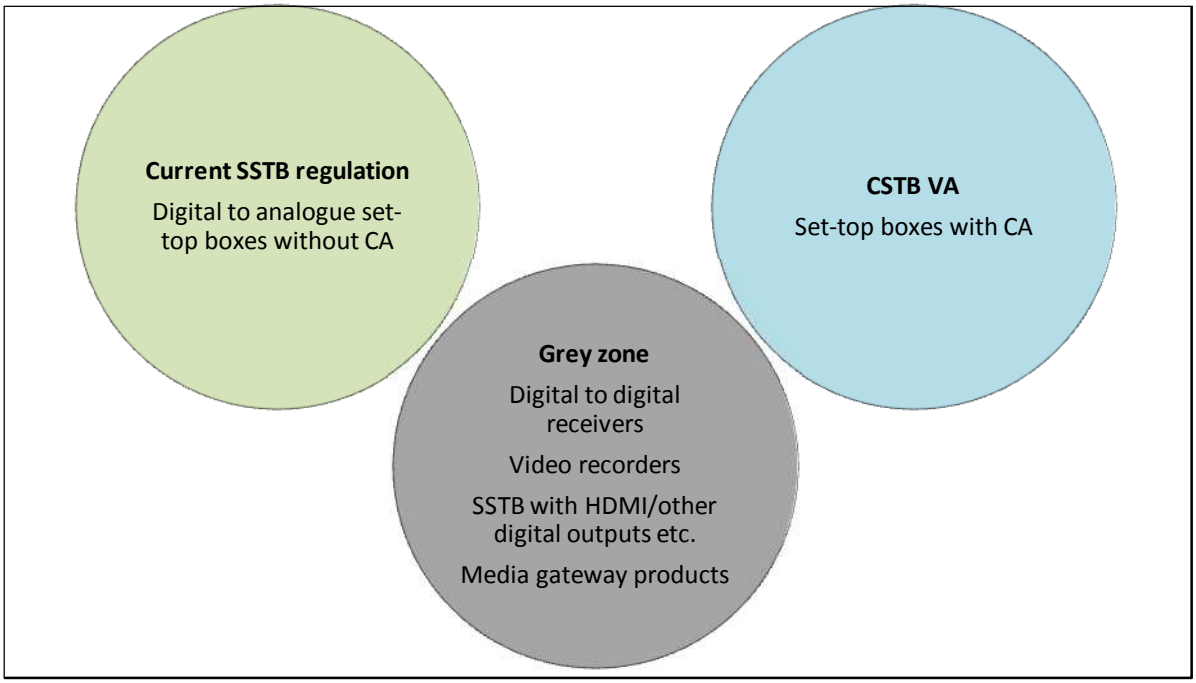
Relevant new products

There are also a number of other products potentially relevant to include in a widened scope of the SSTB regulation:

- **Digital receivers:** Their primary function is to convert MPEG4 broadcasting signals into MPEG2 signals, which are suitable for older digital TVs in areas with switch-over from MPEG2 to MPEG4. These often do not have an analogue output, therefore not covered by SSTB regulation. Due to the lack of CA function, they are not covered by CSTB VA.
- **Media Gateway products (e.g. Apple TV and Popcorn Hour):** Where conditional access, these are covered in the CSTB VA under the IP STB definition. They are not necessarily always protected by conditional access, and are therefore also included in modelling for a revised SSTB regulation.

The figure below sketches up the products and functions with the purpose of highlighting potential 'grey zone products' that may not be covered by any regulation.

Figure 9-1 *Overview of the products covered by SSTB regulation, CSTB VA and "grey zone products" that fall in the gap.*



Conclusions on scope

Due to issues with the current definitions, many products may currently be considered out of scope of the SSTB regulation by manufacturers. In particular, for example, it is possible that some manufacturers assume that presence of an HDMI output shows a primary function other than conversion of digital to analogue free-to-air digital broadcast signals, so that their products that would otherwise be considered SSTB are not within scope of the SSTB regulation. Since they are excluded from the CSTB VA, these products are interpreted by manufacturers and experts as unregulated.

[193] Insight courtesy of Robert Harrison, 2013

In the same way, SSTB products with no CA function, but with a primary function of digital to digital (MPEG 4 to MPEG2) signal conversion, could also be interpreted by some manufacturers as being out of scope from both the SSTB regulation and the CSTB VA.

Therefore, revising the definition is the key to maintaining the effectiveness of the regulation and accessing any future savings.

In general terms, an updating of the definitions within the regulation would lead to consistency by using those contained in the CSTB voluntary agreement, but with the clear stipulation that a SSTB represents the remainder of the products on the market that have not been defined as CSTB.

In particular, the inclusion of products that record onto removable media (video recorders) in the regulation could be considered, although the sound and imaging impact assessment suggested that the impacts relating to high-end AV products would need to be carefully evaluated.

The following potential policy options for energy requirements were considered:

Table 9-5 Considered policy options for analysis

Policy options
1. No change: Leave the regulation in place as is – as a minimum, this ensures that none of the worst performing products can re-enter the market. No changes to current regulation modelled. **Note: in order to account for future potential savings, the BAU in comparison to below options includes all products that could be included in revision scenarios, but which may not currently be covered by the regulation, i.e. cable, satellite, terrestrial and IP SSTB with and without Personal Video Recorder (PVR) function, as well as removable media recorders with SSTB functionality.**
2. Light revision of regulation: Tighten power demand requirements of current regulation and update definitions to enable the majority of SSTBs to be included. Assuming the SSTBs with digital outputs are also included.
3. Widen regulation scope: **As scenario 2, but include video recorders with removable media into scope.**

In this study, formal scenarios were built on all three options by modelling energy savings using as a foundation the modelling carried out by CLASP[194]. In all the scenarios, it was assumed that all SSTBs with or without digital outputs were included in the stock and shipment estimate. Therefore, to achieve the energy savings calculated in the different scenarios, it is crucial to update the SSTB definitions to at the very least remove the wording "digital broadcast signals to analogue broadcast signals suitable for analogue television or radio".

9.4.2 Scenario 1: No change

Scenario 1 is the business as usual (BAU) scenario in this study. The BAU energy consumption estimates differ from the original CLASP analysis, as the current BAU scenario includes the energy consumption of removable media recording products that could be brought under the scope of SSTB as suggested in scenario 3. This enables comparison of the scenarios. The table below shows the stock annual consumption in the current BAU scenario, rounded to three significant figures:

Table 9-6 BAU Stock annual energy consumption from 2010 to 2030

[194] CLASP Simple Set-top Boxes shipment/stock model, 2013

Scenario 1	2010	2015	2020	2025	2030
Stock annual energy consumption BAU (TWh)	3.68	3.45	1.96	1.06	0.13

9.4.3 Scenario 2: Light revision of regulation

In scenario 2, we modelled a potential revision of the energy consumption requirements and the definitions for the current SSTB regulation to the level and wording suggested in Appendix D (small change in scope).

Basing requirements upon the functional allowances of the EU CoC and the base case consumption for simple STB products from CLASP study, the savings potential that can be obtained from the levels recommended in Appendix D are 15 % for basic SSTBs, and 13 % for typical Personal Video Recorder (PVR) SSTBs.

Table 9-7 Base case TEC and proposed TEC

	Basic SSTBs	PVR SSTBs
Base Case TEC, kWh	16.97 kWh	28.47kWh
Proposed TEC, kWh	14.51 kWh	24.64 kWh

The revised regulation is assumed to enter into force in 2016, therefore no savings were estimated for 2015.

Table 9-8 Scenario 2 annual and cumulative energy savings from 2010 to 2030

Scenario 2	2010	2015	2020	2025	2030
Annual energy savings from BAU (TWh)	-	-	0.25	0.14	0.02
Cumulative energy savings from BAU (TWh)	-	-	0.91	1.90	2.19
Annual energy consumption (TWh)	3.68	3.45	1.71	0.92	0.11

9.4.4 Scenario 3: Widen regulation scope

As Scenario 2 resulted in very modest amount of potential energy savings, a widening of scope in scenario 3 was also assessed. Scenario 3 is the same as scenario 2, but with the additional expansion of scope to include removable media recorder products, based upon stock/sales levels for these products predicted in the EC impact assessment on Sound and Imaging products.

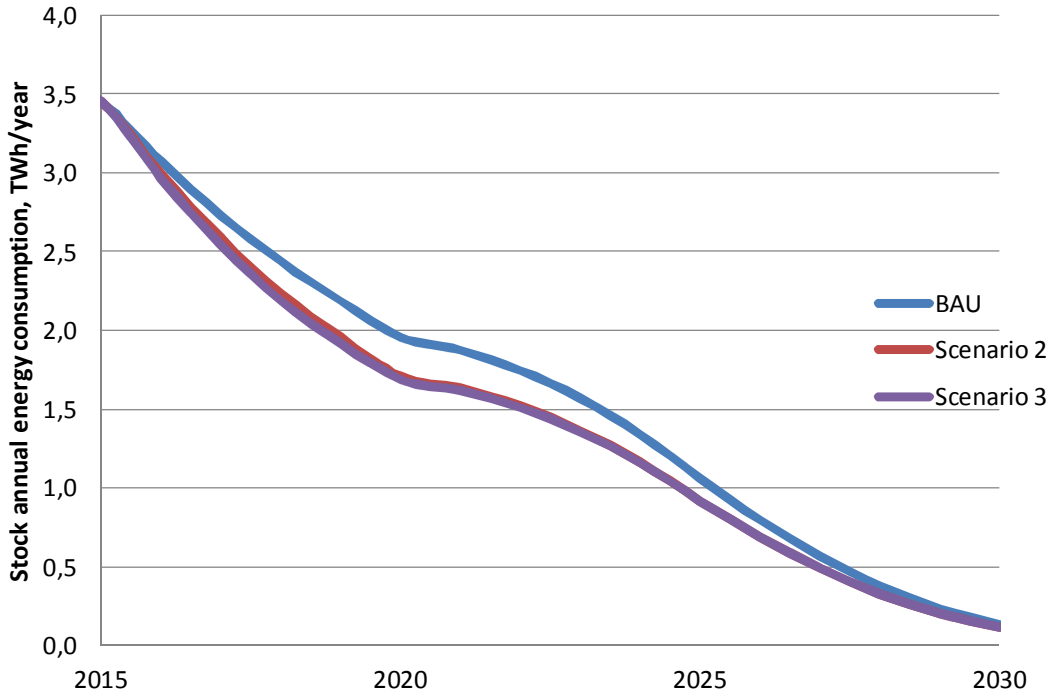
Table 9-9 – Scenario 3 annual and cumulative energy savings from 2010 to 2030

Scenario 3	2010	2015	2020	2025	2030
Annual energy savings from BAU (TWh)	-	-	0.27	0.14	0.02
Cumulative energy savings from BAU (TWh)	-	-	1,09	2,12	2,40
Annual energy consumption (TWh)	3.68	3.45	1.69	0.92	0.11

9.4.5 Comparison of scenarios

The results show very little difference in savings between scenario 2 and 3, due to the small number of video recorders predicted to be sold. The results of the three scenarios are illustrated in the figure below.

Figure 9-2 SSTB annual stock energy consumption for BAU, scenario 2 and 3 from 2015 to 2030



9.4.6 Least Life Cycle Cost (LLCC)

A simple LLCC analysis was carried out for Scenario 2 (updated definitions of SSTB and tighter power requirements). Two product groupings were assessed: SSTB with PVR and SSTB without PVR. To allow comparison of costs, a product 'base case' with a set use pattern and efficiency expressed in TEC/year was defined for the two categories. The base case is in line with the CLASP report. We assessed the net energy savings in product lifetime against the costs of manufacturing[195] a product that achieves the energy requirement recommended in Annex **Error! Reference source not found.**. The electricity cost per kWh is averaged over the EU-27. Product lifetime is assumed to be 6 years as our previous model. The table below shows LLCC analysis result:

Table 9-10 LLCC analysis for scenario 2

	Total cost of change, EUR	Electricity cost savings from base case, EUR	Net savings, EUR
SSTB with PVR	1.9	5.3	3.4
SSTB without PVR	1.8	3.4	1.6

Net savings from LLCC are positive for both SSTB with PVR and without, although the net savings are greater for SSTB with PVR. This indicates that whilst consumers may have to pay a higher price for an SSTB that meets the requirement proposed by scenario 2, net savings would still result, and therefore scenario 2 can be considered cost-effective. LLCC for scenario 3 has not been carried out due to the complexity in taking the video recorders into the scope.

[195] Costs of manufacturing products that achieve our suggested requirement were estimated from US DOE's LLCC for STB. In the analysis, the manufacturing costs for achieving different level of energy savings were provided. The level difference closest to our suggested energy consumption was from level 2 to level 3. Therefore the average manufacturing cost for 3 types of STB with and without PVR to reach level 3 of energy savings was used for our LLCC analysis.

9.4.7 Chapter conclusions

The user behaviour analysis suggests that SSTBs are often left on for long durations. Therefore APD has been a crucial element in the current regulation, and it is suggested that such a requirement is retained.

Based on our analysis, scenario 2 and 3 show small numerical energy saving potentials, and it could be classified as low priority in regulation revision. However, if no change is made to update the regulation, there would be unregulated products of the EU STB market. This could risk that very poorly performing products (claimed by manufacturers to be neither SSTB nor CSTB) could be introduced to the EU market if nothing is done. This risk has not been estimated in this review and thus only appears as a qualitative argument.

In view of this, revising the regulation is beneficial compared to doing nothing when looking from an environment perspective, especially with implementation assessed to be cost-effective.

9.5 Policy options related to resource efficiency

As well as the consideration of potential energy savings, there is also the option of developing requirements that relate to the wider lifecycle impacts of products – particularly relevant where there are diminishing returns in terms of tightening energy-related requirements as concluded in Chapter 5.

The assessments in Chapter 6 deal with product lifecycle phases other than the use phase.

9.5.1 Policy options considered

Table 9-11 SSTB Policy options considered

Policy options
4. Extending product lifetimes: As experts indicate that SSTBs may have only a 2 year lifetime in reality, Scenario 4 assumes a 2 year lifetime as BAU. Scenario 4 considers how lifetimes could be prolonged by introducing ecodesign requirements. It models how much energy and resources could be saved if 30 % of sales had 6 year rather than 2 year lifetimes.
5. Reduced footprint design: The potential for lighter weight designs or 'slim designs' is explored in Scenario 5 as a potential policy option via a weight based limitation within a revision of the SSTB regulation.
6. Design for recyclability: Scenario 6 evaluated the potential energy and resource savings due to improved ecodesign for disassembly and recyclability – through requirements such as plastics marking and ease of material separation.
7. Reduced use of hazardous materials: Scenario 7 considered the potential savings that could be achieved through reduced volume of hazardous materials. Scenario 7 is presented as a qualitative description without modelling savings in numbers.

In the following sections, these scenarios around wider resource aspects will be presented and assessed.

Scenario 4 – Extending product lifetimes

Whilst the CLASP evaluation (used as a basis for the energy related scenarios in this report) assumed a 6 year product lifetime, and the simple STB preparatory study assumed a 5 year product lifetime, expert insights have suggested that STBs may actually have shorter lifetimes, between 18 months and two years[196].

Some reasons for these shorter SSTB lifetimes and possible ways to extend those could include:

- **Ventilation:** Often STBs are installed in poorly ventilated closed cabinets. Expert discussion with service providers[197] highlighted that the majority of CSTBs failed due to overheating, and the situation is likely to be the same for SSTBs.

In order to extend product lifetimes, an information requirement could be included in a revision of the regulation to address the installation issue. This could inform the user that the product should be placed in a well-ventilated area away from high humidity (i.e. not a closed or partially closed cabinet), otherwise the product lifetime may be drastically reduced and any product guarantees invalidated.

- **Electronic programme guide (EPG) overload:** Digital TV requires an EPG to enable easy navigation of the high numbers of channels. The approach to EPG update (frequency, data volumes etc.) will vary between STBs, but the continuous updates can eventually cause overload of processing components and result in shortened product life. Where this happened with SSTBs bought for purely analogue to digital conversion, rather than purchase a new SSTB, consumers often bought a new DTV[198].

  Intelligent memory management could potentially solve the EPG overload problem by allowing all the memory to be used and exercising its full capacity could increase the product life. This is currently seldom done in a smart way specifically to increase the lifetime, as it is not seen as a design priority from manufacturer's point of view. Memory management is normally implemented for speed or feature support and not for long term life extendibility. Solid State Devices (SSD) are becoming more popular and could help to improve the lifetime but as they are newer technology and tend to be more costly compared to HDD and large format flash[199]. Placing a requirement on products that would encourage intelligent energy management is difficult – especially in terms of measurement for compliance purposes.

- **Product obsolescence:** The newest STBs have a greater range of functions to keep pace with the evolution of television services (e.g. Ethernet connections to allow access to online content, live pause functionality etc.). Thus, basic STBs can be replaced with newer versions before the end of their useful life (without any failure having occurred)[200]. This accelerated end of product life is difficult to avoid by introducing ecodesign requirements.

- **Upgradability:** Requirements around upgradability and lifetime extension as described in the table below showing commonly used procurement criteria could be considered:

Table 9-12 Considered ecodesign requirements for upgradability, post-sale spare part and service availability and assessment of applicability to ecodesign requirements (criteria inspired by green procurement and ecolabelling criteria)

Criteria	Applicability of criteria to ecodesign requirements
Upgrading can be done e.g. with processor, memory, cards or drives	Would result in savings due to extended life, but difficult to enforce as a requirement.

[196] Telephone consultation with experts, July/August 2013: Robert Harrison estimate: 18 months to 2 years for a CSTB. Mr Michael Auer, Kathrein: SSTB lifetime 2 years. Note – the use of longer lifetimes than realistic in the energy scenarios results in a delay in savings being shown in stock but will not have a major impact on the longer term figures (2020 / 2025).
[197] Insights courtesy of Robert Harrison, August 2013
[198] Insights courtesy of Robert Harrison, August 2013
[199] Insight courtesy of David Holliday, September 2013.
[200] Insights courtesy of Mr Michael Auer, Kathrein, August 2013

Upgrading can be done using commonly available tools	As above
Specify number of years spare new or refurbished[201] parts are available for after end of production.	Could be specified. May assist in extending product life but could also incur cost to manufacturer.
Specify number of years' service is available for after end of production.	Might not be relevant to such small and relatively cheap products.

A basic model of resource savings was created for the extended product life scenario in this review. The scenario is built on data and assumptions from preparatory STB studies[202]. If the product life could be extended from 2 to 6 years, the following lifecycle environmental impacts could be avoided in a 10 year period (per household):

- Between 2 and 6 kg of product-specific materials disposed of without recycling (and the need to recycle between 2 and 10 kg of materials);
- 550 to 830 kWh energy consumption in life cycle stages other than the use phase;
- Around 1,500 litres of process/cooling water;
- Up to 5 kg of hazardous waste produced across the lifecycle;
- 200 kg CO2 equivalent greenhouse gas emissions.

Assuming that 30 % of SSTBs in stock by 2020 could have benefited from their lifetimes being extended in this way, the potential savings are shown in Table 9-12.

Table 9-13: Avoided use of resources in the period from 2016-2020 based on 2020 stock.

Resource efficiency impact (other life cycle phases than use phase)	Scenario 4 – improved lifetime, (savings from 2016-2020)
Materials disposed (thousand tonnes)	10.8
Materials recycled (thousand tonnes)	14.9
Indirect energy (GER) (TWh)	1.70
- of which electricity (TWh)	0.51
Water (process and cooling (billion litres))	3.52
Waste non-hazardous (thousand tonnes)	95.0
Waste hazardous (thousand tonnes)	10.6
Emissions - Greenhouse gases in GWP 100 (million kg CO2 eq)	390.2

The savings estimated depend upon 30 % of the users actually acting on information requirements.

Scenario 5 – Reduced footprint design

Simple set top boxes currently on the market can have huge ranges in weight and volume. In this scenario, we carried out a weight-based analysis of products on the market. They ranged from 0.1 to 2.8 kg weight (excluding devices including VCR, which are heavier), and from 1400 to 5300 cubic cm[203] volume.

A reasonable correlation between ON mode power and both weight and volume can be observed in the charts below:

[201] Refurbished in this context meaning products or parts returned to manufacturer or vendor, tested for functionality and re-sold with new warranty.
[202] Analysis carried out on the outputs of the SSTB preparatory study 2007 and CSTB preparatory study 2008 base case analyses. As 2013 SSTBs are including more features and a widening of the definitions has been suggested, impacts across the spectrum of 2007/2008 STB products were considered.
[203] Analysis of products available on Argos.co.uk 28/08/2013

Figure 9-3 Correlation between weight and ON mode power. Figure built on data from Argos.co.uk (28/08/2013)

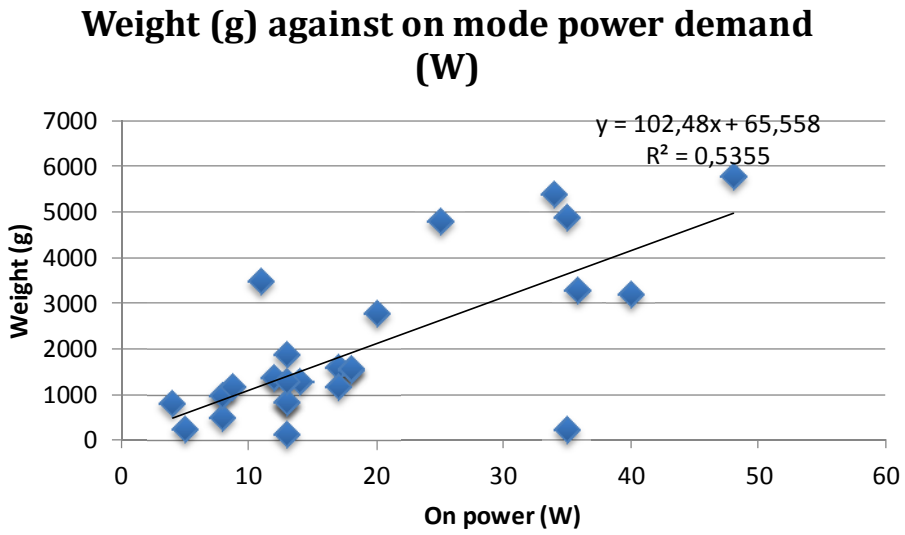
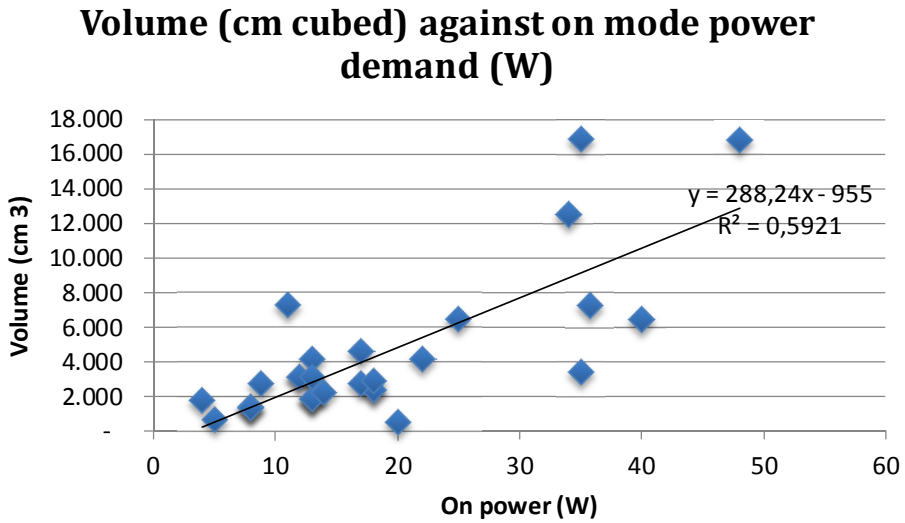


Figure 9-4 Correlation between volume and ON mode power. Figure built on data from Argos.co.uk (28/08/2013)



Figures 3 and 4 indicate a tendency that heavier and bigger STBs also tend to consume more energy.

Figure 5 below shows the weight of different types of STBs in terms of STB features.

Figure 9-5 The division of weight by STB type. Figure built on data from Argos.co.uk (28/08/2013)

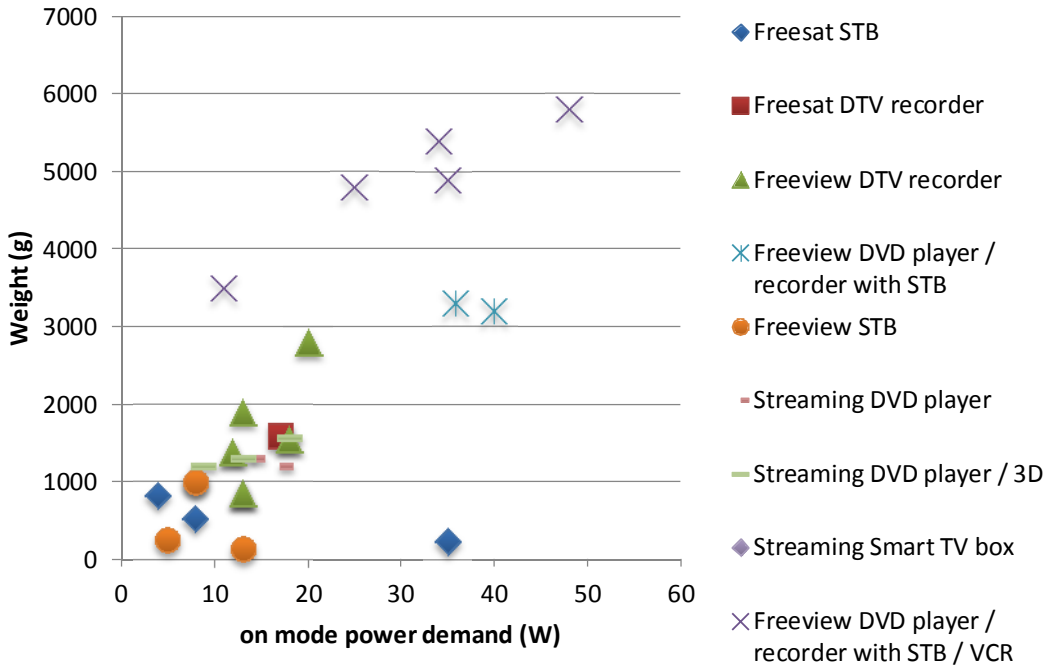


Figure 5 shows that VCR products have the highest weight due to the bulky VCR component, but products with DVD players are observed with a wide range of weights.

The CSTB preparatory study (2008) examined the possibility of a 'slim design' STB featuring the following:

- Miniaturised circuitry;
- LED indicators rather than full display;
- External rather than internal power supply;

Whilst fewer materials (plastics and miscellaneous materials) were used in a compact design, the CSTB study found that there was a larger generation of non-hazardous waste (+ 59 %) and that all other environmental impact categories were reduced in comparison to the study's defined 'base case product'.

Table 9-14 Improvements due to slim STB design[204]

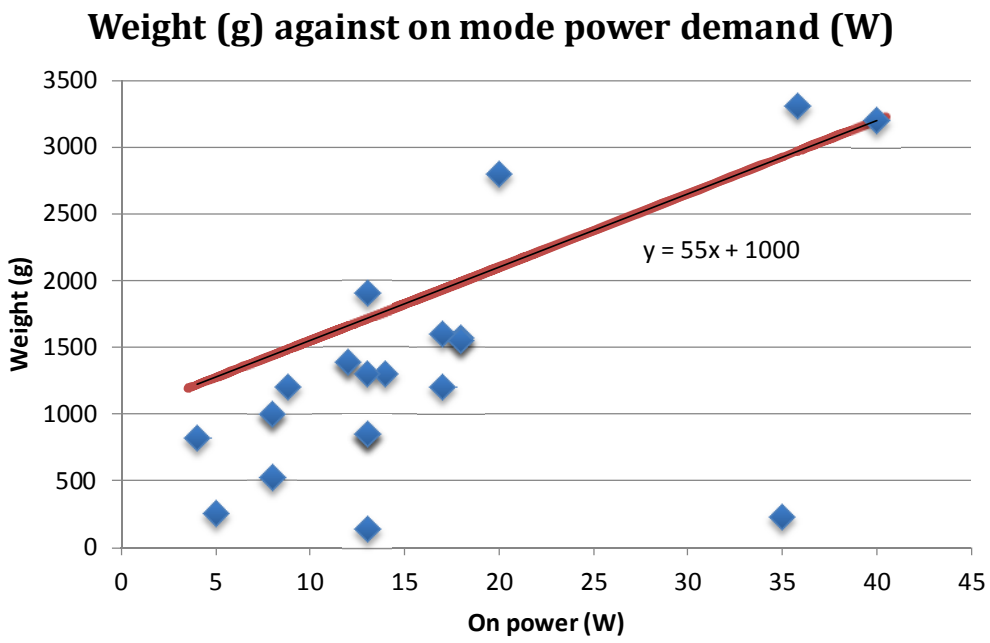
Non-hazardous waste:	+ 59 %
Total Energy (GER):	**- 49 %**
Hazardous waste/incinerated:	**- 47 %**
Greenhouse Gas emissions (GWP):	**- 51 %**
Acidification (emissions to air):	**- 52 %**
Heavy metals (emissions to air):	**- 67 %**
Particulate Matter (emissions to air):	**- 73 %**

An Ecodesign requirement around weight based upon kg per Watt in ON mode or similar could potentially be introduced in order to remove the least resource efficient designs from the market. The result of

[204] CSTB Preparatory study 2008

implementing a potential requirement to the basic market analysis from Argos.co.uk (28/08/2013) is shown below:

Figure 9-6 Potential ecodesign requirement on weight per Watt ON mode



This requirement would prevent the worst performing 17 % of the data set from complying. The formula for this requirement is:

Max weight (g) = 55 x on power (W) + 1000

The formula above allows for a kilogram product weight as a basic level, regardless of ON mode power – which is generous for most products, ensuring that only the least resource efficient products would be removed from the market. Products with VCRs were excluded from the analysis, with the intention that these niche products would be exempted from any weight requirements.

High-end AV products were not included in the data set (no data available). These products sometimes differentiate themselves from standard market products through 'quality' design casings – often rack mounted form factors in metal casings. These products may require an additional allowance or an exemption from a possible weight requirement.

Whilst such an approach could result in wider savings due to resource efficiency, there is clearly the risk that if requirements are too stringent, manufacturers would be forced to use lower quality more lightweight materials that might result in a reduced product lifetime. However, the proposed requirements are generous and would be easily met by the majority of products.

Introducing the weight per Watt requirement, would lead to the following avoided environmental impact.

Table 9-15: Yearly avoided use of resources in 2020 except for a potential increase in non-hazardous waste.

Resource efficiency impact (other life cycle phases than use phase)	Scenario 5 – Reduced Footprint (yearly savings in 2020)
Indirect energy (GER) (TWh)	0.97
Waste non-hazardous (tonnes)	276 increase
Waste hazardous (tonnes)	826
Emissions - Greenhouse gases in GWP 100 (million kg CO2 eq)	1,118

Scenario 6 – Design for recyclability

Product designers can reduce environmental impacts of products by careful consideration of the choice and fabrication of specific materials. As the SSTB preparatory study stated, "the range and mass of used materials, the marking of materials and the ease of dismantling of the product to basic material components are all design considerations".

Criteria that would assist design for recyclability often considered in procurement are evaluated in the table below:

Table 9-16 Considered criteria for recyclability design and assessment of applicability to ecodesign requirements

Criteria	Applicability of criteria to ecodesign requirements
Flame retarded plastic parts >25g in covers / housings are marked according ISO 1043-4:	Could be required. Would assist with disassembly/recycling.
Documents on effective disassembly, modules and the substances requiring selective treatment, components and consumables are made available.	As above
Parts that have to be treated separately are easily separable.	As above
Plastic materials in covers/housing have no surface coating.	As above
Plastic parts >100g consist of one material or of easily separable materials.	As above
Plastic parts >25g have material codes according to ISO 11469 referring ISO 1043.	As above
Plastic parts are free from metal inlays or have inlays that can be removed with commonly available tools.	May impact product performance.
Labels are easily separable. (This requirement does not apply to safety/ regulatory labels).	Could be required. Would assist with disassembly / recycling.

One example of a potential application of these requirements was considered in the CSTB preparatory study which highlighted a 'recycling friendly' STB with the following features:

- Housing fixed solely by clip-connectors, no screws.
- Just one screw fixing the 12 V plug.
- Only one PCB (printed circuit board), clipped in place.
- Manual separation of housing plastics and PCB within seconds.
- Housing plastics un-coated (only full-body coloured), enabling high level plastics

This contrasted with the typical design of STBs described in the study as "a housing fixed with a couple of screws (although usually screws of the same type) and coated front panels."

The highlighted product was a lower end CSTB with more limited functionality which the study speculates may have facilitated the achievement of a simplified mechanical design. However, this also means that it is probably more relevant to SSTBs than CSTBs. In addition, the recyclability testing described in the SSTB preparatory study also found a reasonably clear trend toward design for recycling in a high proportion of "high end" products (medium to low end products were found to be disappointing in this respect, with only two exceptions).

Another option that can assist with recyclability is the use of HTT boards instead of traditional PCBs. These are made from high temperature-resistant thermoplastics (HTT) that allow for higher recycling performance and avoidance of use of flame retardants. Whilst they were thought to be slightly more expensive than traditional PCBs at the time of the SSTB preparatory study in 2007, it is likely that these products have now shifted toward cost neutrality.

The use of connectors and non-coated plastics was assumed in the preparatory study to lead to an increased share of plastics for material recovery and reduced thermal recovery[205]. The following savings were estimated as a result of design for recyclability:

Table 9-17 Estimated savings as a result of design for recyclability based on SSTB and CSTB preparatory study

Total Energy (GER):	**- 80 %**
Waste (hazardous / incinerated), g:	**- 73 %**
Particulate Matter (emissions to air):	**- 27 %**
Heavy metals (emissions to water),mg Hg/20:	**+81 %**

Assuming 50 % of products would benefit from design for recyclability (the other products already complying), the potential savings are listed in Table 9-17.

Table 9-18: Yearly avoided use of resources in 2020 except for a potential increase in non-hazardous waste.

Resource efficiency impact (other life cycle phases than use phase)	Scenario 6 – Design for recyclability (yearly savings in 2020)
Indirect energy (GER) (TWh)	4.66
Waste non-hazardous (tonnes)	1,118 increase
Waste hazardous (tonnes)	3,746
Emissions - Greenhouse gases in GWP 100 (million kg CO2 eq)	1,710

Scenario 7 – Reducing use of hazardous materials

In this scenario, a special focus is put on the reducing of hazardous materials. It suggests which parameters could potentially lead to better ecodesign of products; however no numbers of the effect are estimated.

Criteria that would assist in reduction of hazardous material content often considered in procurement are evaluated in the table 9-18.

Alternatives to polyvinyl chloride (PVC) were considered in the CSTB preparatory study as removal of PVC is often considered a positive environmental development. Alternative wire coatings are available, and whilst costs were considered high in 2008, it was expected that with time and greater use of these alternatives, economies of scale would result in reduced additional cost. Apple pledged to eliminate completely the use of PVC and brominated flame retardants (BFR) in its products by the end of 2008. According to Apple TV environmental report, the Apple TV IPTV STBs are PVC free and BFR free[206], therefore elimination of hazardous materials such as PVC and BFR in STBs is proven achievable.

No evaluation of this option was included in either preparatory study, so it has not been possible for this scenario to be evaluated for total quantitative savings.

[205] SSTB and CSTB Preparatory study, 2007
[206] Apple TV Environmental Report, http://images.apple.com/environment/reports/docs/AppleTV_Product_Environmental_Report_2012.pdf

Table 9-19 Considered criteria for the reduction of hazardous material content and assessment of applicability to ecodesign requirements

Criteria	Applicability to ecodesign requirements
Product packaging free from PVC	Could be required. Difficult to estimate savings.
Of total plastic parts' weight >25g, require a recycled material content.	Not practical as a regulatory requirement as may impact product performance.
Of total plastic parts' weight >25g, require a biobased material content.	As above
Electrical cable insulation materials of *power* cables are PVC free.	Could be required. Savings not clear – more detailed study required.
Electrical cable insulation materials of *signal* cables are PVC free.	As above
All cover/housing plastic parts >25g are free from chlorine and bromine	Could be required. Savings not clear.
All printed circuit boards (without components) >25g are halogen free. as defined in IEC61249-2-21.	Could be required. Savings not clear.
Plastic parts >25g free from flame retardant substances / preparations above 0.1 % classified as R45, R40, R46, R48, R50, R51, R53, R60, R61 and any combination of these.	Could be harder to apply as may impact on product safety.
Products do not contain short chain chloroparaffins (SCCP) with 10-13 carbon atoms in the chain containing at least 48 % per mass of chlorine in the SCCP.	Could be required. Savings not clear.

9.5.2 Assessment of options

The summary table below highlights that whilst the potential for energy savings through further tightening of the regulation becomes less significant, there is still potential for improvement through addressing the wider resource considerations.

Table 9-20 Resource efficiency savings potential in 2020

Resource efficiency criteria	Scenario 4 – improved lifetime, (savings from 2016 to 2020)	Scenario 5 – Reduced Footprint (yearly savings in 2020)	Scenario 6 – Design for recyclability (yearly savings in 2020)	Scenario 7 – Reduced use of hazardous materials
Materials disposed (thousand tonnes)	10.7			
Materials recycled (thousand tonnes)	14.9			
Indirect energy (GER) (TWh)	1.70	0.97	4.66	N/A
- of which electricity (TWh)	0.51			
Water (process and cooling – billion litres)	3.52			
Waste non-hazardous (tonnes)	95,020	276 increase	1,118 increase	N/A
Waste hazardous (tonnes)	10,641	826	3,746	N/A
Emissions - Greenhouse gases in GWP 100 (kg CO2 eq)	390 million	1118 million	1,710 million	N/A

Savings in indirect energy as for instance 4.66 TWh in Scenario 6 refer to a total indirect energy consumption of 11.6 TWh in 2020 (other lifecycle phases than the use phase).

The figures shown in the above table are very approximate, based on a number of assumptions and outputs of analysis in the preparatory studies.

There are a number of issues related to a resource efficiency approach that would need to be further analysed:

- Is it possible in to enforce the considered resource efficiency requirements?
- This review study indicates potential resource savings based on former STB preparatory studies, but are assumptions from these studies still sound?
- What are the costs to industry and thus consumers of such requirements? In this regard, 'costs' should not be seen as avoided sales income due to product life time extension

The two most promising scenarios are the inclusion of information requirements on installation, and the potential to place a maximum limit on the weight of SSTBs. Consultation would be required on the potential inclusion of resource efficiency requirements in any revision of the SSTB regulation, and further study may be necessary to justify any requirements to industry and member states. The introduction of information requirements around these potential scenarios in this revision (see chapter 7) could be relatively easy to achieve and provide the evidence base necessary for inclusion of such requirements in the subsequent revision. However, it should be noted that considering the potential decline in sales of these products, if resource efficiency requirements are not addressed at this revision, the opportunity for substantial savings could be lost.

9.5.3 Assessment of Information Requirements

In addition to the proposed information requirement relating to product installation, this chapter discusses the potential for manufacturers to provide more detailed information in order to assist with future legislative reviews.

The SSTB regulation as it stands includes requirements to provide detailed information for conformity assessment on the power demand in the various operational modes, and details of various aspects of how the tests were carried out. There is also a requirement for consumers to be provided with information on the power demand of the standby and active modes of the SSTB.

No evaluation has been undertaken of how the information obligations of the SSTB regulation have been met to date. However, the review of the CSTB VA found[207]:

- **Compliance information incomplete:** Whilst manufacturers and service providers of CSTB were required to report information on the energy consumption of their products to the Independent Inspector, this information was in a number of cases difficult to obtain and at times incomplete. One signatory defaulted entirely on the information reporting aspect of the VA.
- **Information to consumers poor:** Requirements in the more recent update of the VA were downgraded from information being "made available online and where relevant and possible" to, in V3.0 a requirement that "Such information shall be made available at the point of sale or where relevant and possible, it may be published online". When asked for a "URL where environmental characteristics and performance of CSTB-types are reported", only 30 % of service providers provided URLs on which information on energy consumption and / or power consumption could readily be found. This suggested to the independent inspector "that transparency on energy consumption of CSTBs toward consumers, shows potential for improvement".

It is therefore also possible that SSTB information provision is not optimal.

Conclusions

Information requirements on modal power demand, TEC, APD availability and resource efficiency considerations such as weight, volume, and hazardous material content could be included within the current revision.

If the suggested information were to be submitted to a centrally managed European Commission database, it would ensure that the information was readily accessible and could be quickly analysed in order to support future revisions. This could be particularly important for resource efficiency considerations.

9.6 Conclusions and Recommendations

9.6.1 Potential energy savings

This review shows that there are still further savings available through a very basic revision of the SSTB regulation by changing definitions and power requirements based around the EU Code of Conduct on Digital TV and the CSTB Voluntary Agreement.

Scenario 2 could provide consistency in regulations by covering most products left in the gap between CSTB VA and current SSTB regulation, leaving the CSTB VA in place as the most appropriate mechanism to address the quickly changing CSTB market as new functions or technologies emerge into the market. Definitions and energy requirements of Scenario 2 are shown in Appendix D.

[207] Independent Inspector to the VA on CSTB Report of the STBs 2010 – 2011, ECOFYS

The benefits of further widening of scope to include removable media recording products (Scenario 3) are questionable, as the additional savings are small, and there may be some difficulties in defining requirements for high-end recording products, as highlighted in the European Commission's Sound and Imaging impact assessment.

9.6.2 Potential wider resource savings

Where savings as a result of a revision are relatively low, there is an opportunity to increase savings by defining requirements that address wider lifecycle impacts. The assessment undertaken in this review of possible approaches showed two promising scenarios – the inclusion of information requirements on installation (Scenario 4), and the potential to place a maximum limit on the weight of SSTBs (Scenario 5). Consultation would be required on the potential inclusion of resource efficiency requirements in any revision of the SSTB regulation, and further study may be necessary to justify any requirements to industry and member states.

The introduction of information requirements around these potential scenarios in this revision (see chapter 7) could be relatively easy to achieve and provide the evidence base necessary for inclusion of such requirements in the subsequent revision. However, it should be noted that considering the potential decline in sales of these products, if resource efficiency requirements are not addressed at this revision, the opportunity for substantial savings could be lost.

A number of issues related to a resource efficiency approach would need further analysis:

- The possibility to enforce the considered resource efficiency requirements
- This review study indicates potential resource savings based on former STB preparatory studies, but soundness of assumptions from these studies should be re-assessed
- Costs to industry and thus consumers of such the requirements would need further assessment. In this regard, 'costs' should not be seen as avoided sales income due to product life time extension

9.6.3 Overview of scenarios

The table below summarises conclusions and assumption from the 7 scenarios considered. Furthermore, it summarises assessment of positive and negative considerations and a final assessment of feasibility of introducing the scenario as a policy option.

Table 6.19 Summary of 7 scenarios considered

Scenarios analysed	Energy savings	Assumptions	Potential cost to manufacturers	Pros	Cons	Assessment of feasibility
1 No change	None	All SSTB products included in BAU	None	Preventing worst basic SSTB products re-entering the market.	Definition out-dated, few future products will be impacted. Grey area products remain unregulated.	Easy
2 Light revision of regulation	0.25 TWh yearly in 2020	CLASP figures include products that would require definition change.	Small – LLCC easily met	Covering all SSTBs with digital outputs and new functions.	Requires a change to requirements and to definitions	Relatively easy
3 Revise scope	0.27 TWh yearly in 2020	Removable media recorder stock from Sound and Imaging impact assessment used. Assumed all have some form of SSTB function.	Small – LLCC easily met	Covering all SSTB products left in the gap of regulations.	May raise problems for high end AV products.	Negotiation required
4 Improved lifetime	1.70 TWh from 2016-2020 (lifecycle)	Evaluates difference in 2 and 6 year lifetimes per product household, impacting 30 % of SSTBs in stock by 2020 due to customer information on installation.	LLCC not carried out. Customer information requirement should be relatively low cost.	Potentially minimum cost to manufacturers	Savings depend upon users acting on information requirements.	Easy
5 Reduced footprint	0.97 TWh yearly in 2020 (lifecycle)	Formula as detailed. Worst performing 17 % of products (excluding VCR products) are excluded from market.	Small – few manufacturers affected. Lighter weight materials may cost the same.	Introducing wider lifecycle related requirements without major cost to manufactures	Overly stringent requirements may result in poorer quality products due to use of flimsier materials.	Negotiation required as this is a new area to be addressed.
6 Design for recyclability	4.66 TWh yearly in 2020 (lifecycle)	Assumes savings from preparatory study, and that 50 % of products would benefit from design for recyclability	Medium – might be costs related to redesign. May be compensated for by reduced costs at recycling stage.	Considerable potential savings	Requirements more complicated to include. Little detailed information on current market status.	Potentially complex.
7 Reduced hazardous materials	Not modelled	N/A	Apple already shifted to direction so cost is likely to be affordable.	Reasonably easy to quantify for compliance purposes.	No market data available. Cross over with RoHS legislation.	Negotiation would be required.

The figures shown in the above table are very approximate and based on a number of assumptions and outputs of analysis in the preparatory studies.

The summary table highlights that whilst the potential for energy savings through further tightening of the regulation becomes less significant, there is still potential for improvement through addressing the wider resource considerations. For instance, Scenario 4 of extending product lifetime indicates 6.8 times higher energy savings through products' life cycles in 2020 compared to Scenario 2 of including grey area products and tightening energy requirements in products' use phases.

9.6.4 Recommendations

Based on this review, the following options are identified.

- **Include unregulated products in the SSTB regulation and tighten the energy requirements by implementing Scenario 2 (stated in Appendix** Error! Reference source not found.**)**
    - **APD has been a crucial element in the current regulation and should be retained.**
    - **The timing of a revision to the SSTB regulation means that a general reference to harmonised standards would need to be maintained, as Edition 4 of EN 62087 may not yet be available.**
- **Consider achieving wider energy and resource savings throughout the products' life cycle by implementing Scenario 4 of extended product life time obtained by information requirements**
- **Consider achieving wider energy and resource savings throughout the products' life cycle by implementing Scenario 5 of introducing requirements around weight (based upon kg per Watt)**
- **Include information requirements on modal power demand, TEC, APD availability and resource efficiency considerations such as weight, volume, and hazardous material content regardless of Scenario 4 being implemented or not**
    - **Organise that information is submitted to a centrally managed European Commission database and this way ensure that the information is readily accessible in order to support future revisions.**

10. Water pumps

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10.1 Introduction

In the Request for Services preceding this study (see section 0) not only a preliminary review study for various consumer products was requested, but also a review regarding the tolerances laid down in Regulation 547/2012 on water pumps.

In this **Commission Regulation No 547/2012**[208] the review of tolerances used in the methodology for calculating the energy efficiency is foreseen before 1 January 2014.

After studying the information and discussions about the tolerances of the pumps in the relevant documents (**Lot 11 Preparatory Study, EN ISO 9906:2012, EN ISO 9906:1999, Working Document on tolerances used in Ecodesign and Energy Labelling Implementing Measures**), it seems, that the reason for the review of tolerances goes back to the review of EN ISO 9906 because the version of 1999 was in review at the time when the Commission Regulation No 547/2012 was published.

When comparing the EN-ISO 9906 version of 1999 with the one of 2012, the treatment of tolerances appears to be the same. Exactly the same formulas and values are used in both versions. Whether a revision of tolerances is indeed necessary cannot be concluded on the basis of changes in the test standards alone.

To finally assess this issue, additional information and the views of the EC and Europump have to be taken into account. Unfortunately the relevant stakeholders could not provide their inputs before the date of submission (4 October 2013) of this report. Therefore this information is still missing and will be included in the final version of the report.

In the following the relevant passages of the above mentioned documents are copied.

10.2 Lot 11 Preparatory Study

Regarding tolerances of water pumps the preparatory study[209] mentions in Task .., page 5:

The magnitude of allowed tolerances under the current ISO 9906 class 2 test standard compared to the observed spread of efficiencies for each type of pump mean that multi-level efficiency labelling schemes are inappropriate. Instead, just two efficiency lines (and hence three bands) are the most that is practical, corresponding to the mandatory CE/MEPs level and the voluntary label/HEPs level.

*This **test standard is being revised**, and will have several new grades. **It should be possible to choose a grade with tolerances tighter than the existing situation**.*

[208] Commission Regulation (EU) No 547/2012 of 25 June 2012 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for water pumps.
OJ L 165 of 26.6.2012

[209] AEA Energy & Management (2008): Lot 11 – Water Pumps (in commercial buildings, drinking water pumping, food industry, agriculture), Report to the European Commission

The revised standard EN ISO 9906 however does not show multiple new grades. Instead the same two efficiency lines are shown.

On page 37 of the study is mentioned:

Performance testing of pumps is to one of two ISO grades, Grade 1 (most accurate) or Grade 2 (least accurate) to EN ISO 9906-1999, (currently being revised). The tolerance on efficiency for ***Grade 2, which is the norm for mass produced pumps of the type with which this study is most closely concerned, is 5%*** *of the value.*

And on page 38:

Pump Efficiency Tolerances per EN ISO 9906:1999

The following is the study group's interpretation of these allowed tolerances: Tolerances are applicable when comparing a Test efficiency with a Guaranteed efficiency. The highest relevant Tolerance factor listed below should be used.

A. General.

Grade 1 Test: The Test efficiency shall not be below the guaranteed efficiency by more than (3% x guaranteed efficiency).

Grade 2 Test: The Test efficiency shall not be below the guaranteed efficiency by more than (5% x guaranteed efficiency).

B. Pumps produced in series with selection made from typical performance curves.

Grade 2 Test: The Test efficiency shall not be below the guaranteed efficiency by more than (7% x guaranteed efficiency).

C. Pumps with a driver power input less than 10 kW but greater than 1 kW.

Grade 2 Test: The Test efficiency shall not be below the Guaranteed efficiency by more than (T% x Guaranteed efficiency) where T = [17 – (Maximum driver power input in kW over the range of operation)] [A tolerance is allowed on driver power input of (49+T2) %]

D. Pumps with a driver power input less than 1 kW.

Grade 2 Test: Another special agreement may be made between the parties.

10.3 Commission Regulation No 547/2012

In Article 7 is stated:

The Commission shall review the tolerances used in the methodology for calculating the energy efficiency before 1 January 2014.

The only tolerance described in the current Regulation applies to the verification procedure for market surveillance purposes as described in Annex IV:

The hydraulic pump efficiency measured at each of the conditions BEP, PL and OL does not vary below the values set out in Annex II by more than 5 %.

Therefore the tolerances apply to establishing the hydraulic pump efficiency in the following operating conditions: BEP (best efficiency point), Pl (part load) and OL (over load). PL and Ol refer to conditions at respectively 75% and 110% of the flow at BEP.

The hydraulic pump efficiency is calculated on the basis of the input power [P, in kW], the head (H, in m) and the flow [Q, in m3/h]. The formula is not provided in the Regulation, but is described in the EN 9906.

10.4 Transitory Method 2012/C 402/07

The transitory method[210] published in connection to Regulation 547/2012 specifies that:

For the purposes of verification of compliance with the requirements of Commission Regulation (EU) No547/2012 pump efficiency tests shall be carried out as follows.

1. All measurement shall be done according to ISO EN 9906 Class 2b. The exception specified in that standard for total tolerance of pump efficiency for pump power input of 10kW and below shall not be considered.

The maximum permissible random uncertainty is specified in table 2 of the Communication:

Table 2

Maximum permissible random uncertainty $e_{r,max}$

Measured quantity	Maximum permissible random uncertainty $e_{r,max}$
Rate of flow	± 3 %
Differential pressure	± 4 %
Discharge pressure	± 3 %
Suction pressure	± 3 %
Drive power input	± 3 %
Speed of rotation	± 1 %
Torque	± 3 %
Temperature	± 0,3 °C

The maximum permissible systematic uncertainty is specified in table 3.

Table 3

Maximum permissible measurement device uncertainty $e_{s,max}$

Measured quantity	Maximum permissible measurement device uncertainty $e_{s,max}$
Rate of flow	± 2,5 %
Differential pressure	± 2,5 %
Discharge pressure	± 2,5 %
Suction pressure	± 2,5 %

[210] Commission communication in the framework of the implementation of Commission Regulation (EU) No 547/2012 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for water pumps.
(Publication of titles and references of transitional methods of measurement (1) for the implementation of Commission Regulation (EU) No 547/2012 and, in particular, Annex III and IV thereof)
(2012/C 402/07)

Drive power input	± 2,0 %
Speed of rotation	± 1,4 %
Torque	± 2,0 %
Temperature	± 1,0 °C

The maximum overall tolerance for measurements is t tot = 5 %. Measurement devices shall be chosen not to exceed this overall tolerance. Consequently, measured pump efficiencies for BEP, PL, and OL are not allowed to fall below the threshold value defined as follows:

$$\eta_{threshold} = (1 - t_{tot}) \cdot \eta_{min,req} = 0{,}95 \cdot \eta_{min,req}$$

It is intended that the transitional methods will ultimately be replaced by harmonised standard (pr) EN 16480. When available, reference(s) to the harmonised standard will be published in the Official Journal of the European Union in accordance with Articles 9 and 10 of Directive 2009/125/EC.

A prEN 16480:2012 has been prepared by Technical Committee CEN/TC 197 “Pumps”, the secretariat of which is held by AFNOR.

10.5 Standard EN ISO 9906:2012

As EN 16480 is partly based on the global EN ISO 9906 this latter standard is described in more detail. EN ISO 9906 spends a significant amount of text on the concept of pump grades, which describe the maximum deviation allowed from a declared value. Grades therefore have a relation to verification tolerances.

10.5.1 The overall uncertainty of efficiency

The value for overall uncertainty, *e*, is given by:

$e \cdot (e_R^2 \cdot e_S^2)^{1/2}$

where e_R ad e_S are random and systematic uncertainty respectively (see next section).

Permissible values of overall measurement uncertainties, *e*, are given in Table 6.

NOTE: The overall uncertainty, as defined in this International Standard, is equated with expanded measurement uncertainty (see ISO/IEC Guide 99).

Table 10-1 Permissible values of overall uncertainties

Quantity	Symbol	Grade 1 (%)	Grades 2, 3 (%)
Flow rate	*eQ*	±2,0	±3,5
Speed of rotation	*en*	±0,5	±2,0
Torque	*e*T	±1,4	±3,0
Pump total head	*eH*	±1,5	±3,5
Driver power input	*eP*gr	±1,5	±3,5
Pump power input (computed from torque and speed of	*eP*	±1,5	±3,5

rotation)			
Pump power input (computed from driver power and motor efficiency)	*eP*	±2,0	±4,0

Determination of overall uncertainty of efficiency

The overall uncertainty of the overall efficiency and of the pump efficiency is calculated using formulae [insert reference]:

$e\eta gr = (e_Q^2 \cdot e_H^2 \cdot e_{Pgr}^2)^{1/2}$

If efficiency is computed from torque and speed of rotation:

$e\eta = (e_Q^2 \cdot e_H^2 \cdot e_T^2 \cdot e_n^2)^{1/2}$

If efficiency is computed from pump power input:

$e\eta = (e_Q^2 \cdot e_H^2 \cdot e_P^2)^{1/2}$

Using the values given in Table 10-1**Error! Reference source not found.**, the calculations lead to the results given in Table 10-2.

Table 10-2 Resulting greatest values of the overall uncertainties of efficiency

Quantity	Symbol	Grade 1	Grades 2 and 3
		%	%
Overall efficiency (computed from *Q*, *H*, *P*gr)	*eη*gr	±2,9	±6,1
Pump efficiency (computed from *Q*, *H*, *M*, *n*)	*eη*	±2,9	±6,1
Pump efficiency (computed from *Q*, *H*, *P*gr, *η*mot)	*eη*	±3,2	±6,4

10.5.2 Statistical evaluation of overall measurement uncertainty

The estimate of the random component (random uncertainty)

The random component due either to the characteristics of the measuring system or to variations of the measured quantity or both appears directly as a scatter of the measurements. Unlike the systematic uncertainty, the random component can be reduced by increasing the number of measurements of the same quantity under the same conditions.

A set of readings not less than three (3) shall be taken at each test point. The random component, e_R, shall be calculated as follows:

The estimate of the random component of measurement uncertainty is calculated from the mean and the standard deviation of the observations. For the uncertainty of the readings, replace *x* with the actual measurement readings of flow, *Q*, head, *H*, and power, *P*.

Table 10-3 Values of Student's t-distribution

n	*t*	*n*	*t*
3	4,30	12	2,20
4	3,18	13	2,18
5	2,78	14	2,16
6	2,57	15	2,14
7	2,45	16	2,13
8	2,36	17	2,12
9	2,31	18	2,11
10	2,26	19	2,10
11	2,23	20	2,09

(based on 95 % confidence level)

The estimate of the instrumental measurement uncertainty (systematic uncertainties)

After all known errors have been removed by zero adjustment, calibration, careful measurement of dimensions, proper installation, etc., there remains an uncertainty which never disappears. This uncertainty cannot be reduced by repeating the measurements if the same instrument and the same method of measurement are used.

The estimate of the systematic uncertainty of the uncertainty, *e* S, is in practice based on calibration traceable to international measurement standards. Permissible relative values for the systematic uncertainty in this International Standard are given in Table 5.

Table 10-4 Permissible relative values of the instrumental uncertainty, eS

Measured quantity	Maximum permissible systematic uncertainty (at guarantee point)	
	Grade 1	**Grades 2 and 3**
	%	%
Rate of flow	±1,5	±2,5
Differential head	±1,0	±2,5
Outlet head	±1,0	±2,5
Inlet head	±1,0	±2,5
Suction head for NPSH testing	±0,5[211]	±1,0
Driver power input	±1,0	±2,0
Speed of rotation	±0,35	±1,4
Torque	±0,9	±2,0

The above values are identical to the values in table 3 of the Transitory method, except for the actual wording (EN 9906 uses 'head', whereas the table refers to 'pressure') and the value for suction head for NPSH testing (not present in table 3).

[211] According to NPSH testing, positive tolerances are not permissible for NPSH tests. Moreover, all overall uncertainties should be taken into account to ensure that the specified values are achieved despite the mentioned uncertainties and manufacturing tolerances. In the case of NPSH measurement, this means that neither manufacturing tolerances nor measurement uncertainty should result in non-conformities, e.g. higher NPSH values than agreed upon. For this reason, it is appropriate and necessary to keep the measurement uncertainty and, thus, the instrumental measurement uncertainty ("systematic uncertainties"), as low as possible. Otherwise, requirements regarding the manufacturing tolerances become ever more stringent which can entail a (normally) permanently higher amount of time and work required. This causes a reduced maximum allowable instrumental measurement uncertainty for the NPSH test.

10.5.3 Acceptance grades and tolerances

For acceptance tests the three grades are further subdivided into six acceptance grades which differ as to which overall grade they refer and whether the error is single or double sided: Grade 1 is the most stringent grade, with 1U and 2U having a **u**nilateral tolerance and grades 1B, 2B and 3B having a **b**ilateral tolerance. Grade 1E is also bilateral in nature and is important to those concerned with energy efficiency.

NOTE: The grades 1U, 1E and 1B have the same tolerance for flow and head.

The purchaser and manufacturer may agree to use any grade to judge whether or not a specific pump meets a guarantee point. If a guarantee point is given, but no acceptance grade is specified, this standard reverts to a default test acceptance grade, as described in EN ISO 9906:2012, Chapter 4.5.

Guarantee point acceptance grades for pump head, flow, power and efficiency are provided in Table 8. All tolerances are percentages of values guaranteed.

Table 10-5 Pump test acceptance grades and corresponding tolerance

Grade	1			2		3	
τQ		10 %			16 %	18 %	Guarantee requirement
τH		6 %			10 %	14 %	
Acceptance grade	**1U**	**1E**	**1B**	**2B**	**2U**	**3B**	
τQ	+10 %	±5 %		±8 %	+16 %	±9 %	Mandatory
τH	+6 %	±3 %		±5 %	+10 %	±7 %	
τP	+10 %	+4 %		+8 %	+16 %	+9 %	Optional
$\tau \eta$	≥0 %		−3 %	−5 %		−7 %	

NOTE: $\tau x (x = Q, H, P, \eta)$ stands for the tolerance of the indicated quantity.

Tolerances for pumps with an input power of 10 kW and below

For pumps with shaft power input of below 10 kW, the tolerance factors given in Table 8 can be too stringent.

If not otherwise agreed upon between the manufacturer and purchaser, the tolerance factors shall be the following:

- rate of flow τQ = ±10 %;
- pump total head τH = ±8 %.

The tolerance factor on efficiency, $\tau \eta$, if guaranteed, shall be calculated as given by formula:

$T\eta \cdot - [10\ (1 - P2/10) \cdot 7]$ %

where the pump power input, $P2$, is in accordance with the maximum shaft power (input), $P2$,max, in kilowatts, over the range of operation.

A tolerance factor, τP,gr ,is allowed using formula [26, insert reference]:

$\tau_{P,gr} \cdot ((7)^2 \cdot \tau_\eta^2)^{1/2}$ %

10.5.4 Fluctuations

EN 9906 also describes permissible amplitudes of fluctuations. Where the design or operation of a pump is such that fluctuations of great amplitude are present, measurements may be carried out by providing a damping device in the measuring instruments or their connecting lines, which is capable of reducing the amplitude of the fluctuations to within the values given in . A symmetrical and linear damping device shall be used, for example a capillary tube, which shall provide integration over at least one complete cycle of fluctuations.

Table 10-6. Permissible amplitude of fluctuation as a percentage of mean value of quantity being measured

	Permissible amplitude of fluctuations		
Measured quantity	**Grade 1**	**Grade 2**	**Grade 3**
	%	%	%
Rate of flow	±2	±3	±6
Differential head	±3	±4	±10
Outlet head	±2	±3	±6
Inlet head	±2	±3	±6
Input power	±2	±3	±6
Speed of rotation	±0,5	±1	±2
Torque	±2	±3	±6
Temperature	0,3 °C	0,3 °C	0,3 °C

As fluctuations are more of a quality or performance issue rather than an energy efficiency issue, these permissible amplitudes shall not be considered relevant for the review.

10.5.5 Working Document on tolerances

A Working Document on tolerances[212] used in Ecodesign and Energy Labelling Implementing Measures was presented. This document outlined the preferred approach regarding tolerances for verification purposes. As *Proposed solution for the new and existing implementing measures* it is proposed to consider acting as follows:

Annex on verification procedures

Requirements to be included in the Annex on verification procedures in all existing and forthcoming ecodesign and energy labelling regulations as follows:

- Disallow the use of more favourable declared values by suppliers than the values reported in the technical documentation;
- Ensuring that tolerances relate only to the verification of the measured parameters by Member State authorities and shall not be used by the supplier as an allowed tolerance on the values in the technical documentation to achieve a more efficient

[212] www.eup-network.de/fileadmin/user_upload/Produktgruppen/Lots/Final_Documents/Note_on_Tolerances__01.pdf?PHPSESSID=d68703679da11c2800360d7b99c6d1f8

energy class in energy labelling regulations or to achieve compliance with ecodesign requirements;

10.6 Conclusions

The assessment of tolerances to be used in verification of hydraulic pump efficiency could not yet be finalised as some stakeholders have not been consulted.

Nonetheless it appears that EN ISO 9906 and the forthcoming EN 16480 that is (partly) based on EN ISO 9906 do not deviate strongly from the required test tolerances as described in the Transitory Method.

The current limit value in the Regulation 547/2012 of ±5% relates to the overall uncertainty of efficiency, which for grade 2/3 is ±6.1% and for grade 1 is ±2.9%. The verification tolerance set by 547/2012 appears to be positioned between grade 1 and 2/3 (closer to the latter). Contrary to the standard EN ISO 9906 no specific higher tolerance is allowed for pumps less than 10 kW in the Transitory Method.

The existence of grade 1 with efficient tolerances of less than 5% seems to indicate that a tighter tolerance could be specified in a future revised Regulation. However, the impacts on product price, performance and costs of testing cannot be assessed without further study.

Furthermore, as the first tier of ecodesign requirements entered into force on the 1st of January 2013, almost a year of experience with establishing an energy efficiency according the method set out by 547/2012 is present.

The conclusions are therefore:

- Liaise with the TC responsible for EN 16480 to verify whether the transitory method is respected and its tolerances can be achieved (note: this has been intended for this study, but consultation has not happened yet);
- Consult with manufacturers as regards their experience of almost one year of ecodesign Regulation including the impacts of a possible change (stricter or relaxed?) verification tolerance;

11. Conclusions and Recommendations

11.1 Introduction

As stated in Chapter 1, the aim of this study is to provide the Commission with information to decide on subsequent activities as regards timing and resources to be allocated to review activities.

The review activities relate to the following product groups and regulations/directive (and their amendments, corrigenda).

Table 11-1: Overview of measures to be reviewed

Product group	Reference	Measure
Household dishwashers	Commission Regulation (EC) No 1016/2010 Commission Regulation (EC) No 1059/2010	Ecodesign Energy labelling
Household washing machines	Commission Regulation (EC) No 1015/2010 Commission Regulation (EC) No 1061/2010	Ecodesign Energy labelling
Household washer dryers	Commission Directive 96/60/EC	Energy labelling
Household cold appliances	Commission Regulation (EC) No 643/2009 Commission Regulation (EC) No 1060/2010	Ecodesign Energy labelling
Simple set-top boxes	Commission Regulation (EC) No 107/2009	Ecodesign
Non-directional lamps (incl. special purpose)	Commission Regulation (EC) No 244/2009 [1)]	Ecodesign
Lamps without ballast & ballasts (incl. special purpose)	Commission Regulation (EC) No 245/2009 [2)]	Ecodesign
Water pumps	not assessed as only tolerances were reviewed	

All the product groups considered in this study[213] at one point in time did meet criteria for introduction of delegated regulations (and a directive). These regulations (and a directive) are now up for review. The Commission will need to decide how to go about the review of these existing measures.

The information to be provided to the Commission will be in the form of recommendations regarding the preferred subsequent activity. To arrive at these recommendations a staged approach is applied, that first identifies the context of possible follow-up activities and then gives greater detail to the actual content of these activities. The recommendations conclude with a prioritisation of these activities.

For this, the following steps have been applied:

1. identification of possible or preferred **policy options**. These can be one of four possible options, ranging from "do nothing" to introduction of significant changes to existing measures.
2. In case an significant revision or change in Ecodesign or labelling (delegated) regulations is selected as possible policy option a check regarding **eligibility** criteria (Article 15, item 2 of 2009/125/EC) is appropriate. This check will also cover the criteria for introduction of energy labelling measures (Article 10, item 2 of 2010/30/EC);

[213] "Water pumps" are not covered in this chapter as only a review of tolerances was required.

3. A **prioritisation** of the identified follow-up work is then applied on the basis of the following criteria:
    a. what is the savings potential in energy?
    b. what is the expected level of complexity, or number of issues to address in the follow-up work? (this affects expected timing of study and resources).

    A prioritisation on the basis of resource efficiency aspects appeared not feasible as it was not possible to quantify the savings for the product groups on an even basis. For some product groups resource efficiency aspects have been addressed more thoroughly than others[214]

Note the above assessment applies to, or ties in with, both an assessment of Ecodesign and Energy Labelling as policy options. The above described three steps are further explained in the following sections.

11.2 Policy options considered for review

For the general review of ecodesign and energy labelling (delegated) regulations there are four main policy options to be considered:

Option 1: No change

This option incurs no change to the existing legal framework. The existing Regulation remains in force without changes to scope or requirements (Business as usual, 'BAU').

Option 2: Termination of existing Regulation(s)

This option incurs a change to the existing legal framework. The application of the existing Regulation is terminated for market reasons, technology reasons (and/or other relevant reasons) that justify the termination of existing ecodesign and/or energy labelling requirements.

Option 3: Self-regulation measure

This option incurs a change to the existing legal framework. The existing Regulation is repealed as the relevant industry has proposed a (new) valid self-regulation measure ('SR') for the product group in question.

Option 4: Revision of the existing Regulation

This option incurs a change to the existing legal framework. The application of the existing Regulation will be amended by changing relevant aspects, such as scope, requirements (type, level of stringency and/or timing) and/or the period of the application.

The information presented in Chapter 2 to 10 has led to the following conclusions:

[214] Resource efficiency of simple set top boxes was added as energy savings appeared very small and the team looked for additional saving options. For wet appliances the team assessed the status of development of instruments and methods for resource efficiency and included water as resource parameter in the analysis.

Table 11-2: Assessment of policy options

Product group	Preferred policy option(s)	Conclusions
Household dishwashers	Revision of existing regulation(s)	The assessment provided ample evidence that the current regulations should be revised. This was supported by all stakeholders.
Household washing machines	Revision of existing regulation(s)	The assessment provided ample evidence that the current regulations should be revised. This was supported by all stakeholders.
Household washer dryers	Termination of Directive (outdated) AND Revision of existing or introduction of new regulation (depends on whether the washer-drier is included in scope of existing regulations, or will be covered by a new regulation)	The assessment provided ample evidence that the current Directive should be terminated and a (new) energy labelling regulation should be introduced, combined with measures under the ecodesign directive. This was supported by all stakeholders.
Household cold appliances	Revision of existing regulation(s)	The assessment provided ample evidence that the current regulations should be revised. This was supported by all stakeholders.
Non-directional lamps including special purpose lamps	Revision of existing regulation(s)	The assessment provided ample evidence that the current regulations should be revised. This was supported by all stakeholders.
Lamps without ballast & ballasts, including special purpose lamps	Revision of existing regulation(s)	The assessment provided ample evidence that the current regulations should be revised. This was supported by all stakeholders.
Simple set-top boxes	No change OR Revision of existing regulation	Here two options were considered feasible. The first being a revision of existing measures (extending scope, changing requirements) as assessed in the study Chapter 9, the second being the option for 'no change' to the existing legal framework as the product group in question would become insignificant anyway due to market developments, as expressed by a stakeholder on the 18th of November 2013 (and at the moment the sales become irrelevant, termination of the existing regulation becomes an option).

As all product groups considered contain the possibility of a revision of the existing measure, they all will be considered in the next step, eligibility of the product group for ecodesign and/or energy labelling measures.

11.3 Eligibility of the product groups for measures

The Ecodesign directive 2009/125/EC identifies in Article 15, item 2 eligibility criteria for the product to be covered by implementing measures (or self-regulation) under the Ecodesign Directive. A largely similar set of criteria exists in the Energy labelling Directive, Article 10, item 2. The assessment will be based on the more specific criteria listed in the ecodesign directive, which are as follows:

1. the product shall represent a significant volume of sales and trade, indicatively more than 200 000 units a year within the Community unity according to the most recently available figures;
2. the product shall, considering the quantities placed on the market and/or put into service, have a significant environmental impact within the Community, as specified in the Community strategic priorities as set out in Decision No 1600/2002/EC, and
3. the product shall present significant potential for improvement in terms of its environmental impact without entailing excessive costs, taking into account in particular:
    a. the absence of other relevant Community legislation or failure of market forces to address the issue properly; and
    b. a wide disparity in the environmental performance of products available on the market with equivalent functionality.

The information presented in Chapter 2 to 10 has led to the following conclusions:

Table 11-3: Assessment of eligibility criteria

Product group	Econ. sign.	Env. sign.	Saving potential / environmental disparity	Conclusions
Household dishwashers	Proven	Proven	Proven	The assessment provided ample evidence that the product group is economically and environmentally significant. The assessment also identified an improvement potential and a disparity in environmental performance, although this is based on limited information available. This assessment was supported by all stakeholders. Whether this potential can be realized without entailing excessive costs could not be fully assessed in this study.
Household washing machines	Proven	Proven	Proven	
Household washer dryers	Proven	Proven	Proven	
Household cold appliances	Proven	Proven	Proven	
Non-directional lamps including special purpose lamps	Proven	Proven	Proven	
Lamps without ballast & ballasts, including special purpose lamps	Proven	Proven	Proven	
Simple set-top boxes	In decline, insignificant by 2030	In decline, insignificant by 2030	Depends on scope of products covered, improvement potential at resource level is higher but more difficult to unlock	Although the assessment provided evidence that the product group is currently economically and environmentally significant, the market trends are such that this conclusion is expected to change in the future. The assessment identified an improvement potential and a disparity in environmental performance, although this is based on limited information available. The current (limited) assessment did not identify excessive costs for unlocking this potential. This assessment was supported by all stakeholders.

The scope of the study did not allow the full assessment whether excessive costs or other negative impacts would apply.

In order to better define the need for further study, the following section provides an assessment of possible aspects to consider or issues to address, which may be relevant for the decision for further study.

11.4 Issues relevant for prioritisation for further study

This section will show in greater detail which aspects, topics or issues are expected to be relevant for the decision for and prioritisation of further follow-up studies.

The following sections give 'product group by product group' the main conclusions for the follow-up activities to be developed.

11.4.1 Dishwashers

For household dishwashers the recommended policy option is to revise the existing regulations for ecodesign and energy labelling.

For the revision of measures the following aspects need to be taken into account:

Table 11-4: Dishwashers - Issues to address

Aspect to consider	Remark
Assess possibility to revise energy efficiency classes	There are models available on the market which are beyond the current highest energy efficiency class. The better efficiency can not be clearly shown to consumers. Introduction of new classes and/or revision of existing classes should be considered. This should consider also the expected speed of change in energy efficiency.
Assess possibility to revise energy efficiency requirements	As general energy efficiency has improved over the years, an assessment should be made whether the levels for minimum energy efficiency could be revised. This assessment should take into account how the requirements would affect affordability, use of proprietary technology, etc. .
	This assessment could also cover the feasibility for requiring hot-fill as option (now already possible on most appliances).
Assess possibility to introduce resource efficiency requirements	The assessment of ecodesign requirements should also cover possibilities to introduce resource efficiency requirements.
Assess possibility to revise measurement and calculation methods	The current harmonized standard is expected to change, with respect with load type and soiling type. An analysis how this affects current performance levels should be made. This should be aligned with a possible revision of ecodesign levels and energy label classes.
	The borderline between slim-line (45 cm width, usually max 10 place settings) and standard size appliances (60 cm width, usually more than 11 place settings) should be made more consistent over the two regulations (ecodesign and energy labelling).
	The calculation method for energy efficiency (for both ED and EL) is currently based on a calculation of the annual energy consumption, based on annual cycles and a consideration of low power modes. As this information is also shown on the energy label to inform buyers of typical consumption, it should reflect real life consumption as much as possible. The revision should assess : a) continuation of the need for inclusion of low power modes in the calculation method, as its share in the annual consumption is declining. b) the possibilities for inclusion of part load and cleaning cycles that are not the current standard cycle to be used for declaring performance (high temperature programs). The latter is also related to the revision of the standard with respect to load types and soiling types. c) the assessment should consider the frequency of use (to verify the number of annual cleaning cycles)
Assess possibilities to revise other regulatory	The revision could address inconsistencies between definitions used in the regulation text and the EN standard

text items

The above assessment reveals a possible two staged approach:

An stakeholder consultation could reveal support for a fast-track revision. This fast-track revision should include an analysis which may show that the changes in the test standard have limited effect on the current performance levels, and therefore also on least life cycle costs expected, and that maybe a modest revision can be performed, changing relatively small aspects (such as the inconsistencies between regulations and regulation vis-a-vis test standards).

If however the initial stakeholder consultation shows such a fast-track approach not to be preferred, as the supporting analysis shows a significant change is needed in measurement and calculation methods, then a more thorough revision is required, which could then also address the other issues mentioned.

11.4.2 Washing machines

For household washing machines the recommended policy option is to revise the existing regulations for ecodesign and energy labelling.

For the revision of measures the following aspects need to be taken into account:

Table 11-5: Washing machines - Issues to address

Aspect to consider	Remark
Assess possibility to revise energy efficiency classes	There are models available on the market which are very much beyond the current highest energy efficiency class. The better efficiency is now communicated to consumers by unofficial designations such as "A+++ -50%". Introduction of new classes and/or revision of existing classes must be considered. This should consider also the expected speed of change in energy efficiency and the cause for the rapid change of the market.
Assess possibility to add additional information in energy label	An assessment should be made whether the energy label information should also present wash cycle duration and (typical) wash cycle temperature. Additionally, the re-introduction of washing performance class should be assessed.
Assess possibility to revise energy efficiency requirements	As general energy efficiency has improved over the years, an assessment should be made whether the levels for minimum energy efficiency should be revised. This assessment should take into account how the requirements would affect affordability, use of proprietary technology, etc. . Important aspect is to assess the possibilities for a different washing 'portfolio' (the washing cycles on which energy efficiency etc. will be based upon).
	Possibilities for rinsing performance requirements should be assessed.
	Some stakeholders have requested spin drying performance requirements. The consequences should be assessed.
	Some stakeholders have requested an assessment for hot-fill as requirement.
Assess possibility to introduce resource efficiency requirements	The assessment of ecodesign requirements should also cover possibilities to introduce resource efficiency requirements
Assess possibility to revise measurement and calculation	An assessment should be made on whether and how consumers perceive the difference in indicated temperature of the standard cycle and the actual temperatures, including an assessment of how consumers perceive the increase of washing cycle duration.

methods	This could feed into an assessment of changes needed in washing cycle portfolio and definition of 'standard' cycles.
	An assessment should be made on the corrections for washing machine capacity (the reference energy consumption). This relates to expected real life use of larger capacity machines: what is typical loading behavior?
	The calculation method for energy efficiency (for both ED and EL) is currently based on a calculation of the annual energy consumption, based on annual cycles and a consideration of low power modes. An implementation on how to measure/calculate low power modes is introduced in EN standards. Options for alignment with regulation text should be assessed. The assessment should consider the frequency of use (to verify the number of annual cleaning cycles)
Assess possibilities to revise other regulatory text items	The revision could address inconsistencies between definitions used in the regulation text and the EN standard

An in-depth analysis will be required, to address issues related to consumer perception of temperatures, and cycle duration, consumer research into actual loading behavior, frequency and temperature settings (set and measured), and the change in the portfolio of washing programs to better reflect actual washing behavior.

Considering the above assessment a fast track approach is probably not an option for this product group, as the issues to be addressed may require profound changes to the measurement and calculation of energy efficiency, the classes defined and the requirements set.

11.4.3 Washer-driers

For household washer-driers the recommended policy option is to terminate the existing Directive for energy labelling and to introduce an regulation under Ecodesign and Energy labelling.

For this the following aspects need to be taken into account:

Table 11-6: Washer driers - Issues to address

Aspect to consider	Remark
General	Two main options have presented themselves: Either embark on a new, specific for washer-driers approach for establishing the energy efficiency. This should include a more realistic weighing of washing and drying cycles. Or to align the requirements as closely as possible with those for other laundry appliances (washing machines and tumble driers). This latter option would be easier to implement, but is dependent on development of regulations for washing machines (and tumble driers, in the future). One option is to open up the scope of washing machine and tumble drier regulations to include washer driers, and have requirements imposed at appropriate levels. The consequence is that the washer-drier would carry two separate labels.
Aspects related to energy labelling and ecodesign	All the issues mentioned under 'washing machines' would most likely apply as well.

The above assessment reveals a possible two staged approach:

An initial stakeholder consultation could reveal support for a fast-track revision in which follow-up analysis could assess which of the above described options would be preferred (stand-alone regulation, as separate label and requirements, or seek alignment with washing machines / tumble driers as much as possible). This analysis could also include suggestions for labelling and/or ecodesign requirements.

If the fast track revision is not supported a more in-depth study would be needed to cover the above aspects. Note that the discussion of issues relevant for washing machines apply to washer-driers as well. Adding complexity is that the revision of the tumble drier regulation is not aligned with that of washing machines.

11.4.4 Cold appliances

For household cold appliances (refrigerators, freezers and combinations thereof) the recommended policy option is to revise the existing regulations for ecodesign and energy labelling.

For the revision of measures the following aspects need to be taken into account:

Table 11-7: Cold appliances - Issues to address

Aspect to consider	Remark
Assess possibility to revise energy efficiency classes	There are models available on the market which are beyond the current highest energy efficiency class. Introduction new classes and/or revision of existing classes should be considered. This should consider also the expected speed of change in energy efficiency. This assessment should consider possible consequences from a change in the test standard to be used.
Assess possibility to revise energy efficiency requirements	As general energy efficiency has improved over the years, an assessment should be made whether the levels for minimum energy efficiency should be revised. This assessment should take into account how the requirements would affect affordability, use of proprietary technology, etc. . This assessment should consider possible consequences from a change in the test standard to be used.
Assess possibility to introduce resource efficiency requirements	The assessment of ecodesign requirements should also cover possibilities to introduce resource efficiency requirements.
Assess possibility to revise measurement and calculation methods	Certain stakeholders have questioned the various correction factors that are applied in the calculation for energy efficiency (such as defrost options, climate class, chill compartment and the "M+N" parameters that are used to calculate the reference energy consumption. Especially the latter have not been assessed since their introduction over a decade ago. Technologies and market segmentation have changed considerably since then. The (combined) effect of correction factors should be assessed. This should also consider an assessment for the need of 10 categories.
Assess possibilities to revise other regulatory text items	The revision could address inconsistencies between definitions used in the regulation text and the EN standard

The follow-up analysis is expected to show that more than modest changes to the regulation are required, focusing on measurement and calculation methods, energy label classes and information elements and level/type of ecodesign requirements.

As regards wine storage appliances, the assessment suggests a potential for introduction of ecodesign requirements on energy efficiency, as a wide disparity exists and potential savings are not negligible[215]. As the methodology and standards for establishing energy efficiency are shared with other cold appliances, the above comments and remarks apply to wine storage appliances as well.

11.4.5 Non-directional lighting

The information provided in chapter 6 shows there are considerable uncertainties when and how a revision of the existing regulation should be implemented in order to minimise possible negative impacts in terms of functionality, affordability and industry's competitiveness.

Addressing these uncertainties, in consultation with stakeholders, would require a comprehensive follow-up study. Such a follow study could also look into the possibility of a holistic approach whereby the regulations for all lighting products (including 245/2009 and 1194/2012) are treated in a single piece of legislation.

Therefore, for lighting products, a comprehensive study is the preferred follow-up activity.

11.4.6 Special purpose lamps

The information provided in chapter 8 shows there are options for the review of the legislation as regards special purpose lamps. these options relate to lifting the exemption for rough service lamps, restricting the distribution of special purpose lamps to professional channels and/or requiring a specific declaration on the lamp packaging of the technical characteristics that make the lamp 'special purpose'.

More in general, the definitions of special purpose lamps in lighting related Ecodesign and labelling legislation should be made clearer and more consistent. Within the restricted resources and timeframe of the Omnibus project it was not proven possible to make a comprehensive technical proposal on this subject.

This work would require a comprehensive follow-up study, as for general lighting products.

11.4.7 Tertiary lighting

The information provided in chapter 7 shows there are considerable savings to be achieved, but that there are also uncertainties when and how a revision of the existing regulation should be implemented in order to minimise possible negative impacts in terms of affordability and industry's competitiveness functionality.

Addressing these uncertainties, in consultation with stakeholders, would require a comprehensive follow-up study, as for other lighting products.

Such a follow-up study could also look into the possibility of a holistic approach whereby the regulations for all lighting products (including 245/2009 and 1194/2012) are treated in a single piece of legislation. This approach was abandoned in 2009 due to lack of time but still makes sense. This allows also integrating other elements such as dimming requirements and luminaires that are currently not in the regulation.

[215] This is assuming the analysis of sales, stock, product life and average energy consumption is representative of real life. This is to be proven in a more thorough study.

11.4.8 Simple set top boxes

For simple set top boxes two main options appear feasible:

1) Either to not invest time and resources into a product group whose relevance is rapidly decaying;
2) or to revise the regulation in order to achieve greater consistency across the various related products (voluntary agreement for complex set top boxes, code-of-conduct for digital TV) and to reap the remaining energy savings.

Additionally, the assessment provided in this study indicated further savings possible at resource efficiency level. Although the current analysis is not sufficient as scrutiny against article 15 of the ecodesign directive for possible requirements it does present an interesting case study for development of such requirements.

Table 11-8: Simple set top boxes - Issues to address

Aspect to consider	Remark
Assess acceptance of stakeholders for 'no change' option	The aspects to consider are actually three choices to make regarding changing or revising the current Regulation. This requires a more formal consultation of stakeholders than performed under this study, although it could be based on the findings of this study.
Assess possibility for introduction of energy efficiency requirements	In case the discussion of the interim report of this study, at 18 october 2013 is considered a pre-cursor of this consultation, it may be that the no-change option is supported. None of the participants supported a revision of regulation option.
Assess possibility for introduction of resource efficiency requirements	In case a revision is indeed preferred, than an assessment should both consider the need for a change in the scope of the measure and the requirements . This assessment should consider the appropriateness for introducing requirements regarding energy efficiency as well as resource efficiency. This assessment would take into account how the requirements would affect affordability, use of proprietary technology, etc. .

The information provided in chapter 9 shows there are reasons to either consider a review of the legislation or to ignore the product group as the relevance for such a revision is rapidly declining as sales diminish.
Therefore a more formal stakeholder consultation is proposed to assess the support for either option (no change, slight change in scope and revised energy requirements, or thorough overhaul by changing scope, energy requirements and introduction of resource efficiency requirements).

The stakeholder meeting did not indicate direct support for revising the measure and no comments have been received regarding this product group.

11.5 Final recommendations - summary

The above described assessment has led to the following final recommendations as regards prioritisation and level of follow-up study. These are based on the following criteria:

1. what is the energy savings potential?
2. what is the resource efficiency related savings potential?
3. what is the expected level of complexity, or number of issues to address in the follow-up work? (this affects expected timing of study and resources).

The saving potential for energy has been quantified for all product groups, except washer driers. The quantification is primarily based on information from other parties, supplemented by information extracted or compiled in Impact Assessments supporting the current regulations.

The resources saving potential by increasing resource efficiency could not be fully quantified in this study. It is worth noting that DG ENV has embarked on various studies to develop and assess the appropriateness and feasibility of methodologies and possible resource efficiency requirements for various product groups. It should also be noted that the environmental analysis in the supporting preparatory studies (although now over 5 years old) did not identify such resource efficiency parameters as the most significant environmental parameters. Therefore it is suggested to await the conclusions of the DG ENV initiatives, proving the methodology and the possible impacts / effects and to incorporate the learning effects in upcoming preparatory studies.

The assessment of level of complexity of follow-up analysis is mainly based on the study writers' experience in such analysis. The overview is shown on the next page.

Table 11-9: Final recommendations

Product group	Saving potential (all values relating to year 2030)	Resource efficiency	Complexity of follow-up study +++ = highly complex ++=medium complex +=low complexity	Prioritisation + = high /= medium - = low priority
Non-directional lamps	18 TWh/yr	Not quantified. Proposed to embed resource efficiency in a horizontal approach, although specific product groups could be selected as case studies	+++ The current speed of changes in this product group are astonishing, especially through the market uptake of LEDs	+, in a combined extensive study
Lamps without ballast & ballasts	18 TWh/yr			
Special purpose lamps	0.3 - 1.3 TWh/yr			
Household cold appliances	5 TWh/yr		+++ Considered to be very complex due to assessment of correction factors, product categories, new standard	+, in a extensive study with focus on correction factors
Household washing machines	3 TWh/yr		+++ Considered to be very complex due to assessment of new wash cycle portfolio, which is to be linked to a consumer research study into actual washing habits (part load behavior, actual temp. settings) and expectations (cycle duration, washing temperatures).	+, in a extensive study with focus on washing cycle portfolio
Household dishwashers	1.4 TWh/yr		++ Considered to be of medium complexity due to assessment of new performance standard	/, in either a fast track approach or extensive study with focus on various aspects
Household washer dryers	(not assessed)		++ Considered to be of medium complexity due to existing links to other laundry equipment studies	/, with focus on separate approach or alignment with other laundry appliances
Simple set-top boxes	0.2-0.3 TWh/yr		Depending on outcome of stakeholder consultation on approach to take, either: + low complexity for 'no change' or only consideration of energy requirements, to +++ highly complex if method for assessment of and requirements for resource efficiency are to be introduced	-, with focus on fast track approach ('no change') or extended study

The main conclusions are that the following product groups should be considered to be "High priority", requiring extensive/comprehensive further study:

- lighting products, due to the amount of savings and the complexity of the issues involved.
- cold appliances with also a relatively large saving potential, influenced by an assessment of a.o. correction factors, product categories, effect of new test standard,
- washing machines due to the savings potential and the complexity of issues such as washing temperature, cycle duration, label information, etc.

Of "medium priority", requiring either a modest study to asses a possible fast track approach, or a more elaborate study in case the fast track approach is not feasible, are:

- Dishwashers as no urgent issues requiring immediate action are identified, although the introduction of a new test standard should be closely followed,
- Washer-driers as although the out-dated energy label is up for urgent review, no direct problems identified and alignment with other laundry appliances may be possible.

Of "low priority", requiring no further study, or a study of more explorative nature, are:

- simple set top boxes, as the issues that are addressed by the regulation will become less significant in a decade, and the savings potential is modest.

11.5.1 Remaining horizontal issues

The assessment also unveiled a possible contradiction in regulations for several household appliances in the definition of the scope of the measures (‘including those sold for non-household use’) versus the definition of the household appliances themselves (‘appliances used for non-professional purposes’).

As a solution the text "including those sold for non-household use" could be removed from the definition of the scope.

ANNEXES

A. References

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Simple Set-Top Boxes

Apple TV Environmental Report, http://images.apple.com/environment/reports/docs/AppleTV_Product_Environmental_Report_2012.pdf

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CLASP Simple Set-top Boxes shipment/stock model, 2013

CLASP, Estimating potential additional energy savings from upcoming revision, Feb. 2013

Costs of manufacturing products that achieve our suggested requirement were estimated from US DOE's LLCC for STB. In the analysis, the manufacturing costs for achieving different level of energy savings were provided. The level difference closest to our suggested energy consumption was from level 2 to level 3. Therefore the average manufacturing cost for 3 types of STB with and without PVR to reach level 3 of energy savings was used for our LLCC analysis.

CSTB Preparatory study 2008

ENERGY STAR June 2013-Draft 2 Version 4.1 Set top Box Dataset

Historical market information courtesy of Robert Harrison, July 2013

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IHS Defying Multiscreen Challenge, Set-Top Box Market to Achieve Record Shipments in 2013 http://press.ihs.com/press-release/design-supply-chain/defying-multiscreen-challenge-set-top-box-market-achieve-record-sh

Independent Inspector to the VA on CSTB Report of the STBs 2010 – 2011, ECOFYS

Insight courtesy of David Holliday, September 2013.

Insights courtesy of Mr Michael Auer, Kathrein, August 2013

Insights courtesy of Mr Michael Auer, Kathrein, August 2013.

Insights courtesy of Robert Harrison, July-Aug. 2013

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Page G-8, Estimating potential additional energy savings from upcoming revision, by CLASP, 2013

R66141 Household Energy Survey Final Report March 2012, Intertek.

Refurbished in this context meaning products or parts returned to manufacturer or vendor, tested for functionality and re-sold with new warranty

SSTB and CSTB Preparatory study, 2007

US DOE Life Cycle Cost analysis for set top boxes.

VMAS, Analysis carried out on the outputs of the SSTB preparatory study 2007 and CSTB preparatory study 2008 base case analyses. As 2013 SSTBs are including more features and a widening of the definitions has been suggested, impacts across the spectrum of 2007/2008 STB products were considered.

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Commission communication 2012/C 402/07

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OJ L 165 of 26.6.2012

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B. Presentation stakeholder meeting "Omnibus" study

[total 99 slides, available as separate -pdf- file]

C. Minutes stakeholder meeting "Omnibus" study

Date: 18 Nov 2013

Place: DG ENER, Rue DM24 room 3/47

Time: 9:30 – 16:30

Participants (list annexed)

Juan Moreno Acedo (DG ENER) welcomes the participants and explains that although DG ENER C.3 is hosting this meeting, study consultants VHK plus consortium partners VITO, VMAS and Wuppertal Institute are chairing this meeting as part of the study execution. He also indicates that DG ENER will organise after the completion of the current study a Commission's stakeholders meeting on this subject in spring 2014 in the frame of the Ecodesign Consultation Forum.

Martijn van Elburg (VHK) commences the presentation (attached as separate pdf file) starting with a general introduction and agenda. The morning session will focus on the white goods (DW, WM, WD and COLD), whereas the afternoon session covers lighting products (NDLS, Tertiary LS and special purpose lamps) plus simple set top boxes and water pumps. The following paragraphs present the discussion following the individual presentation sections (the presentation is sent along as a separate file to this document).

Household dishwashers

A.Michel (Topten International) states that, as there is no urgent problem associated with the ED/EL Regulations, the current procedure for the measurement and calculation method may be retained, which could allow a fast track revision (without extensive study of standards and effects).

Household washing machines

A.Michel (Topten International) states that the increase of the capacity is one of their main concerns. The (on average) higher efficiencies may guide consumers to buying larger equipment than actually needed. This may lead to more inefficient part load washing process.

A.Malikou (BEUC) mentions that consumer organisations have observed that higher efficiency classes are overpopulated by washing machines with increased capacity, compared to the past. These observations were confirmed by market research by German consumer organisation Verbraucherzentrale Rheinland-Pfalz which conducted two market surveys 2012. The market surveys reveal similar tendencies on other appliances such as fridges and TVs. The correlation between the energy label and the offer of appliances with larger capacities needs to be further explored. Particularly as the average household size is declining which makes the question whether such increased capacities are necessary more relevant.

E. Seiffert (Bosch Siemens) replies that larger machines are actually more efficient per kg wash load than smaller machines. He adds that the annual energy consumption is now solely dependent on the number of cycles; and not the annual wash load. The main question is, how much 'under-loading' occurs.

More in-depth analysis on the actual amount of laundry per machine size should be performed.

According to B.Soenen (Belgium) part load is not really considered in the standardised testing method of washing machines. M.v.Elburg replies that 4 out of 7 cycles required in the testing and calculation method are at part load.

S.Sivitos (ECOS) states that the capacity and how it relates to energy should be better addressed on the label. He states that the capacity determines the annual energy consumption as much as the label class. This is not made clear to the consumers.

R.Kemna (VHK) adds that since 1993 (the first study for energy labelling of WM) the capacity has increased, but recent A.I.S.E. figures show that the average real life load has increased as well. Furthermore the average wash frequency has decreased. This indicates a possible response to larger capacity machines. This will however probably not be a linear effect.

I. Oehme (Umweltbundesambt) mentions the option of fixing cycle duration and washing temperature, e.g. as proposed in Lot 24 Working Document on professional washing machines.

M.Rambaldi (CECED) states more information is needed on the consumer perception/acceptance of longer cycle duration and lower temperatures. Furthermore he states that the members of CECED are working on a new wash program portfolio (the number of cycles at a certain temperature, load and load type for which the efficiency shall be declared) to better reflect real life consumer behaviour.

B.Soenen (Belgium) agrees that longer programmes may lead to a highly efficient process but that are not used by consumers. Maximum cycle duration for the standard programme is an option.

M.Rimmer (Defra) mentions a study assessing real life consumer behaviour data available (link[216]).

B.Verckens (Belgium) suggests changing the regulation in a way that producers are more inclined to improve technology rather than enlarge cycle time. He states that not too many products should be included in the top class to make it possible for consumers to choose the most energy efficient option.

M.v.Elburg (VHK) mentions the possibility to include the cycle time on the label as is done on the label for tumble driers.

Household washer-driers

J.Moreno (DG ENER) asks the stakeholders if they think the current label should be updated.

There appears no disagreement within stakeholders that the out-dated label for combined washer-driers causes confusion with current washing machine and drier labels and should be updated. Several options have been mentioned:

- to base an updated regulation on a better balance of programs or functions (as apparently washing is a more dominant function than drying);
- R.Kemna (VHK) mentions the possibility to introduce a double label system (one for washing, one for drying) which appears also to be the easiest option for policy makers;
- CECED states it would like to see the washer-drier label to be aligned with that for washing machines and tumble driers, as regards measurement and calculation methods;
- any suggestion for new labelling should be investigated

R. Siedentopf (Electrolux) mentions that consumers will benefit from an aligned label. Aligning with the current label of washing machines and driers should be possible.

A.Michel (Topten International) thinks that consumers benefit by one label with clear relevant information.

Household cold appliances

216

http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&ProjectID=17359&FromSearch=Y&Publisher=1&SearchText=Household%20Electricity%20Study&SortString=ProjectCode&SortOrder=Asc&Paging=10#Description

A.Michel (Topten International) shows slides (see separate pdf) that indicate that category 7 appliances (refrigerator-freezer) have on average higher efficiencies (lower EEIs) although they consume significant more energy to cool a certain volume than Cat.1-4 refrigerators. She feels the calculation method for Cat.7 appliances, together with the options for correction factors, leads to unbalanced information on energy efficiency and reduces transparency for consumers.

A discussion took place on whether combined fridge/freezers offer comparable functionality as separate fridges and freezers.

C.Lopes (Swedish Energy Agency) indicates on the basis of Topten data that having separate appliances at home would lead to a higher annual consumption.

The need for discussing the parameters is recognized by CECED as well, although they state that the outcomes of the Defra/Intertek study (mentioned in the report) should not be the starting point.

F. Arnold (Bosch Siemens) adds that indeed the M/N values for reference lines were established some 20 years ago and should be reconsidered in the light of technological progress.

A new international test standard IEC 62552 is under development. Australia and China have already expressed the intention to base regulations on that global standard. The industry would like to see the EU use this standard as well.

B.Soenen (Belgium) and M. Janssen (RE/GENT BV) agree that the factors are up for a revision.

J.Moreno (DG ENER) asks if there is a need to adopt ecodesign requirements for wine storages as well.

A.Michel (Topten International) states that a requirement for wine storage appliances has been introduced In Switzerland in January 2013, requiring class A as minimum.

F.Arnold (Bosch Siemens) states that data for wine storages did not exist, or did not allow comparison, until the label was introduced. The intention for having wine storage appliances in the scope of the ecodesign/labelling regulations was to allow collection of energy efficiency information on these specific appliances so that after some years it should allow checking the feasibility and need for ecodesign requirements.

CECED states that it would be best if all changes (renewed factors and adaption to new standard) are made in one effort.

F.Arnold (Bosch Siemens): The usage of the "Global Standard" in itself would not enforce a revision of the EU label system..

Horizontal issues

household vs professional

Several ED/EL Regulations refer in their scope to "including for professional uses" whereas the definition is limited to "designed for principally domestic use". The question is whether there should be a clearer separation between household and professional products.

E.Seiffert (Bosch Siemens) states that for safety issues household appliances are covered by the Low Voltage Directive 2006/95/EC, whereas professional products are covered by the Machinery Directive[217] 2006/42/EC. The Machinery Directive has a clear statement on how to declare the intended purpose.

Clear definitions on what is a professional machine are difficult to give and borders between market segments are becoming blurred as more consumers (can) buy 'professional' equipment.

[217] As an example: the hotel 'mini-bar' coolers are bought by professional buyers, but the user is a lay person (ie household). Currently these products are assessed for safety on the basis of the LVD which means that they are CE marking occurs on basis of non-professional use.

HP.Siderius (Agentschap NL) suggests making a standardized solution for all products. Differentiation should be based on clear criteria that apply to all products.

Beyond A^{+++}

S.Sivitos (ECOS) asks whether the results of the evaluation of the energy labelling directive will be taken into account in the omnibus review and whether this will be discussed in the consultation forum on horizontal issues.

J.Moreno (DG ENER) replies that indeed the omnibus review will be on the agenda of the ecodesign consultation forum next year and that discussions will need to take into account these other relevant studies

Resource efficiency:

F.Pekar (DG ENV) starts a discussion on non-energy related subjects. He makes a reference to a study from a year ago performed by DG Environment.

L.Spengler (Oekopol) mentions several options for improving recyclability that could be relevant for Ecodesign .

It was stated that lifetime should be included in the upcoming revisions of products, for instance as information.

M.Len (RREUSE) states that recyclability is negatively affected by recent trends that reduce removability of components and serviceability. It should not be so difficult to improve potential for disassembling, a.o. by providing information, service manuals, etc.

R.Kemna (VHK) states that a holistic view is required so that certain benefits at end-of-life are not outdone by certain impacts at other (production/use) stages. He uses the example that improved recyclability and removable parts can result in a higher weight and therefore larger production energy and higher resource use. This should be taken into account.

A. Malikou (BEUC) mentions that, aside from reparability, durability is a major consumer expectation that can have a very positive impact on resource efficiency. She also mentions as an example the recent ecodesign measure on vacuum cleaners which contains durability requirements (i.e oscillation of hose) in order to illustrate that durability does not always come as a trade off to other parameters.

AC.Rasselet (Orgalime) says it is not always a trade-off, but indeed all aspects should be taken into account. The material chosen also influences the price of the product.

B.Soenen (Belgium) mentions the possibility of an extended warranty requirement instead of lifetime requirements.

C.Lopes (Swedish Energy Agency) mentions the challenge to develop a method of including all aspects of life cycle correctly. He adds that improving recycling rates of products of which the actual material composition is not known, may lead to a continued presence of hazardous substances in products.

Lunch break 12.15-13-45

After lunch M.v.Elburg (VHK) presents the study objectives to newly arrived stakeholders. R.Kemna (VHK) then presents slides regarding the lighting products, being non-directional light sources (NDLS), special purpose lamps and tertiary lighting.

NDLS - non-directional light sources

After the slide presentation, S.Sivitos (ECOS) asks whether the analysis will show in which year A/A+ (read: LED) are economically feasible.

R.Kemna (VHK) replies that given the speed of change it is difficult exactly predict a specific year in which such an ambition level will be achieved.

M.Rimmer (Defra) asks whether the impacts on EU SME's will be assessed.

R.Kemna (VHK) replies that this is not a subject for this relatively modest Omnibus study, but should indeed be subject to larger in-depth study. He adds that there is anecdotal knowledge of SMEs involved in LED-lamp production, but at the moment it is impossible to identify all of them.

P. van Tichelen (VITO) adds that modelling of impacts on industries involved is complex since most products come from Asia.

B.Soenen (Belgium) asks whether there is more information available on LED / lamp luminaire sales. The difference between LED lamps and LED luminaires is not clear.

W. de Kesel (Legrand – CLC TC 23BX) asks whether the possibility to regroup the lighting products will be assessed.

R.Kemna (VHK) replies that there is a need for revising all lighting related regulations in a consistent manner and regrouping or combining groups could be the result.

Special purpose lamps

R.Kemna (VHK) mentions the need for aligning the various definitions applied to special purpose lamps.

He mentions that there appears to be two main problems: 1) the 'wrong' use of special purpose lamps and 2) the issue of imported products circumventing the "bulb-ban". The study deals only with the first problem.

Four options to deal with these problems are discussed.

B.Verckens (Belgium) mentions the problem that once a bulb is sold, its application (either as real special purpose lamp or as a general lighting bulb) cannot be verified.

R.Kemna (VHK) agrees but suggests that the focus of market surveillance could shift to the sales channel, where average consumers should not be confronted with possibility of buying lamps that are not intended for them. This entails a check of sales channels (shop floors, websites).

HP.Siderius(Agentschap NL) proposes to much better define special purpose lamps to enable better market surveillance. The first option does not work for wrong use of special purpose; better market surveillance will not help. It has to be combined with other options. There appears to be a preference to go along the last option and better prescribe technical purposes. Industry could help with technical specifications.

L.Spengler (Oekopol) indicates that some solutions will address only part of the problem. In the case of rough service lamps, halogen lamps are also possible for some exemptions.

B.Soenen (Belgium) mentions the issue of cheap lamps being used by installers to check operation of lighting systems. Currently these lamps remain installed after the check.

M.Scholand (CLASP) appreciates the option for better definitions as it may allow a market following system that establishes "quota" for lighting products placed on market – deviations could lead to revoking of sales quota and introduction of regulation (similar to US rules).

C.Briatore (Lighting Europe) doubts on the number of Special Purpose lamps. She believes there are more special purpose lamps than presented on the slides, but this will be discussed internally within 'Lighting Europe'.

B.Verckens (Belgium) says the higher price (shockproof lamps have a more elaborated technique than conventional lamps and are therefore more expensive) may deter consumers.

R. Kemna (VHK) replies this higher price is still a much lower price than its alternatives.

A discussion takes place on the illegal import from Eastern Europe.

R.Kemna (VHK) states that this is a problem but a different problem than the misuse of special purpose lamps. In other words, there should be no illusion that when a satisfactory solution for misused special purpose lamps is found, the problem of the illegal imports is also solved.

M Rimmer (Defra) mentions that they did a study on reflector lamps. There is now a 65% of sales for reflector lamps, while this was only 2 or 3 % in the beginning of their research. If doubling of imports is noticed in a product group it should lose its exemption status, because it is obvious it is used for cheating.

HP.Siderius (Agentschap NL) suggests making exemptions stricter to better tackle side effect such as illegal import and misuse of exemptions.

Tertiary sector

F. Pagano (Lighting Europe) states that although the inclusion of LED in the scope of HID (High Intensity Discharge) lights etc. is useful, the characteristics change every month. R.Kemna replies that this is indeed the case, but this doesn't mean that LED should be ignored in a follow-up review study.

W. de Kesel (Legrand – CLC TC 23BX) states that the problems identified with dimming etc. at NDLs section also apply to tertiary lighting.

R.Kemna (VHK) agrees.

J.Sturm (Lighting Europe) states that Regulation 245/2009 did not foresee inclusion of LEDs.

R.Kemna (VHK) replies that LED's should be considered in the follow-up study leading to a revision.

W. de Kesel (Legrand – CLC TC 23BX) asks about the status and relevance of the lighting systems study.

P. van Tichelen (VITO) replies that this study is ongoing. A major aspect is providing the definitions for parts, components, products, systems etc. covered by the study. Suggestions and feedback from stakeholders will be appreciated.

W. de Kesel (Legrand – CLC TC 23BX) states that establishing the saving potential of lighting systems is mainly determined at building level, and questions the relevance of ecodesign in trying to regulate this.

P. van Tichelen (VITO) replies that indeed this is a difficult subject.

O.Franz (Osram) states that an efficacy of >100 lm/W is not feasible for certain retrofit applications. A requirement at this level would mean that for certain luminaires there would be no replacement bulbs and the complete luminaire needs to be replaced.

R.Kemna (VHK) is aware of this issue for certain lamp types or applications. A thorough inventory would be required of such impacts.

O.Franz (Osram) adds that for certain applications 'replacing the ballasts' is an infringement on the conformity with CE marking.

R.Kemna (VHK) adds to the discussion that for certain lamp types investments in improving lamp efficacy are reduced to free up resources for developing LED applications.

P. van Tichelen (VITO) adds that apart from lamp issues, the drivers or control gear increasingly becomes relevant for overall lamp/luminaire life and functionality.

Simple set top boxes (SSTB)

HP.Siderius (Agentschap NL) questions the need for the effort to unlock very modest savings for a product group that shows little potential and is expected to dwindle in 15 years. The resources

required for such a study may be rather put into a different product group or could be used for an investigative study into resource efficiency aspects with SSTB as test case.

No other request to rigorously revise the current regulation is voiced.

Water pumps

The presentation does not lead to further questions or discussions.

Horizontal issues:

S.Sivitos (ECOS) asks DG ENER as to what criteria will be applied to decide on the need for an in-depth of further study (fast track approach or full blown study).

J.Moreno (DG ENER) replies that the decision to go for in-depth investigation will be based on at least two elements: The level of energy savings that can be expected, indicating a certain threshold as limit for extended and more in-depth studies. And second, other aspects beyond energy issue for which significant environmental improvement is possible, such as resource efficiency aspects. Below this level of expected energy savings, a quick-fix review of ecodesign efficiency provisions would be suggested for those measures with a reasonable level of expected energy savings. Below this reasonable level of expected energy savings, no action would be suggested.

M.v.Elburg (VHK) presents in addition to the above the 'intensity of study' as possible criterion, indicating the level of complexity as a possible criterion for fast track, quick-fix or in-depth analysis.

M.v.Elburg (VHK) asks participants to send in comments within two weeks (**2 December 2013**), due to the requirement to finalize the report by (mid) December.

S.Sivitos (ECOS) stated already earlier in the meeting that although he understood the need to finalize the study soon, he preferred the normally accepted period of one month for comments to be used for future stakeholder review periods.

[comments can be sent to: m.van.elburg@vhk.nl, a Cc: to k.brakkee@vhk.nl is appreciated]

As there were no items under 'any other business' the meeting was closed at 16.15hr and all participants were thanked for their input.

MvE/KB, 20-11-2013

List of participants "Omnibus" stakeholder meeting 18-11-2013

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D.Comments Stakeholders

CECED comments

Dishwashers

Page	Paragraph	Comment	Additional note
3	Other aspects to consider	The review ~~provides an opportunity to~~ **requests a reconsideration of** the calculation method for the EEI ~~(cycles per year, low power mode consumption)~~ and to remove inconsistencies between the ecodesign and labelling regulations.	A review does not automatically lead to a reconsideration of (calculation) methods, although this could be an outcome. The second rephrasing is accepted.
10	Energy label Regulation 1016/2011	Another inconsistency is that in the Ecodesign regulation dishwashers are categorised according a width of 45cm, while the calculation of the Labelling EEI is based on a threshold width of 50cm. *For the future alignment of the two documents a threshold of 50cm width to allow a possible tolerance is preferable.*	Accepted
15	2.2.1 Market and stock data	"Both the Impact Assessment of the Regulation 1016/2010 and CLASP predict a growth in penetration towards 70-75% for EU-15 and 30-40% for NMS-12. In total this results in 60-70% ownership in EU-27 in 2030." *This statement has to be questioned because it is based on the assumption of the Regulation and CLASP. The real sale figures by GFK 2013 (see table 2-5) show that in 2011 and 2012 the sold units stayed stable or even decreased a little bit. This trend is additionally caused by the €-crisis in several countries (Spain, Portugal, Greece). Who dares to say that in 2015 the estimated increase in sold volume will really happen due to this circumstances?* "The increase in penetration is expected to even out in the future as the average size of households is decreasing and smaller households might have limited space for dishwashers and/or will have less need for it." *On the other side the European population shows a relatively static number of inhabitants (according to European commission Eurostat) and in some countries the population is even decreasing in the future. So by static number of sold*	This is mentioned in the report. Indeed recent sales figures show stalling of sales, but predictions on ownership are based on long term projections. Future predictions in impact assessments should take recent development into account. We have no indication that long term predictions of sales show static values. The number of EU households is expected to increase even with

		appliances and decreasing population the saturation rate for Dishwasher will also increase but without or only little effect to the average energy consumption.	decreasing population in certain countries.
17	2.2.2 Trends in Energy Efficiency	The above GfK data for February 2013 show that within 3 years the sales of dishwashers in class A+ and higher has increased from 27% in 2011 to over 61% in January/February 2013 of which 3% are in the top class (A+++). This trend exceeds the expectations expressed in the Impact Assessment study. *Figure 2-4 applies to which type of dishwasher? -> need for clarification: In general, Ecodesign requirements call for a phase out of A-class dishwasher with standard (60cm) size. Standard size dishwasher have the biggest share. Observation made in the study is down to legal requirement. The shift towards better EEI is forced by legislation.*	All types. Text adjusted to "total annual sales".
18	2.2.3 Characteristic of dishwashers	The databases show that about 6% of the models are represented in the top A+++ level. Related to the sales presented in Figure 2-4, only 3% of the sales are represented in A+++. Models in the top class are bought less by consumers. *The CECED database is related to models but not to sold volumes. Therefore there is no contradiction between the numbers of CECED database (6%) and the sales figures shown in table 2.4*	That is correct. In the paragraph it is concluded that because of higher share in models the most efficient types are relatively less sold.
19	2.2.3 Characteristic of dishwashers	The eco-programme is often indicated by manufacturers as a programme suitable for cups and plates (see Figure 2 6). People who use their machines for washing pans and pots as well are more likely to use a different programme that uses more energy. If the eco-programme is suitable for regular types of dishes, people are more likely to choose this option. *This topic of the generic ecodesign requirements [Regulation 1016/2010 ANNEX I 1 (2)] already came into force on the 1st of June 2012:* *"(2) The booklet of instructions provided by the manufacturer shall provide: (a) the **standard cleaning cycle referred to as 'standard programme' and shall 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;"*	Normally soiled tableware in the current standard does not include pots and pans.

		The rework on the standard (IEC 60436 4th ed.) will implement pots & pans and plastic to the standard.	
28	2.5 Conclusion	The possibility for the introduction of new classes on the energy label has to be investigated with an economic assessment including lowest life cycle costs. *The evaluation about the introduction of new classes of energy and phase out of lower classes has to be investigated considering that the zeolite technology is already patented and that other available technology could not be applicable on all DW structures.*	Accepted.
28	2.5 Conclusion	Due to the Ecodesign requirements only machines in the top three energy label classes will be allowed on the market (with exemptions of small machines till 2016). This allows room for differentiation of energy efficiency of machines, but rather limited when compared to Energy Labelling main purpose (labelling to apply in seven energy efficiency classes). *In order to keep a variety of choices of products for the consumer a wide range of appliances needs to be maintained on the market. A dishwasher should be available for each budget (low end and high end).*	Noted. The level of requirements is not subject of this study. The Ecodesign Directive requires measures to be checked against impacts on affordability etc.
29	2.5 Conclusion / Current test program does not reflect consumer behaviour	"There is evidence that the programme on which the requirements of the regulations are based is not the most used programme. Other programmes than the eco programme are not considered in the regulation and improvement of these programmes is therefore not stimulated by legislation." *This should be changed with the generic ecodesign requirements with which the Eco-programme is preselected if a machine contains an automatic programme selection. The influence on the user behaviour is not yet known.* "The number of cycles per year is overestimated in the calculation." *The lower the number of cycles per year the lower the overall difference between high energy efficient appliances and lower energy efficient appliances. A smaller multiplication makes it more difficult to sell high efficient but more expensive machines to consumers.*	Added. That is correct, but the purpose of the label is to provide consumers with information, preferably as realistic as possible. The relative differences between appliances will remain, even if lower annual cycles are used.
3	another aspect to consider	For dishwashers: A change in the test standard in the **EN 50242 (according to IEC 60436)** as regards the test load might incur changes on energy efficiency values,	Accepted.

		cleaning and **drying** performance.	
8	Energy label Regulation 1059/2010	The legend of Equation 2.5 should be the same as reported in the official document 1059/2010. Please state the rounding and measurement units.	Accepted.
9	2.1.2 / Table 2-2	**Table 2 2 Overview of the requirements, which classes are phased out:** From December 2016 (Tier III) the **Energy Class "A" is only banned for appliances >7PS**. So table top dishwashers are still allowed to have "A" class in energy. This has to be considered also for the energy label rework because the table top appliances do not have the possibility to contain the best available technology due to the lack of space. **If this ban would be forced a complete sector of dishwasher appliances would disappear from the market.**	Accepted.
9	Energy label Regulation 1016/2011	**Table 2 2 Overview of the requirements, which classes are phased out:** Tier I Dec 2011: Class B **Allowed for ps=10 or width<=45cm**	Accepted.
9	Energy label Regulation 1016/2011	**Table 2 2 Overview of the requirements, which classes are phased out**: Tier II Dec 2013: Class A **Allowed for ps<=9 or width<45cm or 10ps and width=45cm**	Accepted.
10	2.1.2 / Related EU legislation	**Standby/Off mode Regulation:** *"Commission Regulation 1275/2008 applies to domestic dishwashers and requires as maximum power for low power modes of 2 W in left-on mode and 1 W in off mode. After **2014** this decreases to 1W and 0.5 W respectively. More details can be found in Annex B."* The 2nd phase came already on the **7th of January 2013** into force. **The left-on mode has no requirement in the Regulation. Please replace "left-on mode" with "standby".**	Accepted.
10	2.1.2 / Related EU legislation	**Off-mode:** *"The test method for low power modes is described by standard **EN 50564:2011**"* EN50564 only contains the general description of standby measurement but **EN50242:2008/A11:2012 annex O contains the specific low-power-mode measurement methodology for dishwashers. Therefore this standard has to be**	Accepted.

		named here.	
10	Related EU Legislation - The Standby/off mode Regulation	"Commission Regulation 1275/2008 applies to domestic dishwashers and requires sets as maximum power for low power modes of 2 1 W in left-on stand by mode and 1 0,5 W in off mode since January 7th 2013. After 2014 this decreases to 1W and 0.5 W respectively. More details can be found in Annex B. This means that standby and off mode of Dishwashers are to be regulated through 1275/2008, but as many dishwashers have a safety feature that prevents water leakage but which consumes energy". **Please replace "left-on mode" with "standby".**	Accepted.
10	Related EU Legislation - The Standby/off mode Regulation	The definitions used in this document are taken in Regulation 1016/2010 but they are not equal to the definition reported in the Regulation 1275/2008. A more consistent harmonisation should be considered for the future.	Accepted.
11	2.1.3	**Tolerances only apply to verification procedures for market surveillance purposes.** These values are not to be applied for energy labelling. Moreover, the old data from the RRT 2003 is used; please use the 2009 data. In 2009, in a round robin test performed by CECED the standard deviation in reproducibility for energy measurements by 16 laboratories was 2.6 %, which means an expanded uncertainty of 5 %. A new CENELEC/CECED RRT is initiated to assess current uncertainties in energy measurements. Also, EN50242:2008/A11:2012 annex ZC contains the uncertainty of measurements as the result of RRT 2009.	Accepted.
11	2.1.3 Tolerances / Table 2-3	**Table 2-3 Existing tolerances for the required parameters of regulation 1016/2010 and 1059/2010** The list only reflects the measured parameters for 1016/2010. In the Table for 1059/2010 additionally the water consumption and the Airborne acoustical noise emissions is listed. On the other side 1059/2010 does not contain the Cleaning efficiency index due to the fact that the cleaning is not listed on the label anymore. **The name of the table is wrong- it only contains the parameters of regulation 1016/2010.**	Accepted.

12	2.1.4 Standard	"Dishwashers are tested according **EN 50242:2008** which is based on IEC 60436." Meanwhile the standard is updated according the Mandate M481 from EC: **EN50242:2008 + EN50242:2008/A11:2012 (listed in the OJ of EU under 2013/C169/01)**	Accepted.
12	2.1.4 Standard / Test Programme	"According to the Ecodesign regulation the test programme should be indicated as the 'standard programme', which is the standard cleaning cycle to which the information in the label and the fiche relates; that this programme is suitable to clean normally soiled tableware, and that it is the most efficient programme in terms of combined energy and water consumption. **So there is no indication formulated of 'eco', but it has to be called 'standard'**." Within the **Mandate M481 of the European Commission to CENELEC** the standardization was asked: *" to ensure that the prospective harmonised standard(s) **defines univocal and common word(s)**, sign(s), pictogram(s) or symbol(s) to be displayed on the programme selection device of the machines and on the machines display (if any) or both, **to clearly and easily identify the standard programme(s) referred to in the Commission Regulation 1016/2010 and in the Commission delegated Regulation 1059/2010."*** **The standardization defined the programme name "eco" in EN50242:2008/A11:2012:** *"The programme to be tested shall be the cycle which cleans normally soiled tableware (standard cleaning cycle) and shall be named "eco". The name "eco" shall be used once and exclusively for this standard test programme. The only other additional information which could be combined with the term "eco" is temperature."* **We suggest writing 'The programme shall be named "Eco" to have presumption of conformity.'**	Accepted - citation added.
12	2.1.4 Standard Test load	A revision of this standard is currently worked on and is expected to be harmonised in 2015. **If "this standard" refers to EN50242 then the statement is not correct. IEC 60436 4th Edition has good chances to be finally revised in**	Change accepted.

		2015. The EN standard will follow accordingly.	
13	2.1.4 Standard Soiling	Therefore it cannot be said yet ~~whether~~ how much the different load will result in a different energy consumption of the machine tested. **We cannot say that heating and drying different materials does not change the energy consumption, however estimating the amount of change requires experimental evidence.**	Change accepted.
18	2.2.2	According to the CLASP prediction there will be no A class machines on the market in 2015 while these are still allowed until the end of 2016 for small appliances. Therefore the sales are not likely to be zero. **EE class A retained for dishwasher with 7 or less place settings (countertop dishwashers) even after end of 2016. Please rectify this statement every time it occurs.**	Change accepted.
18	2.2.3 Programmes	Most modern machines have a so-called "Eco programme" which can be selected on the machine. **"Most modern machines" have to pre-select the Eco programme due to Ecodesign requirements (Annex I, point 1 (1) requires that the cycle used for the calculation of the energy consumption and other parameters "shall be set as the default cycle for household dishwashers equipped with automatic programme selection.") The effectiveness of this requirement needs to be assessed in future studies.**	Change accepted.
19	2.2.3 Characteristic of dishwashers/ Capacity of the dishwasher	*"When the capacity of a dishwasher is increased, the EEI has been shown to increase as well, (see Figure 2-7) suggesting that the required **extra energy to wash the additional load, is more than compensated for by the allowed extra energy consumption** (the standard annual energy consumption is capacity dependent)."* According to the weight and heat capacity (china, glass, cutlery) for an additional place setting the needed energy amount is in practical higher than the granted amount of extra energy by calculation. This can be easily calculated in an example: Threshold for A++ with 12PS: 258kWh/year → ~21,5kWh/ps/year Threshold for A++ with 13ps: 262kWh/year → ~20,16kWh/ps/year Threshold for A++ with 14ps: 266kWh/year → ~19kWh/ps/year Threshold for A++ with 15ps: 270kWh/year → ~18kWh/ps/year	The drivers for higher EEIs at higher capacities are not known in detail: It may be a convergence of factors such as more recent models, but also economy of scale effects. Further analysis should separate the various effects.

		With increased number of place setting the total value of energy is increased(12ps:258kWh to 14ps:270kWh), but the energy you are allowed to use per place setting is decreasing if you want to reach the same energy class (12ps:21,5kWh/ps/year to 15ps:18kWh/ps/year) **The trend to higher number of place settings is driven by marketing and not related to energy! The allowed extra energy consumption is NOT compensating the really used energy!**	
20	2.2.3 Characteristic of dishwashers/ Figure 2-7	**Figure 2 7 The Relation between the capacity of ~~washing machines~~ dishwashers and the energy efficiency of machines that are on the sales market. On the x-axis you see the number of place settings, on the y-axis the EEI. Source: CECED database 2012**	Change accepted.
20	2.2.3 Characteristic of dishwashers/ Water consumption	**Water consumption** **"Besides energy efficiency, reduction of water use is also part of ecodesign regulations."** **Water use is not part of the ecodesign regulations for dishwashers!** **Table 2 8 Water consumption of ~~washer driers~~ dishwashers**	Change accepted.
20	Graph	The graph shows a correlation between the EEI and the capacity. The machines with a low EEI more often have a higher capacity than machines with a higher EEI. Modern machines tend to have a higher capacity and a lower energy efficiency index. **Correlation analysis should not be done over all dishwasher sizes (countertop - slim line (45) - standard size), that is why size classes are differentiated in Ecodesign requirements. Correlation analysis within the class of standard size is not likely to show similar behaviour.**	Indeed the graph does not take into consideration changes on basic configuration (table-top, slim line, standard). More in depth analysis of the correlation should be addressed in a follow-up study.
20	Figure 2-7	EEI is usually not expressed in percentage.	Change accepted.
22	2.3.2 Chosen programme	The temperature of the normal or automatic programme is often between 60 and 65 °C, where the eco programme is more often 50°C. **Temperatures of AUTO programmes range from 40°C to 70°C to cover all possible levels of soils (fresh/light to heavy soil) and load sizes and material compositions.**	Change accepted.

23	2.3.3 Load size	"The preparatory study estimates that a 12-setting machine in real-life will be loaded on average with 9 settings. This lowers the real-life energy consumption, but –as mentioned in the previous paragraph—**because the real-life wash temperature is higher than in the test there is still a 9.1% higher-than-standard energy consumption.**" **Due to the argumentation in the point 2.3.2 Chosen programme, the estimated 9,1% higher than standard energy consumption has to be cast into doubt and has to be re-evaluated under the light of the latest evolution.**	More in-depth analysis needs to be performed in a follow-up study
23	2.4.1 Best available technology -- Energy & Water	Rather than mentioning only one available technology (here zeolite), when referring to best available technologies we would appreciate the use of this non exhaustive list - also because the definition of available, or not-yet-available is rather debatable; high efficiency motors (inverter permanent magnets); open drying systems (i.e., automatic door opening), closed drying systems with absorbing material as high efficiency drying. The most efficient available (e.g. zeolite) is proprietary technology.	Suggestions accepted.
23	2.4.2. New Technologies	Generally, the dishwasher's effectiveness in cleaning will increase with more vigorous mechanical action, more detergent, higher water temperatures and longer wash cycles. **There are limits to what extent mechanical action (water pressure must ensure stable positioning of load items) and detergent amount (detergent residues) can be increased.**	Suggestions accepted.
24	Improved Drying technology	Normally the drying performance is increased by a hotter last rinse which requires more energy or a ventilation system.	Suggestions accepted.
28	2.5 Conclusion	**Eligibility of product group regarding Article 15 criteria** The most recent data shows the product group of dishwashers is still economically significant. The growing household penetration and the limited increase in average efficiency lead to the conclusion that the environmental impact will also be significant. **A growing household penetration would be more significant to energy savings than an increasing energy efficiency of household dishwashers! See attached graphs**	An assessment comparing automatic dishwashing with other (hand) wash up systems is outside the scope of this analysis.
28	2.5 Conclusion	**"Due to the Ecodesign requirements only machines in the top three energy label classes will be allowed on the market (with exemptions of small machines**	Suggestions accepted.

		till 2016). This allows room for differentiation of energy efficiency of machines, but rather limited when compared to Energy Labelling main purpose (labelling to apply in seven energy efficiency classes)." **From December 2016 (Tier III) the Energy Class "A" is only banned for appliances >7PS**. So e.g. table top dishwashers are still allowed to have "A" class in energy. This has to be considered also for the energy label rework because the table top appliances do not have the possibility to contain the best available technology due to the lack of space.	
29	2.5 Conclusion / Possibility of requirements for water consumption hot water inlet	**"Possibility of requirements for water consumption hot water inlet** The water consumption has gone down in the last decade. **Machines with more place settings generally use more water per cycle."** **This Statement is not correct in general. It does not fit to what is shown in Table 2-9 on page 21: 12ps = 12,5l / 13ps = 9,0l / 14ps = 10,2l**	Historically the statement is correct, but more recent (larger) machines indeed show a reverse trend with total water consumption lower than that of smaller machines.
29	2.5 Conclusion	**Please rephrase the sentence** "This will make the label program, called 'eco', **even more** suitable for common types of dishes, making it a better option for consumers to choose for." **The energy label cycle must be already suitable for normally soiled tableware, as required by both the labelling and ecodesign Regulations.**	Clarified in text: normal soiled tableware corresponds with the standard load of mainly cutlery, cups and plates whereas the most common types of dishes include plastics, pots and pans.

Washing Machines

30 / 32	3.1.3 Energy labelling and Table 3-1 page 32	"Before 2010 the energy labelling of washing machines was based on directive 95/12/EEC. The energy classes of washing machines were **distributed according to Table 3-1** based on a standard energy use per cycle with a 60º C cotton wash." Table 3-1 on page 32 does not refer to the energy label used before 2010. Please delete "distributed according to Table 3-1"	Suggestion accepted.

31	3.1.3	"A recent analysis of the energy consumption of various cycles of **36 washing machines**", Please provide further information on how these data were obtained and if they are publicly available on Topten website.	Clarified in footnote.
32	3.1.4 Ecodesign Table 3-2	Overview of the requirements, which classes are phased out: ***"Tier II Dec 2013 - Banned for all machines"*** From December 2013 banned machines (EEI <59 is required - not for all machines, only >= 4 kg). Please revise the text.	Suggestion accepted.
32	3.1.4 Ecodesign Paragraph below Table 3-2	*"In addition specific requirements apply to the water consumption of a full load (2011)**and partial load** (2013)"* This statement is not correct, the water consumption that has to fulfil the criteria is always the full load. The calculation of the threshold refers to the value c or c/2, but this only used to calculate the value for the threshold. Please correct the text.	Suggestion accepted.
32	3.1.4	We would like to highlight the important link between limits to water usage and rinsing efficiency. We would invite you to add the following consideration/text. **These limits were not based on data or any evidence of feasibility and industry was not in favour of this requirement because the link to rinsing efficiency was missing.**	Suggestion accepted.
33	3.1.5	If only a few brochures have been checked we suggest a more in depth analysis of products in the shop floors before making assumptions. We suggest deleting the following sentence or to modify it. "Based on a very limited study of product brochures and promotional materials it appears the implementation **is weak**." If the sentence is not deleted please modify it as follows: "Based on a very limited study of product brochures and promotional materials it appears **that some companies have not chosen this option to prove**	Suggestion accepted.

		conformity with this requirement." The symbols included in the Communications only give presumption of conformity, their implementation is not mandatory as there are other ways to claim conformity.	
33	3.1.5	A word is missing "**According to** Regulation 1015/2010"	Suggestion accepted.
		Please delete the sentence related to the replacement of the symbol with harmonised standards. Industry is discussion with the Commission about a publication of a Communication that will identify a final symbol that will no longer require harmonise standards.	Suggestion accepted.
33	3.1.5	"As the Communication **bears no direct legal powers** manufacturers may opt to prove conformity with the requirements in a different fashion." Please delete this whole sentence that can be confusing since it has already been clarified that the Communication gives only presumption of conformity.	Suggestion accepted.
34	3.1.6 Tolerances Second Paragraph below Table 3-3	**"This means that the calculated annual consumption can have a maximum of 192 kWh/year."** The wording can be misleading, applying tolerances means to talk about measured values. In case of verification this would be the maximum allowance for test results of a machine declared with 175 kWh/year. Tolerances are made for verifications. Please replace in the first sentence **'calculated'** by **'measured'**.	Suggestion accepted.
34	3.1.6 Tolerances Two last paragraphs this page	*"The last round robin test that could be used to assess reproducibility and repeatability was carried out in 2004. Various stakeholders underline the importance of a new round robin tests to obtain important information on real verification tolerances. Interesting in this respect is the ATLETE II program which will be finalised by 31 October 2014.* *As there is not enough information on the actual absolute measurement tolerances, it cannot be concluded that the proposed EEI's do not result in tolerances allowing more than one class jump. "* Round robin test will provide figures for measurement uncertainties of standardized measurement methods. Tolerances set for verification will not be	Suggestion accepted.

		the output of any round robin test carried to this purpose. The term **"measurement tolerances"** is misleading. In last sentence, replace **'measurement tolerance'** with **'measurement uncertainty'**.	
35	3.1.8 Non-European legislation and other initiatives	"Australia standardization has announced its willingness to adopt the IEC rinsing method, which is under development." The development of a new rinsing method is under way in US and EU (AHAM will adopt a new standard soon, CENELEC is checking whether the same principle can be implemented for EN60456 under the mandate from EC), CECED is supporting this work. CENELEC will offer the outcome of their work to IEC for Ed.6 update of IEC60456. We suggest you to integrate this information.	Suggestion accepted.
35	3.1.7 Related EU Legislation	Standby/Off mode Regulation: "*Washing machines are covered by Commission Regulation 1275/2008 on standby and off mode power. This regulation allows as maximum power consumption 2 W in left-on mode, 1 W in off mode. After **2014** the maximum power is reduced to 1W and 0.5 W respectively."* The 2nd phase (standby 1W and off mode 0,5W) was implemented already on the **7th of January 2013**. This comment is valid for several sections of the document for both WM and DW.	Suggestion accepted.
36	3.1.9	Delete Table 3-4: These definitions are only relevant for the reference machine. These definitions do not define a programme design in household washing machines. The reference machine is a test equipment needed to run performance tests for household washing machines. The washing result of the reference machine is used to allow comparability of test results from lab to lab, from year to year, from batch to batch of test material like stain strips, detergent and load items (textiles). Please delete the following text ***"The programmes are defined as follows*** ***Table 3-4 Programme definitions according to standard EN 60456*** ***Programme Description*** ***Cotton 60 °C Maximum temperature 60 °C, Main wash and 4 rinses, Normal agitation, Spin time 5 minutes***	Suggestion accepted.

		Cotton 40 °C Maximum temperature 40 °C, Main wash and 4 rinses, Normal agitation, Spin time 5 minutes"	
36	3.1.9	Please correct the sentence. "Stain test strips are attached to cotton base loads in order to assess **washing performance** ~~energy and washing performance and water consumption. ''~~	Suggestion accepted.
40 top	3.2.3 'the most energy efficient programme'	"The most efficient one is the often declared **eco** program or energy saving program." The word **eco** is used by some brands, but it is not the standardized naming. Please modify the sentence as follows: **"The most efficient one is declared by some companies as eco program or energy saving program. The word eco is used by some brands, but it is not the standardized naming. A different situation compared to dishwashers where eco it is the standardised naming. For WM eco is used by some companies for cold wash."**	Suggestion accepted.
40	3.2.3	Please refer to the energy label cycle by using the terms of the Regulation 1015/2010; if data on the consumption of alternative cotton programmes is available please cite the source of information. For clarity refer to the 'energy label cycle' or 'standard cotton programme' as the term 'eco' is used in different ways by different manufactures. The sentence should report: "The most efficient programme ~~one~~ **in terms of energy and water consumption suitable to clean a normally soiled cotton laundry** ~~wash is in the often declared eco programme or energy saving programme~~ **must be indicated as "standard cotton programme"**-. This programme uses less energy and less water than another cotton washing program at 60 and 40 degrees. ~~This 'normal'~~ **Other available cotton** programmes can have energy and consumption twice that of the ~~Eco~~ **standard** programme. **As shown in the Figure from data collected on 15 machines**~~"~~	Suggestion accepted.

40	3.2.3	Please revise as follows. Figure 3-5. The difference between the ~~standard~~ **alternative** 60 degrees cotton program (blue) and that of the ~~eco~~ **standard** 60 degrees cotton programme (red) of 15 machines.	Suggestion accepted.
40	3.2.3	The reduced temperatures are compensated through a longer cycle duration time: where the normal 60 degrees cotton programme needs between 2 and 3 hours, the ~~eco~~ **standard** cotton 60 degrees programme runs for 3 to 5 hours	Suggestion accepted..
40	3.2.3	The manufacturer can determine the cycle temperature and duration of the program used for the standard EN60456 test, as long as it is declared by the manufacturer as suitable for washing cotton **and it is clearly identified on the selection panel and indicated as "standard cotton programme". Based on both Regulations 1015/2010 and 1061/2010, the manufacturer must communicate to consumers that the "standard cotton programme" is the most efficient in terms of energy and water consumption.** ~~Since the~~ ~~eco~~ **Therefore this** programme **which** scores better on energy efficiency ~~this programme is often~~ **and has to be the one** used for the standard test ~~to receive the highest label rating.~~	Suggestion accepted.
41	3.2.3 'low-power modes (standby, left-on)	It appears that washing machines have **standby-modes that are higher than the maximum allowed 2,0W.** Left-on-mode and delay-start are no standby functions and therefore are not limited by the Standby Regulation. The way the text is written is confusing. Please revise it. If an analysis has been conducted please cite the source of the data and representativeness of the test sample. How many models?	Suggestion accepted.
41	3.2.3 Low-power modes (standby, left-on)	Please add this clarification **" it must be noted that the left on power consumption is defined in the Regulation 1015/2010, while the stand by is defined in the 1275/2008 Regulation. These definitions are not equivalent: stand by is a state in which no other function is available other than consumer information and reactivation function, for this state a maximum consumption is set; left on is the state following end of cycle regardless of functionalities available, on this state no maximum consumption is set. The energy**	Suggestion accepted.

		consumption in left on and off mode must be included in the yearly energy consumption. A product in left on will also be considered in stand by if no functionality other than consumer information and reactivation is available and if this state can persist for an indefinite time. The power consumption indicated in the product fiche is the left on power consumption, which may be different from the stand by power consumption either because the left on state is not steady and is followed by an auto switch off, or because additional functionalities are still available."	
41	3.2.3 Low-power modes (standby, left-on)	Please cite the source for this piece of information "The standby consumption of machines that are on the market today varies between 0 and 12 kWh. " 12 kWh is 20% of the energy consumed by an A+++-50% approximately 60kWh per year. Note that a washing machine compliant with the stand by Regulation and working 8000 h per year will consume at maximum 4 kWh, this can be checked with a simple calculation. This is 6-7% of an A+++-50%. At page 41, last paragraph ask to change **"standby"** with **"low power modes".**	Suggestion accepted.
42	3.2.3 Spin drying performance	When assessing the opportunity to set requirements on spin-drying performance, please consider that spin drying per se is an energy consuming function, spinning more than strictly needed is not energy efficient. Higher spinning speeds have higher wrinkling effects, many consumers who hang dry the garments in mild climates prefer lower spinning speeds in order to reduce work and energy consumption when ironing. Consider also that the previous preparatory ecodesign studies carried out for lot 14 found a clear geographical distribution of spinning speed values which is highly correlated to climate conditions (see Figure). The study in chapter 4.4.6 reports "To the extent that the household is a 'sun-dryer' and does not want or use the higher speeds, this becomes a feature of partial use with all the related issues of extra costs for the user and producer." The other issue is the trade-off between high spin velocity and the subsequent use of a dryer. At some point it is probably preferable to limit the spin speed and use the tumble dryer because the over-all efficiency is greater.	Suggestion accepted.

		Before making any proposal related to spin drying performances we suggest an in depth analysis of Lot 14 section 4.4.6 which is still valid.	
43	Table 3-8	Trend in water consumption. The comparison between 2005 and 2011/2012 is not useful as the reference point is different. The statement above the table is correct but cannot be deducted by the table so avoid the to link it with it. The preparatory study of 2005 was considering full load, while the 2011-12 data are based on the new portfolio (including half load). The trend can be seen anyway using the database we have provided, see also Figure.	We added clarification.
43	Rinsing efficiency	Please add this consideration: **"In a regulation all defined parameter should be measurable with high reproducibility and repeatability with a reasonable effort. Setting requirements on rinsing without a reliable measurement method (reproducible and repeatable results) should not be forced. Additional eco design requirements on water consumption also have to be seen in correlation with rinse performance requirements."**	Suggestion accepted.
45	3.2.3	Please add: **"For the correct comparison of energy consumption among different washing machines it is correct to consider the relative energy consumption for kg of load."**	Suggestion accepted.
45	3.2.3 Capacity of the washing machines	"..machines with a higher capacity generally use more energy. For instance a B label machine with a 5 kilogram capacity has a yearly reference energy use of (47*5+51.7)*77%= 221 kWh/a while an A+ 8 kg machine has an AE of (47*8+51.7)*77%= 252 kWh/a. **However, considering the energy consumption per Kg it is easy to see that the higher capacity machine has a higher energy efficiency than the smaller one and this is important when considering the increase of the average load size washed by consumers."**	We added some information on this. The concern on higher EEI with larger machines is a concern to NGO's as expressed in the stakeholder meeting. Therefore more research on this topic is required.
47 top	3.3.2 chosen programs	The statement that more people use the cold program is not confirmed by the graph just below the text. This graph shows no change in cold (20°) and 40°C program. There is an increase for 30° program and a minor decreases for the high temperature programs (50°, 60° and 90°). We propose to write **"people use less frequently high temperatures."**	Suggestion accepted.

49	3.4.1 Best available technology - energy	Please correct the Line 2: A+++ (**EEI 66**) should be A+++(**EEI 46**)	Suggestion accepted..
51	3.4.2	The section on motors is not correct. Please substitute as follows: **"Motor efficiency** **The most common motor systems are AC phase motors and brushless DC motors. The latter are more energy efficient. DC motors eliminate the heat losses;"** with: **"Motor efficiency** **The most common motor systems are universal motors and brushless motors. The latter are more energy efficient."**	Suggestion accepted.
51	3.4.2	Reference to specific Company names. When referring to technologies, only the technology itself should be mentioned, without indicating the name of the company using it. In case, it could be relevant to mention if it is a proprietary technology or not. In addition, we suggest them to present more than one source before giving a positive or negative appraisal on a specific technology.	Suggestion accepted.
51	3.4.2	Please delete the following sentence: **"the direct drive system reduces vibrations and noise is reduced."** It is demonstrated that it is not true. There are machines in the market with lower noise and without direct drive.	Suggestion accepted.
51	3.4.2	Please delete the following sentence: **"Alternatively machines often offer a part load program option."** Half load option is not anymore in use, was used in the past, it is not possible to use the option for energy label cycles that should recognize the half load automatically.	Suggestion accepted.

56	3.5.1	From the report it is not clear how 3 TWh/year can be saved for washing machines through ecodesign, the lowest class A+ in 2013 is still the most widely used with 49% of the volumes. However the market pull potential of the energy label can stimulate savings in this range. The assumptions made by CLASP are based on the analysis of trends, but more analysis required to make an in depth assessment of the saving. An ad hoc study should be carried out.	The estimates are based on the CLASP study mentioned. In depth assessment should be performed in a follow up study.
186	Annex B	We should add also that 4 years after the entry into force of the measure a power management function had to be implemented. Since 7.1.2013 this function is mandatory and all appliances should be equipped, unless inappropriate for the intended use. The equipment has to switch after the shortest possible period of time, appropriate for the intended use, automatically into standby or off-mode. This explanation is missing. As a result the saving potential is reduced.	Suggestion accepted.
	general comment	The review provides an opportunity to reconsider the calculation method for the EEI (difference between regulations and EN60456) and to remove inconsistencies in and between the ecodesign and labelling regulations.	Suggestion accepted.
	inconsistencies in delegated regulation	In the delegated regulation 1061/2010 appears to be a mismatch in the requirements for spin drying efficiency between Annex I and Annex II. In Annex I, the spin drying efficiency class is based on a scale from A to G. The classification is related to the average remaining moisture content measured and calculated according to the “3+2+2” approach. (The 3+2+2 approach is a combination of three test treatments: 60 °C cotton full load, 60 °C cotton part load and 40 °C cotton part load.) Annex II (fiche) requires a declaration of the “remaining moisture content attained for the standard 60 °C cotton programme at full load or the standard 40°C cotton programme at partial load whichever is greater”. This requirement considers only 2 out of 3 treatments for the highest remaining moisture content for declaration in the fiche.	The classification is based on the 3+2+2 approach in accordance with Annex VI, point 2. The absolute value on the fiche is based on the greatest value of remaining moisture content. It is not a contradiction, but a mismatch indeed.
	inconsistencies in delegated regulation	In the delegated regulation 1061/2010 , Annex II (fiche) the requirements for spin speed declaration appear to be different to the approach used for the requirements for most other parameters. The delegated regulation requires that the declarations for most parameters	See above.

		are based on the 3+2+2 approach which is a combination of three test treatments: 60 °C cotton full load, 60 °C cotton partial load and 40 °C cotton partial load. Annex II states that the "Maximum spin speed attained for the standard 60 °C cotton programme at full load or the standard 40°C cotton programme at partial load whichever is lower" shall be declared. This requirement considers only 2 out of 3 treatments for the minimum value of the maximum spin speed for declaration in the fiche.	
		The regulation 1015/2010 and the delegated regulation 1061/2010 use a definition of 'left on mode' that is difficult to establish under normal test conditions. They also use two different formulas to calculate annual energy consumption, depending on whether or not the washing machine has a power management system. 'Left on mode' is defined in the draft Regulation as "the lowest power consumption mode that may persist for an indefinite time after completion of the programme without any further intervention by the end-user besides unloading of the household washing machine." It is generally accepted that there are no good reasons why washing machines using existing technology should not be able to reach their lowest power consumption within 30 minutes of the door being opened at the completion of the programme. Similarly, for washing machines with power management systems, there is no reason why they should not be able to revert to their lowest power state within 30 minutes of the door being opened at the completion of the programme. Measurement of 'left on mode' power can therefore commence at that point. EN60456:2011 considered this fact and in agreement with EC this formula was implemented for the measurement standard. A revision of the regulations should include the measurement for energy consumption as follows: Post-programme phase LU (Unstable left on mode) – Beginning when the washing machine door is opened immediately after the completion of the programme. LU lasts for 30 minutes. Post-programme phase LO (Left on mode) – Beginning immediately after LU. LO lasts for 10 minutes. This value shall be used for fiche declaration of left-on mode.	Explanation is added

		For further details see the attached documents.	

Washer-Driers

58	4.1.1	It is stated that Commission Directive 96/60/EC on energy labelling of household washer-driers **does not contain a clause or article stating the date and subjects for a revision of the measure**. Yet it misses to say that in Regulation 1061/2010 on energy labelling of household washing machines (under Whereas) it is stated that: (5) Household combined washer-driers fall within the scope of Commission Directive 96/60/EC of 19 September 1996 implementing Council Directive 92/75/EEC with regard to energy labelling of household combined washer-driers (3) and should therefore be excluded from the scope of this Regulation. However, considering that they offer similar functionalities to household washing machines, a revision of Directive 96/60/EC should take place as soon as possible. Also in regulation 1015/2010 on ecodesign of washing machines (under Whereas): (5) Household combined washer-driers have particular characteristics and should therefore be excluded from the scope of this Regulation. However, considering that they offer similar functionalities as household washing machines, they should be addressed as soon as possible in another implementing measure of Directive 2009/125/EC. We suggest including a reference to the request of this revision made in these two regulations.	Information is added.
60	4.1.3	It is written that **"the standardisation commission for washer-driers is updating the standard 50229 and the international standard IEC 62512 to meet up with the new standards for washing machines and dryers."** Please note that the IEC 62512 is published and not under revision. In addition, at IEC level no European energy label test procedure has to be / is defined. Please add also that the EN 50229 is not linked to the existing IEC and revise the sentence as follows, eliminating the part in red: **"the standardisation commission for washer-driers is updating the standard 50229 [and the international standard IEC 62512] to meet up with the new standards for washing machines and dryers."**	Suggestion accepted.

60	4.1.3 Standard	Please add the following sentence at the end of the paragraph. **"The revision is considered maintenance work; however, some modifications have to be made to be adapted to the WM and TD standards, in particular for the drying part."**	Suggestion accepted.
60	4.2.1	Please correct that figure. **Sales of washer-dryers in the EU were above 700,000 in 2012** (Gfk data)	Suggestion accepted.
61	4.2.3 Characteristics of washer -driers	The following statements are not correct, fact based and cannot be confirmed: **"Stopping, unloading and reloading in between, causes the load to get cold and thus loose energy"** We suggest deleting these sentences.	A source has been quoted, and in larger professional laundry services re-use of heat from one process into another is quite common. The sentence was not intended to suggest that such appliances currently exist, or are technically viable.
61	4.2.3 Programmes	Please delete the following sentence or provide the source of information: **"This is the most used drying option where available"** Many machines have this option but CECED does not have data to support that it is the most used. It is used but we cannot support that it is the most used.	Source is given.
61	4.2.3 Programmes	Please delete the following sentence: **"This option can save energy as when having a continuous wash-and-dry cycle one may transfer energy from the washing to the drying part and thus reduce the total amount of energy."** Since data are not available and no source is reported about energy saving through continuous operation. The main reason for continuous operation is comfort to users and avoiding that the clothes sit wet in the machine.	See above (4.2.3).
61	4.2.3	Water consumption: The listing of different technologies should be extended to WD using heat pump technology for drying. Please introduce it.	Suggestion accepted.
63	4.3.1 Household	Please confirm the source of data for this poll: The reason for people purchasing a washer-drier was: • Lack of space for separate washing machine and tumble dryer (52%) • The option to dry laundry sometimes (40%) • Cheaper than two separate machines (34%) • They want a continuous wash-and-dry programme 25%	Added.
63	4.3.1 Household	Please check the correctness of the percentages reported for ownership of	Clarified.

		extra washer (37%) and extra dryer (18%) in the same household. Consider that the total ownership of washing machines in the EU is 90% and of dryers is less than 26%	
63	4.3.2 Numbers of cycle	We suggest that in this paragraph a recommendation is introduced that a future study includes a user behaviour research to look at this specific functionality of WD (number of continuous cycles)	Included in recommendations.
65	4.4.1	This statement has to be extended to WD with heat pump technology. With the introduction of heat pump technology into the market, the energy consumption of the BAT will change. We recommend adapting the text.	Information added.

Cold appliances

71	5.1.2	Please modify the following text "Compared to static appliances the functionality of no-frost uses more energy **just during the standard test"** (because in real use this function provides an overall energy saving.	Suggestion accepted.
71	5.1.2	Please modify the text as follow: "However, **in the standard test** the extra energy **consumed** by static appliances during real use due to frost build up is not considered."	Suggestion accepted.
75	5.1.5	Modify the second sentence of 5.1.5 **"A new standard will soon be published at IEC level (IEC 62552-1, 62552-2, 62552-3)"**	Suggestion accepted.
76	5.1.5	Add at the end of the list of advantages the following sentence: "**Industry supports the introduction of the new standard in combination with the new label"**	Suggestion accepted.
87	5.5	The title of the paragraph is wrong. Please replace it with the following **"Changes in the performance standard - New IEC 623552-1-2-3 coming into force in 2014"**. Modify also the first sentence. **"The new global standard introduces a way of testing with different ambient temperatures and reduce the target temperature of the fridge compartment".** Please replace "Future revision" with **"First revision"**	Suggestion accepted.

Comments Topten International, Ecos and RREUSE

We call for a discussion on establishing a framework for the review of measures to be held during the horizontal Consultation Forum, which has been tentatively placed in the first quarter of 2014.	This will be part of the discussion in the forum
Empty top class needed: Where the top class of the energy label has been reached, a better class should be introduced to restore the incentive for on-going innovation towards higher efficiency. More specifically, this calls for new, better classes on the labels for dishwashers, washing machines and cold appliances.	Will be part of recommendations
Changes should be undertaken only when necessary: Each fundamental change of the Energy Label's efficiency index calculation or test method leads to difficulties to compare the efficiency values before and after the change and makes it difficult or impossible to observe the development of energy efficiency in these products.	Will be part of recommendations
We support any option that would increase the focus on energy sufficiency and reinforce drivers towards not only energy efficient but also low energy consuming products. We would particularly welcome **more information concerning the absolute energy consumption of the products under investigation**	Although in principle agreed, neither measures under the Ecodesign nor Energy labelling Directive can easily avoid 'wrong use' or over dimensioning of appliances. Here we see a role for non-regulatory tools as well.
Non Energy Aspects of product design: We would very much welcome the opportunity for future preparatory studies to include an assessment for product reparability.	Will be part of recommendations, but alignment of approach and methodology should be sought with DG ENV studies.
The report often refers to the 'CECED database'. More details and a description of this database should be given, including its market coverage and to what extent the current market supply is included for the different product categories.	The database is not sales weighted and the extent of market coverage could not be verified by us - please contact CECED directly.
The report mentions the need for an LLCC analysis in order to investigate the possible addition of new classes on the label several times. We understand such an analysis is not necessary when setting new classes.	Suggestion accepted - the comment refers to ecodesign requirements.

Dishwashers

One of the major topics in this chapter is the possible overestimation of the average number of cycles per year. We think this is a minor problem, because it applies equally for all models and does not impede the comparability of different models. Moreover, this specific number can never be absolutely accurate, since it differs for each household in everyday life.	The chapter deals with real-life use and frequency of use is an aspect of this. Other real life use aspects have been less thoroughly investigated and less information is available.
At the bottom of page 21 there is a conclusion with which we do not agree: if the number of cycles is overestimated, the calculated annual energy consumption is not necessarily also overestimated, because the number of cycles is not the only parameter used for the calculation.	This is clarified in the text.
Page 20: there are wrong graphs and/or titles, referring to other product groups.	Amended.
Page 22/23: we do not understand the statement that loading the dishwasher only partially saves energy. There is a wrong assumption behind this logic: not the number of cycles is constant, but the amount of dishes that is washed.	Clarified in the text.
BAT: the same most efficient dishwasher that is mentioned here, is also available on the Topten website: EEI= 41%, 17% better than the A+++ threshold[1].	Noted.
Hot fill can save 50% energy in dishwashers (30% in washing machines) and should be further considered in this report.	Hot fill options can be further investigated in a follow-up study. The difficulty is that the expected savings depend on systems outside the product boundary.

Washing Machines

It seems that not real improvements have enabled the new washing machines to reach the top class, but rather artifices such as colder wash temperature, longer program duration and larger capacities. These issues should be stated and investigated clearer in the report.	They are clearly stated in this report and issue of recommendation for follow-up study
As long as no robust, quality data proves otherwise, it has to be assumed that the average load is still below or around 4kg. It is very implausible that it has doubled, especially as the average household size is decreasing.	This is to be investigated in a follow-up study.
The increasing absolute energy consumption of the bigger appliances should be highlighted.	This is mentioned in the report. However we suggest this is further investigated in the light of real consumer use.

The EEI calculation formula should be changed to no longer promote **oversized washing machines**.	Buying oversized machines can not be avoided by regulations on appliances. The way and content of information conveyed to consumers however is regulated, and how the two items are linked should be subject of further study.
Clearly, more stringent energy labelling classes for more efficient washing machines are needed.	This is part of the recommendations.
spinning performance requirements. **Potential requirements could set Class B in tier 1 and class A in tier 2, considering the market shares.**	This should be investigated in a follow up study as it may not be a straightforward benefit for all.
Measures against unrealistically long program durations (e.g. declaration on the Energy Label of the duration of the standard program) and to secure a good rinsing efficiency are also welcome.	This is part of the recommendations.
Editorial issues to consider: in the EN/ FR and DE versions of the Ecodesign and Labelling regulations are some mistakes in the calculation formulas for the AEc (sometimes only 200 cycles, or Tl instead of Tt).	Added to issues in regulatory text.

Washer driers

Switzerland has banned washer-driers less efficient than class C a long time ago.	Included in the report. More information has been requested.
An Energy Label that allows comparing these products with washing machines and tumble driers should be introduced. We would welcome a further investigation of communicating to consumers the water consumption of the drying cycle as well.	This is part of the recommendations.
The loophole in the ecodesign requirements should be closed. The most straightforward way would be to include washer-driers into the scope of the ecodesign requirements for washing machines and driers.	This is part of the recommendations.

Cold appliances

The A+++ has been oversaturated, so clearly a new class for better models is needed.	This is part of the recommendations.
BAT on Topten: a 2-door refrigerator-freezer with an EEI of 17.7%, 20% better than A+++.	Noted.
The 'correction factors' are clearly an issue of importance that needs to be addressed in detail in the upcoming review of this regulation. Instead of transparently communicating the energy consumption to consumers, they	This indeed affects the efficiency index, but the annual energy consumption is also

hide the extra energy consumption of extra features. Inbuilt models with No-Frost and a chill compartment which can operate in the tropics can use nearly 40% more energy while this is not reflected in the EEI and the energy class (a jump from A+ to A++ is possible only due to these correction factors). Additionally, there is the flat 50 kWh/year for products with a chill compartment – even though this compartment is already included in the adjusted volume. **These correction factors,** which do not make sense, **contradict the Energy Label's aim**. We find astonishing that the report considers the 'technical data' provided in the 170-pages Intertek/Defra study on the correction factors as 'not sufficient', while it gives equal or more weight (1:1 citation of ¼ page) to input by other stakeholders (CECED comment). No measurements (as raised by CECED) are needed to highlight that these bonuses undermine the Energy Label's aim to transparently communicate the true energy consumption of these products.	displayed on the energy label. The report clearly quotes CECED here. The recommendations include a study into the need for the various correction factors.
Correction factors hide differences in energy consumption of up to nearly 40%. The application of **different reference lines** ('standard energy consumption', defined by the 'M' and 'N' values in the regulations) for different cold appliance categories on the other hand leads to **energy consumption differences of up to 200%** (looking at equal total net volume) between products **not being reflected in the EEI**.	The relation between energy consumption and energy efficiency should be further investigated as recommended.
The Energy Label should treat all technologies, shapes etc. equally and make differences in energy consumption transparent. One reference line, equal for all cold appliance categories, is sufficient and guarantees transparency. The '**efficiency**' (unit of function per energy consumed) must apply uniquely to a product's **primary function** (e.g. cold appliances: amount (=volume) and degree of 'cold'), **without taking into consideration additional comfort functions or technical features**. For cold appliances it is sufficient to account for different compartment temperatures with the 'adjusted Volume', all other corrections impede the Label's transparency.	See previous comment
The new, harmonised measurement standard should also be applied in Europe. The Energy Label however does not necessarily have to be adjusted to the results according to the new standard – only if the resulting energy consumption is lower and lead to many products being in the Label's top class. If most products result in having similar or higher energy consumption, no adaptation of the Label is needed for that. Technical progress will lead to more efficient products that progress though the various Energy Label classes.	Noted.
Ecodesign requirements: Switzerland has banned class A+ since January 2013. For wine coolers, the minimum efficiency requirement is class A.	Information has been added.
Price premium for A+++ models: the data to which the report refers to (page 85, 87) is from February 2011, when the A+++ class was brand new and not yet mandatory for another nine months. We have doubts that this price data is still relevant, as it refers to outdates prices of those very first few A+++ models.	We collected data from 2012, which we included. More details should be covered by a more extensive study into LCC of such appliances. Such analysis was outside the

	scope of this study.
Refrigerants: we ask that links to studies or articles be given concerning the conclusion in the report that high-GWP refrigerants are no longer a problem (page 86) for these appliances. Recent data we have found suggest that around 90% of the models sold use isobutane. Based on this, an ecodesign requirement asking for a **GWP < 50** would be appropriate to phase out the last 10% of climate-harming refrigerants and to prevent new products using high-GWP refrigerants from entering the market.	Thank you for the comment. We checked the CECED cold appliances database and found 98% of the models using hydrocarbons. Models using other refrigerants are mainly present in category 7 (combined refrigerator / freezers). Within category 7 alone, around 85% of models uses hydrocarbons, 3.5% uses HFC and 12% is 'not specified'.

Light sources / products (all)

52	The combination and streamlining of all lighting regulations would be a logical way forward and is therefore welcome. In case the regulations in the scope of this omnibus review are combined as proposed, the following points should be considered, among others:	
53	Define more ambitious requirements for LED lamp switching cycles (1194/2012): Stiftung Warentest has shown in October 2013 that all lamps survived more than 70'000 switching cycles. The Ecodesign regulation sets only a requirement for 15'000 or less, therefore not promoting the introduction of low-quality LED lamps. Lamps that are able to be rapidly switched allow for large energy savings.	Noted. But the fact that a product far outperforms the minimum is not in itself a reason for change.
54	Clarify the declaration obligation for LED luminaires (1194/2012): today manufacturers declare the product information for the lamps only, even if integrated in a luminaire, since the formulation is not clear. The measured power is often twice as high. It should be stated clearly (in 1194/2012) that the product information should be declared for the luminaire as well, including standby power.	Opinion will be mentioned in the report
55	Introduce an Energy Label for tertiary luminaires based on the Luminaire Efficiency Factor LEF (874/2012): the background conditions supporting such a measure are good, since the relevant data is measured and declared by the manufacturers.	It was suggested. Opinion will be added

Comments Agentschap-NL

Dishwashers

p. 8, table 2-1	Can the labelling classes be compared?	Old classes deleted.
p. 20, figure 2.7:	please indicate the R2 of the correlation and the significance level.	Added.

p. 25:	also take learning curve into account	Noted. Follow up study to assess greater details of the improvement and efficiency feasible.

Washing machines

p. 39, figure 3-4:	the number of models in the CECED database has grown considerably (by around 1/3)	Noted.
p. 41:	Spurious correlation? What about linear relation?	That is possible as well, although we assume negative EEI impossible
p. 45:	R2 in graph is 0.02 and not 0.3. What is the significance level?	Corrected.

Lighting products

44	We welcome the Omnibus approach and the interim report. We have one general remark. The revision of the various regulations should be an opportunity to streamline and simplify the regulations as much as possible. Making more regulations ever more detailed is not the way to go to make ecodesign and energy labelling implementation future proof. Therefore we suggest that the study provides suggestions to streamline and simplify regulations, including opportunities to harmonize with legislation outside the EU.	Opinion noted
45	p. 97, note 105: please provide a link to these reports.	OK
46	p. 98 (section 6.2.4): in earlier chapters self-regulation is not mentioned.	Will correct
47	p. 106 (second bullet of main conclusions): there is no such thing as “permissible tolerance” in Annex IV. The Annex IV provides the verification procedure for market surveillance purposes and therefore is not addressing manufacturers. Moreover the word “tolerance” is not used in the Annex.	Will correct
48	p. 120 (special purpose lamps): the biggest problem with the definition in article 2 is not mentioned; it is that it is sufficient to be a SPL when the related product information (product packaging) indicates that it is unsuitable for household room illumination. In this case better market surveillance does not have any effect, since this is a legal way to sell lamps that do not comply with the requirements (because they do not need to comply being SPL). [Also compare this definition with the definition of SPL for DLS/LEDs in the box on page 123.]	Will add this in the report
49	p. 123 (definition of special purpose lamps for DLS/LED): please note that also this definition is not without problems; see Annex (which gives an interpretation that is not shared by the Commission).	Opinion noted

50	p. 137 (restriction of the distribution of special purpose lamps): this seems hardly an option within ecodesign because ecodesign sets requirements when products are placed on the market and/or put into service. The distribution channel is not the target of ecodesign.	See answer to comment no. 40 (UBA)

Comments ANEC_BEUC

Dishwashers

2.3	We recommend taking as reference a lower number of cycles in order not to overestimate energy consumption and savings potential. As the previous preparatory study was conducted in 2008 and consumer behaviour may have changed in the last couple of years, we believe that new preparatory study would be necessary for the review of this important product group, paying special attention to current consumer behaviour. In product groups such as dishwashers and washing machines, where energy consumption could vary considerably according to consumer behaviour, a thorough EU wide consumer survey would be necessary in order to determine the energy consumption values of the energy label.	Added to recommendations
2.3	The need for a better understanding of behavioural aspects is apparent also in this case. We would suggest assessing whether the automatic program could be used as a basis for the calculation of the energy consumption per year.	This should be part of further in-depth study. We note that allegedly certain models already do so (use the automatic program for energy label efficiency declaration)
2.3	We agree with the recommendation to assess the frequency of use, the possibility of testing at different load types and testing at different temperatures.	Noted.
2.3	We support giving priority to the revision of measures on dishwashers together with other product groups under this study such as dishwashers and cold appliances. As the Energy Label is an EU wide tool and in order to achieve the best possible energy savings results we urge the Commission to undertake a full preparatory study, that thoroughly assesses user behaviour. It would be desirable from a consumer point of view to consider requirements in the following parameters: □ Duration of test program	Recommended for further research

	- Product life time (durability) - Hazardous substances - Water consumption	

Washing machines

3.3	We would support a reduction of the number of cycles based on which the annual energy consumption is calculated. However, such a reduction has to be based on new consumer research and take into account if and to what extent the increased capacity of the latest generations of washing machines have affected the frequency of use.	Recommended for further research
3.3	The reasons for which the eco 'standard' programme is not the first choice for consumers needs to be assessed through real life user research. Would it be because of the length of the "eco programme" or because it might be more water and energy consuming that another programme with lower temperature?	Recommended for further research
	In order to better reflect user behaviour it would be worth investigating the use half load as a base for the calculation of the EU energy label.	Part load is already used in the calculation.
	It would be desirable from a consumer point of view to consider requirements in the following parameters: - Duration of test program - Product life time (durability) - Hazardous substances - Water consumption - Spinning efficiency - Rinsing efficiency	Recommended for further research

Washer driers

4.3	We recommend lower temperatures –40°C and 60°C -to be used as bases for the calculation of the Energy Label if a dedicated consumer behavioural study confirms	Recommended for further research

	this is necessary.	
	A more realistic cycle should be determined. To allow a more realistic calculation of the energy consumption per year there is a need for more consumer based research.	Recommended for further research
	We agree with the study's suggestion to align any actions on washer-driers with any approach adopted for washing machines. Among the most relevant points for washer-driers would be: □ New EU energy label □ Ecodesign requirements □ Update of the standard test □ Alignment of requirements, tests with washing machines	Recommended for further research

Cold appliances

5.3	It should be checked if an average number of door openings should be integrated in the test standard for energy consumption. Measurement of energy consumption at different ambient temperatures and with different compartments should be considered, both reflecting the current situation better than the calculation method of EU energy label at the moment.	Recommended for further research
5.4.3	The data cited are from 2011 – so it would be worth to check with current data (2013) if the prices for A+++ appliances already have gone down by now.	Recommended for further research
	The following points must be considered through a full preparatory study on the revision of the Ecodesign and Energy Labelling regulations: □ Changing of labelling scheme (e.g. step from A++ to A+++ is relative high and might prevent innovation) □ Tightening of ecodesign requirements in the light of economic assessment (lowest life cycle cots).	Recommended for further research

	▯ Changes in performance standard EN 62552 ▯ Calculation of EEI and correction factors. In the past, we have expressed reservations on whether correction factors provide transparent information to consumers about energy consumption. We ask the study team to provide information on EEI both with as well as without correction factors as well as cost models for consumers, in order to allow an informed discussion during the Consultation Forum on the upcoming revisions.	

Light sources / NDLS

28	*Note: ANEC/BEUC tests show that the LED replacing lamp types are not yet ready. Their comments do not address individual pages of the report, but demonstrate this point on various aspects, as cited below*	*this is a comment of the study team*
29	During the development of regulation 245/2009 with regard to ecodesign requirements for non-directional household lamps consumer organisations were very supportive of an ambitious measure which would provide legal certainty to manufactures and at the same time would urge them to continue investing on more innovative and energy efficient technologies. Nevertheless, through our member organizations and the comparative tests they regularly conduct, we now have serious indications that the quality of products available at the moment does not fully meet our expectations expressed during the elaboration of the regulation. More specifically, our members have been conducting comparative tests since 2004, from 2008 on and in particular since 2010 they intensified their activities through international comparative tests of different lighting technologies such as halogens, CFLs and LEDs. So far, 36 halogen models, 86 LED models and 255 CFL models with E27 caps have been tested since 2011. Their activity allowed them to important conclusions about a rapidly transforming lighting market over the past decade.	Opinion noted
30	For example, tests conducted showed that halogen technology never reached the claimed efficiency. In 2004, several IL bulbs were measured and their average efficiency was of 10.2 for 40 lm/W lamps, 11.5 lm/W for 60W lamps, and 13.1 lm/W for 100W lamps. Halogen light bulbs accompanied by an “eco” claim and an extra 30% to 50% efficiency would in reality not exceed 15% more efficiency. In 2010, a consortium of consumer organisations from The Netherlands, Portugal, Spain, Italy, Belgium, England, the Czech Republic, Finland and Sweden performed tests on non-directional halogen, CFL and LED light bulbs with E27 sockets. The tests performed on halogen lamps show that their efficiency is well below what could be expected. In fact, the ratio Lumen/watt is closer to what is expected from an old incandescent lamp, especially for lamps with low light output:	Info will be added in report

	With regards to LED and CFL technology, our members have observed improvements in the energy efficiency of LEDs. Although during the first tests, LEDs could be only comparable to CFLs, the most recently tested LED models seem to be already more efficient. They have found already 6 models with an efficiency ratio higher than 80 lumen/W, which was never yet measured in consumer CFL's of the same ranges of light output before. Comparing the following test results on the efficiency of CFL and LED's of the same lumen range, one would easily observe that the differences from an energy savings point of view are considerable:	Info will be added in report
	However, when it comes to functionality features, in terms of light quality, LEDs (and, as expected, also the CFL's) cannot provide equivalent quality of light as halogens do. As indicated in the following test results, for a comparable light temperature, our members only found 10 models out of the 86 with a CRI higher than 90. However, no LED is capable of reaching a full colour spectrum. The consumer consortium expresses reservations about the correspondence of this good CRI performance to the light quality of the light bulb and fears that such a high CRI score stems from technical adjustments, which does not ensure LED light quality equivalent to halogens. **We would therefore advocate in favour of the development of a light quality measurement that corresponds to the nature of the LED technology.**	Info will be added in report

	# models (3 samples/model)	Average efficiency after: 100hrs lm/W	1500 hrs lm/W	# models burned out
<500 lm	6	11,0	9,8	0
500-1000 lm	28	13,2	9,2	6
>1000lm	2	15,1	14,1	0

LED:

	# models (3 samples/model)	Average efficiency after: 100hrs lm/W	2000 hrs lm/W	5000 hrs lm/W	# models burnt out
<500 lm	57	54,0	51,4	53,7	2
500-1000 lm	27	71,2	68,4	69,6	0
>1000lm	2	74,5	74,1	73,1	0

CFL:

	# models (3 samples/model)	Average efficiency after: 100hrs lm/W	2000 hrs lm/W	5000 hrs lm/W	# models burnt out
<500 lm	24	52,3	45,3	34,1	5
500-1000 lm	191	57,8	50,9	42,3	18
1000-1500 lm	35	63,1	54,8	49,8	3
>1500 lm	5	68,5	60,5	54,8	0

Halogen:

	# models (1 sample/model)	CRI Average	CRI Min	CRI Max	Average light color K
<500 lm	6	99,4	99,1	99,7	2634
500-1000 lm	28	99,3	98,1	99,8	2739
>1000lm	2	98,6	98,2	98,9	2844

LED:

	# models (1 sample/model)	CRI Average	CRI Min	CRI Max	Average light color K
<500 lm	57	82,5	62,0	93,5	3129
500-1000 lm	27	82,4	72,0	99,6	3102
>1000lm	2	81,8	81,7	81,9	2710

CFL:

	# models (1 sample/model)	CRI Average	CRI Min	CRI Max	Average light color K
<500 lm	24	79,8	50,2	83,0	2748,3
500-1000 lm	191	81,5	46,7	85,0	2765,1
1000-1500 lm	35	81,8	79,6	85,2	2863,0
>1500 lm	5	81,8	80,9	82,5	2655,0

Contact: Angeliki Malizou – environment@beuc.eu
Ref.: ANEC-PT-2013-ErP-000
L/2013/340 - 06/12/2013

In order to justify the switch to LED technology, the available products must meet both the expected energy efficiency as well as lifetime expectations. Also, we recognise that the prices of LEDs are rapidly decreasing over the past years but consumers must be able to trust that their investment in a more expensive technology will be returned through the long product lifetime. In their tests, our members explore three aspects associated with the durability of the product: lumen maintenance, durability over a number of switching cycles and the lifetime of the product after certain burning hours. When it comes to light decrease and switching cycles, LEDs seem to perform very well even after 30.000 switching cycles. However, when it comes to burning hours, our members encountered problems even after a restricted number of tested hours (5000).

It should be ensured that LED lamps are used and built into luminaires that allow for proper heat dissipation. Heat dissipation is instrumental in safeguarding LED lamps' lifetime (the chip of LEDs produces a lot of heat that needs to be dissipated; otherwise the chip will be damaged). This is a relevant aspect for LED lamps used as retrofits for non-directional lamps (besides being used as directional light sources).

(Shorter) Info will be added in report

	In 2011, 5 consumer organizations (Portugal, Spain, Belgium, Italy and England) performed a life-cycle assessment of CFL's and LED's. The main objective was to find out what materials and potentially hazardous substances form part of CFLs and LEDs. These results were crossed referenced with durability and efficiency, in order to assess the global environmental impact of using the different types of lamps. According to the LCA test that was performed, the main impacts are related to the use phase, so the efficiency of the light bulb is a very important factor. Nevertheless, the LCA also showed that, when the durability of the light bulb does not correspond to the claim, the impact of the production phase cannot be neglected. The biggest difference is in the amount of metal used and on the electronic circuit as LEDs use much more aluminium, copper and zinc than CFLs. With regards to the use of lead, cadmium and chromium, LEDs are comparable to CFLs but use much less mercury. This is particularly important in the case of LEDs since they use a higher quantity of materials than CFL's and in order to really replace CFL's, from a global point of view, LEDs should be able to guarantee that they will indeed last as long as they claim and they will consume less energy than they currently do. We recommend that the lamp lifetime information provided to consumers be honest, i.e. indicates a lifetime reached by most samples of a same model. **LED:** Burning hours # models | # samples failing (5 samples/model) | <1000hrs | >=1000 & <2000hrs | >=2000 & <4000hrs | >=4000 & <5000hrs | 5000hrs (or more) <500 lm | 57 | 1 | 5 | 18 | 13 | 248 500-1000 lm | 27 | 0 | 0 | 0 | 1 | 134 >1000lm | 2 | 0 | 0 | 1 | 0 | 9 **CFL:** Burning hours # models | # samples failing (5 samples/model) | <1000hrs | >=1000 & <2000hrs | >=2000 & <4000hrs | >=4000 & <5000hrs | 5000hrs (or more) <500 lm | 24 | 4 | 7 | 24 | 6 | 79 500-1000 lm | 191 | 12 | 38 | 116 | 84 | 704 1000-1500 lm | 35 | 4 | 10 | 13 | 10 | 138 >1500 lm | 5 | 1 | 1 | 3 | 2 | 18	
	With regards to existing regulations/legislative developments (6.1.1/6.1.2): labelling regulation 874/2012 more or less adopted the EEI-curves from the old regulation and added A+/A++ classes. Nevertheless, the curves still refer to lighting properties of conventional light bulbs. As it is the case with other product groups, the escalation to A+ and A++ classes is not linear (A+ is not twice as good as A; A++ is not twice as good as A+) and we believe that this is not providing transparent information to consumers. Consequently, we believe that before consumers are left only with the choice of LEDs, the aforementioned functionality issues must be addressed. Furthermore, we consider necessary to address uncertainties associated to dimmability of LEDs and compatibility with existing luminaires. We would be in favour of an in depth follow-up study which looks into the	(Shorter) Info will be added in report

	possibility of a single piece of legislation that deals holistically with all lighting products, as the “omnibus” study suggests.	

Special purpose lamps

	We welcome the study’s proposal to address loopholes created through provisions for special purpose lamps, which can undermine the aims of the Ecodesign regulations on lighting such as distribution only via a professional channels including permissions for businesses or requiring a password for internet purchase.	Opinion noted

Comments UmweltBundesAmbt

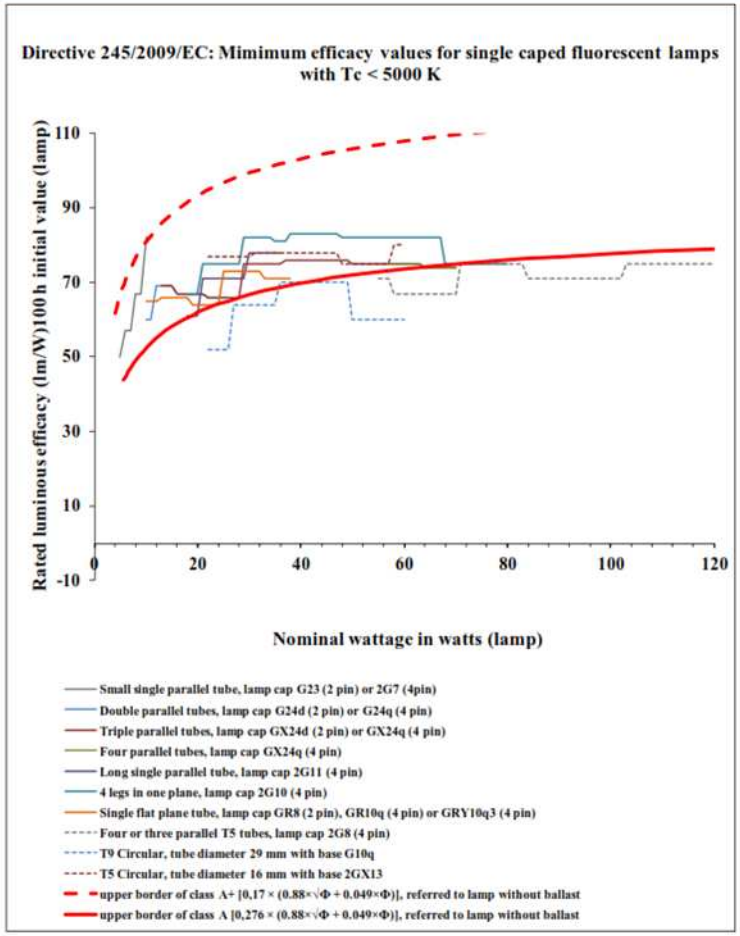
	The study does not discuss in detail the significance of environmental aspects other than energy efficiency. We accept that this cannot be done in such a short overview study, but we would like to stress that this task should be performed with sufficient care in possible following in-depth studies for particular product groups.	The topic is recommended for follow-up study
p. 28, conclusion	Life Cycle Cost assessment is necessary for ecodesign requirements, however the possibility for the introduction of new label classes is not limited by such considerations. Please correct 5th paragraph of the conclusions.	Indeed the Life Cycle Cost assessment is mandatory for ecodesign requirements only.
p. 51, p. 21	We wonder that only a small amount of washing machines provide a hot-fill option while many dishwasher provide such a option. Is it possible to provide an explanation for such a difference?	When 60ºC hot water enters the washing machine it may 'fix' protein stains in clothing - a gradual temperature increase is preferred. This issue is less problematic for dishwashers.
p. 36	As regards EN 60456, it is worth mentioning that further aspects (which are already addressed by the study) could be integrated into the standard: • Rinsing efficiency (to increase reproducibility between laboratories) • Programs with lower temperature (30°C, 20°C) • It should be checked if hygiene tests can be included also, as the trend is to use lower temperature programs.	This should be covered by the follow-up study
page 45	it is pointed out that washing machines with higher capacity but the same energy consumption as smaller machines have a lower EEI. As according to figure 3-9 the capacity 2 of sold machines increases, Ecodesign measures restricting high EEI values may even lead to an overall increase of energy consumption. This aspect of size of the machines, as was discussed also during the meeting on 18 November, should be reflected adequately in the study.	The topic is recommended for follow-up study
p. 88	We recommend that the scope should be compatible with the definition for professional refrigeration for which a regulation is in preparation (Lot ENTR 1), i.e. there should be a clear distinction between household and professional refrigeration, but with no loophole in between. If household appliances are sold for professional use and do not fall under the definition of professional appliances, they should comply with the regulations for household appliances.	

Non-Directional Light Sources

36	In general, phasing out by law all but one lighting technology could lead to a real large-scale lock-in effect in the case of e. g. potential material supply problems for LED technology. Exemptions are likely to be necessary (as briefly mentioned on p. 100), not only for high temperature environments but probably also for conditions where electronic components degrade quickly (humidity etc.). We therefore agree very much with the statement (p. 101) that "the question if and when the above functional problems can be solved is vital in deciding whether in 2021 the „minimum A+" („LED only") strategy can be made mandatory through an Ecodesign regulation. The answer to this question is complex and most certainly requires a follow-up study." **A similar statement regarding the analysis of potential risks of material supply shortages could be added.**	Opinion noted and will be added in report

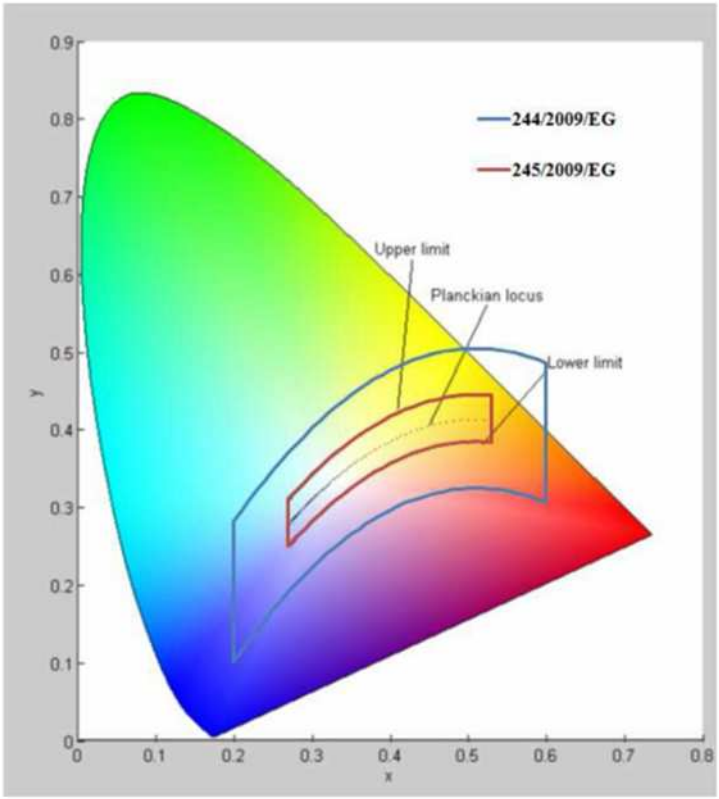
Tertiary Lighting

37	The review study proposes to include LED lighting in the scope of tertiary lighting. LED technology is rapidly being applied in tertiary lighting systems and thus should be captured in order to ensure that efficiency and quality are at least in line with best-available fluorescent / HID technology. A "technology-neutral" approach could be taken as far as possible. Attention should be paid to the IEA 4E developments in this area: http://ssl.iea-4e.org/task-1-qualityassurance.	will add the 4E reference in a footnote
38	The review study proposes, that a follow-up study could also look into the possibility of a holistic approach whereby the regulations for all lighting products (244/2009, 245/2009 and 1194/2012) are treated in a single piece of legislation. We appreciate such a holistic approach, because it allows a higher level of consistency. We recommend that the review study explores a little bit more on the interconnectedness of these three regulations, especially with regard to LED lighting. E.g. the efficiency of non-directional LED-lamps for household lighting is regulated in 244/2009, while the efficiency of directional LED lighting is regulated within 1194/2012, however independent of application area, i.e. not restricted to household use. The same regulation sets functionality requirements for LED-lamps. As 1194/2012 does not refer only to household lamps like 244/2009 the border to which LED lighting it applies (e.g. also to street lighting) seems to be not entirely clear.	will add this suggestion
39	In this regard a further aspect is, that regulation 245/2009 defines efficiency requirements as minimum efficacy values (lm/W) as a function of power demand (W) while 244/2009 as well as 1194/2012 define limits as maximum values for power demand (W) as a function of luminous flux (lm). Using efficacy values leads to a number of disadvantages as pointed out in a number of comments given by UBA and German delegation respectively during the past years. The 245/2009 and 1194/2012 approach is the better choice from our point of view. The figure below shows as an example the minimum efficacy values of Directive 245/2009/EC for single caped fluorescent lamps and the upper borders of Class A and A+ for comparison.	There seems to be no consensus with the industry position that 244/2009 should be adapted to the others. To clarify…



Special purpose lamps

40	We doubt that an increase in market surveillance would solve the problem of misuses of the exemption of special purpose lamps. Market surveillance could tackle illegal imports of normal incandescent lamps. However it seems that there is no legal ground to stop the offer of non-household lamps (special purpose lamps) for household use. The ecodesign directive has to our understanding not the power to regulate trade. Therefore it seems that the proposal "Restrict the distribution of these lamps only to the professional channels, e.g. password protected on-line sales or sales through shops that are accessible only for professionals and not the general public." (p. 137) can't be implemented under the ecodesign directive.	The intention was to regulate the offer of SPL not through Ecodesign but through the Energy Label directive. Will clarify

41	Furthermore, the definition of special purpose lamps in regulation 244/2009 is not clear enough, as also stated in the review study. Especially rough service lamps are not defined. Therefore market surveillance authorities have hardly any argument to deal with normal incandescent lamps which are just declared as special purpose lamps. Beside the proposal to set an energy efficiency requirement for rough service lamps (e.g. just to exempt them from stage 6 of regulation 244/2009) a more precise definition is necessary, if applicable based on a standard for testing.	Opinion noted
42	While the study states that regulation 1194/2012 defines special purpose lamps more precisely than 244/2009, we wonder why it is not recommended to include those definitions in regulation 244/2009.	Not everything that is 'clearer' is clear enough. Anyway, suggestion noted
43	The study mentions on p. 121 that the definition of white light needs to be harmonised between the various lighting regulations and that the regulation of non-directional light sources (NDLS) need to be adjusted. We support that the definition of white light sources in regulation 1194/2012 (NDLS) follows regulation 244/2009. This is one step on the way towards a coherent lighting regulation. The same applies for regulation 245/2009, where the same definition is used as in 1194/2012. Please note, that the definition of white light in regulation 244/2009 was set in a way to cover also soft tone lamps. It seems that Figure 8-1 contains a mistake. It shows the chromaticity coordinates of regulation 1194/2012, while the heading refers to 244/2009. Please see also the following picture, where the red line for 245/2009 applies to 1194/2012 too.  source: preparatory study lot 19; blue and red lines added by UBA	There seems to be no consensus with the industry position that 244/2009 should be adapted to the others on this point. To clarify in follow up study

Comments Lighting Europe

	General:		
1	"EU industry: no LED for general lighting purposes in Europe"	LE has Manufacturing in EU: not only LED chips! Lamps are made in Treviso (OSRAM), Erlangen and Tienen (SLI), Nagykanizsa (GE). Luminaires are made in many Member States already, e.g. LED modules and systems are made in Pila, Poland (Philips).	Report text adjusted
	Comments on Chapter 7 (Tertiary Lighting)		
2		The efficacy target of >100 lm/W is not feasible for retrofit lamps. Therefore new systems including control gears, lamps and luminaires (reflectors) are needed. A users would have to exchange/buy new luminaires	Info will be added
3		Danger of monopoly situation for new high efficient stand alone systems (proprietary technology) and no lamp retro fitting possible to old installations (specific control gear needed)	Info will be added
4		HID: >= 400 W LE/users needs quartz-MH lamps, no ceramic-MH available. In general quartz-MH should be kept as very efficient lamp technology.	Info will be added
5		Wrong 'MH 70W clear >= 80 lm/W' correct is >= 75 lm/W (see 245/2009)	
6		In reality less drop of luminous flux as mentioned in report. Dimming of power down to 60% equal to luminous flux of 55%.	Report text adjusted
7		lamp efficacy of linear fluorescent lamps on FH electronic ballasts are not correct and need to be revised (downwards)	Report text adjusted
	Comments on Chapter 8 (Special Purpose Lamps)		
8		For **special purpose lamps** (especially for Shockproof lamps) LE requires a specific declaration on the packaging, of the technical characteristics that would make a lamp special purpose, like EISA definition…	Suggestion noted

		"(X) ROUGH SERVICE LAMP.—The term 'rough service lamp' means a lamp that— "(i) has a minimum of 5 supports with filament configurations that are C–7A, C–11, C–17, and C–22 as listed in Figure 6–12 of the 9th edition of the IESNA Lighting handbook, or similar configurations where lead wires are not counted as supports; and "(ii) is designated and marketed specifically for 'rough service' applications, with— "(I) the designation appearing on the lamp packaging; and "(II) marketing materials that identify the lamp as being for rough service.	
9		LE will support the creation of a special TF guided by Commission and will be happy to actively contribute improving the special purpose lamps' definition.	Suggestion noted
10		LE believes/assumes that the figures are much higher; nevertheless we have no clear evidence.	Will be included in footnote
11	*A standard (medium or high quality) halogen lamp is already more shockproof than a 'shockproof' incandescent bulb and costs roughly the same.*	LE: This is not true, a halogen lamp is for sure not more shockproof than a rough service incandescent lamp.	Info will be added
	New trends & system considerations		

12	Comment to Page 82 of VHK slides presentation. VHK report says: *"Luminaires: inclusion of luminaire efficiency to be reconsidered"*	Inclusion of luminaire efficiency will lead to complicate requirements. There are lots of different photometric luminaire designs on the market related to the large variance of luminaire applications which implies different quality parameters. These different technical designs creates also different energy efficiencies. A possible solution should therefore take care on the achievable energy efficiency level of each relevant luminaire design class. Investigations from the former CELMA together with the DIAL institute have lead to 34 different interior luminaire classes and to 25 different exterior classes. For further considerations LE can provide the full DIAL report according to Energy efficiency classification of tertiary luminaires.	Info will be added
	Comments on ppt slides presented during the stakeholder meeting		
13	Graph of Japan LED strategy (Slide 46)	This graphic does not include Halogen ECO types and is misleading in its indication of market share for LED.	remark will be added in footnote
14	On payback period for LEDs ('LED Economics', Slide 52)	Since EU average burning time in retail sales is 1000h/year (as indicated on all our packaging) it would be helpful to have payback periods also calculated on a similar basis.	payback time will be half that of 500h which is fairly obvious from the two examples give (no action)
15	Slide: 'Functionality concerns 'LED only' (slide 53) On 'high temperature' problems with LED	There are also problems in general lighting, e.g. the obligatory fire-rated type of down lights in UK, in which LED retrofit operating temperatures are typically 30°C higher than ambient, and lamp lifetime is then typically reduced to about 15% of the declared value.	Info will be added
16	Slide: 'Functionality concerns 'LED only' (slide 53) On 'colour rendering' problems with LED	In consideration of the fact that CRI 80 class linear fluorescents are specified as being the desired sources for the vast majority of new professional lighting installations, plus the fact that making e.g. Ra90 a minimum requirement for LED would lead to significant increases in cost per lumen for LEDs which may hinder rather than help LED sales, Sylvania would not welcome a strengthening of the minimum CRI requirements. However we could appreciate the value of, for instance, requiring a minimum value for the red colour rendering of R9=Zero so as to exclude the lowest end of the current Ra80+ products.	industry opinion noted. Remark will be added in footnote
17	Slide 55 ('Competitiveness concerns')	Incorrect that there is no EU LED-production (see comment above)	as above (see no. 1)

18	Slide 59 (Legal Definitions)	Use general description instead of company-specific brand names. e.g. Double Jacket / Cold Atmosphere fluorescent lamps	we use the official text
19	Slide 60, high-powered 200W, 130 V shockproof lamp	This is not a good example because it is a 130V lamp and therefore in any case not used for general lighting in EU markets.	will remove example from slide to avoid confusion
20	Slide 61, Size of the problem [2]: Industry statistics	The units data demonstrates that although there was a small surge in shockproof lamp sales following the GLS ban in 2009, about half that quantity has since gone again by 2013. It conflicts with the LE claims that sales of RS lamps are a growing problem. The data would appear to show otherwise that what was a problem in recent years is now subsiding. Of course the % figure is growing but this is meaningless because it is driven primarily by the decreasing volume of standard GLS.Problem with this table is that it shows only the stats for the Real RS volumes. We need a third column which shows the volumes of what are in fact standard GLS lamps being marketed in RS packaging, which LE estimates at a much more significant 16M units for this year.	If such a year-on-year data was available we would gladly include it. But it isn't. The opinion of LE that it is 'more than 16M' will be included in a footnote.
21	Slide 61, Size of the problem [2]: Industry statistics (footnotes of table)	There is no data with double or triple asterisk. Remove the footnotes or include the data to which these relate	we will add the asterisk
22	Slide 65, Options. Option 1 (better surveillance)	Preferred option of SYLVANA	this is too specific the opinion of 1 stakeholder
23	Slide 65, Options. Option 2 (lift exemption for rough service lamps)	What are the alternatives? CFLi, LEDi and Halogen Eco types are not generally resistant to vibration. LED emitters themselves are OK, but the construction of LED retrofit lamps is generally NOK for vibration service. Halogen Eco types exist as alternatives for some oven lamps	Also incandescents are NOK, but have been made OK. Can't be done with the other types? Anyway, info will be added
24	Slide 65, Options. Option 3 (restrictions in distribution channels)	This may be even more difficult to enforce than market surveillance, which itself is not yet functioning as desired.	Opinion noted
25	Slide 65, Options. Option 4 (declare technical characteristics on lamp package to show why they are 'special')	May not be effective. The lamps in question already bear a warning stating "Not suitable for household room illumination" and yet the consumers still buy them for such purpose. Simply adding an additional statement that the lamps are only intended for shock/vibration service is maybe not likely to make any real difference.	Please note that this was an LE suggestion. Does LE now retract its position.

26	Slide 71. LFL: "New technology, especially for the least efficient types of LFLs, would allow to raise the minimum requirement. Also (in a later stage because of the economic impact) switching from HF to magnetic ballasts can be reconsidered."	Need to be careful here, don't look at just the raw lamp specs but the performance of the whole lighting system. The new highest efficacy Xe filled Eco tubes can have higher efficacy under the nominal datasheet conditions but not necessarily in real applications, depending on the actual operating temperature. Sometimes the flux may be decreased considerably and no longer meet the requirements of the original lighting design scheme. Therefore requiring an increase in LFL efficacy, for instance by phasing out the apparently "less efficient" types such as T8 Krypton may not necessarily benefit either the consumer or industry.	Info will be added in report
27	Slide 77. 'Higher LFL targets'	Again need to consider the system efficacy, not just the lamp datasheet specs. If HO types are phased out, no replacement lamp will be available for many luminaires (the similar-sized HE types cannot be dropped in as retrofits due to the different ballast requirements). So the luminaire will have to be changed for a type accepting higher efficacy tubes whose luminous flux per unit length is always lower. To compensate for this and maintain lux levels in the installation, more lamps will have to be used and that also means additional ballasts (more electrical losses) and a second optic for the second tube (again more optical losses). Our opinion is that these extra system losses will effectively negate the saving to be had by elimination of HO tubes. Therefore we find it misguided to consider a phase-out of HO-tubes.	Info will be added in report

Comments Samsung

On page 51 there is reference to the Samsung 'eco-bubble' technology.	The text refers to one article without any context and it is not representative of the facts. In light of this, we propose that the existing 'eco bubble' text under 'Bubbles and steam' is removed, and the following section is added instead: *Recently washing machines with a so-called "eco bubble" technology were introduced. This technology introduces detergent/air/water bubbles (to create wet foam) in the wash water during the wash cycle, allegedly creating a better wash performance at lower temperatures. Initial tests from consumer organizations however reported little difference to washing performance versus "non-bubble" machines. Upon further study the consumer organizations realized that the test method no longer reflected modern wash behaviors, and penalized unfairly the benefit of the ecobubble technology. Recent test results from consumer organizations using modern test methods have reported ecobubble washing machines delivering very strong performance.* We have also removed reference to Samsung in order to maintain the neutrality of the report.	Text has been adjusted. We appreciate the extra information provided on this (test report of independent institute, comparing wash performances). It shows that performance depends on soiling applied and weighing of results

E. Specific comments on Special Purpose products

Explanation by Hans-Paul Siderius (Agentschap NL) on Special Purpose products, 3 April 2012[218]

Annex

What are special purpose products in Regulation EU/1194/2012?

Hans-Paul Siderius (NL Agency) – 3 April 2012

Relevant articles

Directive 125/2009/EC (the Directive)

Article 1.1: 'Energy-related product', (a 'product'), means any good that has an impact on energy consumption during use which is placed on the market and/or put into service, and includes parts intended to be incorporated into energy-related products covered by this Directive which are placed on the market and/or put into service as individual parts for end-users and of which the environmental performance can be assessed independently;

Article 1.2: 'Components and sub-assemblies' means parts intended to be incorporated into products which are not placed on the market and/or put into service as individual parts for end- users or the environmental performance of which cannot be assessed independently;

Regulation EU/1194/2012 (the Regulation)

Article 1: This Regulation establishes ecodesign requirements for placing on the market the following electrical lighting products … including when they are integrated into other products.
The Regulation also establishes product information requirements for special purpose products. …
Article 2.1: 'lighting' means the application of light to a scene, objects or their surroundings so that they may been seen by humans;
Article 2.3: 'electrical lighting product' means a product designed for use with electricity and intended for use in lighting;
Article 2.4: 'special purpose product' means a product that uses technologies covered by this Regulation but is intended for use in special applications because of its technical parameters as described in the technical documentation. Special applications are those that require technical parameters not necessary for the purpose of lighting average scenes or objects in average circumstances. They are of the following types:
(a) applications where the primary purpose of the light is not lighting, …

(b) lighting applications where: …

(c) products incorporating lighting products, where the primary purpose is not lighting …

Analysis

The answer to the question "What are special purpose products in Regulation EU/1194/2012?" will be provided in two parts:

- The 'product' part: a special purpose product is a *product*.
- The 'special purpose' part: a special purpose product has a *special purpose*.

What is a product?

A special purpose product is a product, so according to Article 1.1 of the Ecodesign Directive it is a good that is placed on the market and/or put into service. A part that is

[218] The watermark ("draft") could not be removed

placed on the market as individual part for end-users and of which the environmental performance can be assessed independently is considered equal to a product. This is used in Article 1 of the Regulation where it indicates "including when they are integrated into other products".
On the other hand a component is not a product; it is a category of parts. The distinction between a part that is considered a product and a part that is a component is that the former is placed on the market as individual part for end-users and that the environmental performance can be assessed independently. So a LED in a toothbrush or a (LED) backlighting module for a television are components since they are not placed on the market as individual part for end-users. Whether the environmental performance can be assessed independently is then irrelevant.
Since these parts are components and not product-parts, they are not covered by the Regulation.

What does special purpose mean?

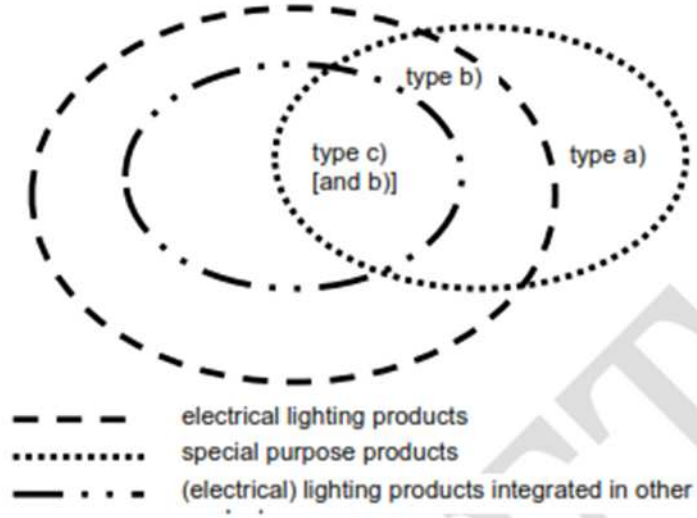
According to the definition in Article 2.4 special purpose is defined by the intended use in special applications (because of its technical parameters as described in the technical documentation). Special applications are those that require technical parameters not necessary for the purposes of lighting average scenes or objects in average circumstances. Note that the wording 'lighting average scenes or objects in average circumstances' is more specific than 'lighting' as defined in Article 2.1.
The Regulation limits the type of special applications that define the special purpose products to:

a) Applications where the primary purpose of the light is not lighting. Products that have these applications are not electric lighting products as defined by the Regulation because they are not intended for lighting (as definition 2.3 requires) but they still have to comply with the product information requirements in Annex I.

b) A limited number of lighting applications. Products that have these applications are electrical lighting products, so they fall under the scope of the Regulation. However, because they are special purpose products, according to Article 3.1 they do not have to comply with the ecodesign requirements in Annex III. But they have to comply with the product information requirements in Annex I.

c) Lighting products incorporated in other products (of which the primary purpose is not lighting). Although the formulation does not contain the word 'application' it defines a type of application and not a product.

The definition of type c) special application and the wording 'The Regulation also establishes product information requirements for special purpose products.' in Article 1 suggest overlap. The overlap is that both indicate (electrical) lighting products that are incorporated or integrated in other products. However for a lighting product that is integrated into another product to fall under type c) it also requires technical parameters not necessary for the purpose of lighting average scenes or objects in average circumstances. So e.g. a "normal" lamp used in a refrigerator falls under Article 1 (and has to comply with the ecodesign requirements of Annex III) whereas a lamp with technical parameters not necessary for the purpose of lighting etc. used in refrigerator falls under type c) (and has to comply with the information requirements in Annex I).
The figure below provides an overview.



The figure shows that electric lighting products and special purpose products overlap but that a special purpose product is not always an electric lighting product.

Conclusion

Components or sub-assemblies like LEDs in toothbrushes, LED backlighting in televisions, LEDs lighting displays in shavers, coffee machines etc. are not products (unless they happen to be placed on the market as individual parts for end-users and their environmental performance can be assessed independently) and therefore do not fall under the scope of the Regulation.

Amongst the special purpose products as defined in the Regulation are (electric) lighting products that are incorporated into other products. However, these are only special purpose products when they have technical parameters not necessary for the purpose of lighting average scenes or objects in average circumstances. Otherwise they are not special purpose products but electrical lighting products integrated into other products.

F. Calculation of "low power" modes

CENELEC proposal to deal with low power modes

CENELEC recognised difficulties in the measurement method for determining the low power mode consumption of washing machines and proposed a method that would alleviate these problems. The method is described below (extract from CENELEC document by CEN TC 59xWG1 of February 2010).

5 Calculation of annual energy consumption

The draft Regulation and the draft labelling Directive use a definition of 'left on mode' that could be difficult to establish under normal test conditions. They also use two different formulas to calculate annual energy consumption, depending on whether or not the washing machine has a power management system:

$$AE_C = E_t \times 220 + \frac{\left[P_o \times \frac{525.600 - (T_t \times 220)}{2} + P_l \times \frac{525.600 - (T_t \times 220)}{2}\right]}{60 \times 1.000}$$

$$AE_C = E_t \times 220 + \frac{\{(P_l \times T_l \times 220) + P_o \times [525.600 - (T_t \times 220) - (T_l \times 220)]\}}{60 \times 1.000}$$

'Left on mode' is defined in the draft Regulation as "the lowest power consumption mode that may persist for an indefinite time after completion of the programme without any further intervention by the end-user besides unloading of the household washing machine."

It is generally accepted that there are no good reasons why washing machines using existing technology should not be able to reach their lowest power consumption within 30 minutes of the door being opened at the completion of the programme. Similarly, for washing machines with power management systems, there is no reason why they should not be able to revert to their lowest power state within 30 minutes of the door being opened at the completion of the programme. Measurement of 'left on mode' power can therefore commence at that point.

CLC/TC59X/WG1 proposes two additional definitions and an implementation of the following formulae for calculating annual energy consumption:

Post-programme phase LU (Unstable left on mode) – Beginning when the washing machine door is opened immediately after the completion of the programme. LU lasts for 30 minutes.

Post-programme phase LO (Left on mode) – Beginning immediately after LU. LO lasts for 10 minutes. This value shall be used for fiche declaration of left-on mode.

The Annual Energy Consumption AEC is calculated in kWh/year as follows and rounded to two decimal places:

$$AE_C = W_{total} \times 220 + \frac{(525600 - 220 \times t_t)}{2 \times 60} \times \frac{P_o}{1000} + \frac{525600 - 220 \times (t_t + t_{mLU})}{2 \times 60} \times \frac{P_{LO}}{1000} + \frac{220 \times t_{mLU}}{2 \times 60} \times \frac{P_{LU}}{1000}$$

where:

W_{total} **is the average total energy consumption as calculated in kWh**

P_{LU}	**is the average power during post programme phase LU as calculated in W**
P_{LO}	**is the average power during post programme phase LO as calculated in W**
t_{mLU}	**is the duration of post programme phase LU in minutes** (30, as defined above)
P_o	**is the average power in off-mode as calculated in W**
t_t	**is the average programme time as calculated in minutes**
220	**is the total number of standard washing cycles per year"**

This formula has the following benefits:

- It is a practical implementation of the requirements expressed in the draft Regulation
- It allows 'left on mode' power to be measured in a concise and reproducible way
- It accounts for all power consumed from the beginning of the programme through to 'left on mode' thus blocking a possible circumvention opportunity.
- It is also valid for washing machines with a power management system.

Regulation 1275/2008 on standby and off mode

Commission Regulation 1275/2008[219] implements ecodesign requirements for standby and off mode electric power consumption of household appliances. Standby mode is defined as a condition where the equipment is connected to the mains power source, depends on energy input from the mains power source to work as intended and provides only the following functions, which may persist for an indefinite time:

— reactivation function
— information or status display

Off mode means a condition in which the equipment is connected to the mains power source and is not providing any function.

The regulation came into force at the 6th of January 2009. A year after that the following ecodesign requirements apply:

— Power consumption of equipment in any off-mode condition shall not exceed 1.00 W.
— The power consumption of equipment in any condition providing only a reactivation function, or providing only a reactivation function and a mere indication of enabled reactivation function, shall not exceed 1,00 W.
— The power consumption of equipment in any condition providing only information or status display, or providing only a combination of reactivation function and information or status display, shall not exceed 2,00 W.

Four years after this Regulation has come into force:

— Power consumption of equipment in any off-mode condition shall not exceed 0.50 W.
— The power consumption of equipment in any condition providing only a reactivation function, or providing only a reactivation function and a mere indication of enabled reactivation function, shall not exceed 0,50 W.

[219] COMMISSION REGULATION (EC) No 1275/2008 of 17 December 2008 implementing Directive 2005/32/EC of the European Parliament and of the Council with regard to ecodesign requirements for standby and off mode electric power consumption of electrical and electronic household and office equipment

- The power consumption of equipment in any condition providing only information or status display, or providing only a combination of reactivation function and information or status display shall not exceed 1,00 W.
- Equipment shall, except where this is inappropriate for the intended use, provide off mode and/or standby mode, When equipment is not providing the main function, or when other energy-using product(s) are not dependent on
- its functions, equipment shall, unless inappropriate for the intended use, offer a power management function, or a similar function, that switches equipment after the shortest possible period of time appropriate for the intended use of the equipment, automatically into a low power mode condition

G. Definitions of CSTB

The following definitions are the same in the Voluntary Agreement for CTBS and Code of Conduct for CTBS. The definitions below are taken from the two papers.

Definition of CSTB

Following definitions are taken from Voluntary Agreement (VA) for CSTB, but the Code of Conduct (CoC) has similar definitions. In the event that a particular CSTB might fall into more than one of the categories below, then it shall be treated as falling solely into the first such category.

A. **Cable CSTB** is a CSTB which is capable of receiving digital television signals from a coaxial or hybrid fibre/coaxial distribution system and delivering them to a consumer display and/or external rendering/recording device. If the CSTB meets the definition of a Cable CSTB and the CSTB is capable of receiving a cable service protected by conditional access, the base functionality is defined to be cable, regardless of whether the cable reception is considered the "principal functionality" by the Manufacturer or Service Provider.

B. **Satellite CSTB** is a CSTB which is capable of receiving digital television signals from a satellite transmission system and delivering them to a consumer display and/or external rendering/recording device. If the CSTB base functionality is not cable and the CSTB meets the definition of a Satellite CSTB and the CSTB is capable of receiving a satellite service protected by conditional access, the base functionality is defined to be satellite, regardless of whether the satellite reception is considered the "principal functionality" by the Manufacturer or Service Provider.

C. **Internet Protocol (IP) CSTB** is a CSTB which is capable of receiving digital television/video signals encapsulated in IP packets and delivering them to a consumer display and/or external rendering/recording device. If the CSTB base functionality is not cable or satellite and the CSTB meets the definition of an IP CSTB and the CSTB is capable of receiving an IP service protected by conditional access, the base functionality is defined to be IP, regardless of whether the IP reception is considered the "principal functionality" by the Manufacturer or Service Provider.

D. **Terrestrial CSTB** is a CSTB which is capable of receiving digital television signals from a terrestrial transmission system and delivering them to a consumer display and/or external rendering/recording device. If the CSTB base functionality is not cable, satellite or IP and the CSTB meets the definition of a Terrestrial CSTB and the CSTB is capable of receiving a terrestrial service protected by conditional access, the base functionality is defined to be terrestrial, regardless of whether the terrestrial reception is considered the "principal functionality" by the Manufacturer or Service Provider.

E. **Thin-Client/Remote CSTB**: A CSTB that is designed to interface between a CSTB and a TV (or other output device) that has no ability to interface with the Service Provider directly and relies solely on a Cable, Satellite, IP or Terrestrial CSTB for content. Any CSTB that meets the definition of Cable, Satellite, IP or Terrestrial CSTB is not a Thin-Client/Remote CSTB. If the CSTB base functionality is not cable, satellite, terrestrial or IP, and the CSTB

otherwise meets the definition of Thin-Client/Remote, the base functionality is defined to be thin-client/remote.

Voluntary Agreement and Code of Conduct energy allowances for CSTB

A Voluntary Agreement (VA) for complex set-top boxes (CSTB) entered into force in 1 July 2010. The following Tier 2 energy consumption targets became effective 1 July 2013. Code of Conduct (CoC) version 9 Tier 1 requirements began effective 1 July 2013 and Tier 2 1 July 2015:

	VA Annual Energy Allowance [kWh/year]		CoC Annual Energy Allowance [kWh/year]	
Base Functionality	**Tier 1**	**Tier 2**	**Tier1**	**Tier2**
Cable	45	40	45	37
Satellite	45	40	50	40
IP	40	35	26	20
Terrestrial	40	35	37	32
Thin-Client/Remote	40	35	26	20

	VA Annual Energy Allowance [kWh/year]		CoC Annual Energy Allowance [kWh/year]	
Additional Functionalities	**Tier 1**	**Tier 2**	**Tier 1**	**Tier 2**
Additional RF channels	20	15	7	6
Advanced Video Processing #	20	0	0	0
High Efficiency Video Processing #	-	20	20	13
Full High Definition *	20	20	0	0
Ultra High Definition *	-	30	20	13
3DTV	-	20	20	13
Advanced Graphic Processing	-	5	5	0
Multi-encoding	38	25	10	8
Multi-display	-	6	5	5
In-Home Networking interface technology	-	-	18	14
In-Home Networking network port	-	12	12	5
In-Home Networking Access Point Router	-	-	53	37
Return Path functionality	60	25		
Return Path technical interface ADSL/DOCSIS 2.0	-	30	30	30
Return Path technical interface VDSL/DOCSIS 3.0	70	50	45	25
DVR	20	20	15	10
VOIP	20	15	20	16

H.Suggested revisions to SSTB regulation

Proposed definitions for the SSTB regulation:

- "Simple STB" (SSTB) means a standalone device where the primary function of the device is the reception and processing of data from digital broadcasting streams and related services, and which has no 'conditional access' function enabled at the time of shipping. A simple STB may also have the following:
    - Audio and video decoding and output capability
    - A recording function based on removable media in a standard library format (VHS tape, DVD, Blu-ray disc and similar).
    - Use of fixed key descrambling or the inclusion of an HDMI interface and/or Huffman coding.
    - An unpopulated Common Interface socket.
    - OTT capability.

  Requirements are defined for the following types of SSTBs:

  A. Cable SSTB is a SSTB that is capable of receiving digital television signals from a coaxial or hybrid fibre/coaxial distribution system and delivering them to a consumer display and/or external rendering/recording device without the need for conditional access.
  B. Satellite SSTB is a SSTB where the principal functionality is to receive digital television signals from a satellite transmission system and delivering them to a consumer display and/or external rendering/recording device without the need for conditional access.
  C. Internet Protocol (IP) SSTB is a SSTB that is capable of receiving digital television/video signals encapsulated in IP packets and delivering them to a consumer display and/or external rendering/recording device without the need for conditional access.
  D. Terrestrial SSTB is a SSTB that is capable of receiving digital television signals from a terrestrial transmission system and delivering them to a consumer display and/or external rendering/recording device without the need for conditional access. [220]

- "Complex STB" is a device equipped to allow conditional access by descrambling using dynamically allocated keys, where the primary function of the device is the reception, descrambling and processing of data from digital broadcasting streams and related services. It may also have audio and video decoding and output capability and/or the ability to provide content to one or more dedicated Thin-Client/Remote CSTBs via a home network. A device shall not be considered to be a CSTB unless it can fulfil the functions of a CSTB when activated by the operator of the network. If a product has a populated Common Interface socket it would be considered a CSTB. For avoidance of doubt, the use of fixed key descrambling or the inclusion of an HDMI interface and/or Huffman coding does not make a STB that would otherwise be classified as a Simple STB into a Complex STB.

[220] Note: Thin client STBs are assumed to be fully covered by the VA

- "Conditional access" means the encryption, decryption and authorization techniques employed to make access to content conditional upon authorisation using a key that is dynamically allocated using a Conditional Access (CA) or Digital Rights Management (DRM) system.

- "OTT" means the ability to go "over-the-top" to access additional optional content that arrives from a third party, such as Netflix, Hulu, etc. and is delivered to an end user device. The service provider is not responsible for, nor able to control, the viewing abilities, copyrights, and/or other redistribution of the content. There is no conditional access between the service provider and the user platform.

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Suggested energy requirements

Allowances in specification	TEC, kWh/yr
Base Functionality	**Allowances**
Cable	14,5
Satellite	
IP	
Terrestrial	
Thin-Client/Remote	N/A
Additional Functionalities	**Allowances**
Additional RF channels	6
Advanced Video Processing #	0
High Efficiency Video Processing #	13
Full High Definition *	0
Ultra High Definition *	13
3DTV	13
Advanced Graphic Processing	0
Multi-encoding	8
Multi-display	5
In-Home Networking interface technology	14
In-Home Networking network port	5
In-Home Networking Access Point Router	37
Return Path functionality	N/A
Return Path technical interface ADSL/DOCSIS 2.0	30
Return Path technical interface VDSL/DOCSIS 3.0	25
DVR	10
VOIP	16

#,* : mutually exclusive

The additional functionality requirements above are consistent with tier 2 of the EU Code of Conduct on Digital Television (applying to complex set top boxes). These levels have been used as simple set top boxes are likely to have less power demand than their complex counterparts.

Relevant duty cycle in latest EU VA / EU CoC specification	ON, hours	Standby, hours	APD, hours
CSTB with APD	4,5	15	4,5

Alternative energy requirements

Alternatively, the current modal approach of the regulation could be retained, by tightening requirements as follows:

	Standby mode	Active mode
Simple STB	0.50W	4.50 W
Allowance for display function in standby	+0.50W	-
Allowance for PVR	-	+6.00W
Allowance for second turner	-	+1.00W

The issue with this approach, is that it does not account for the range of additional functionalities that new and future products are likely to have, and does not allow manufacturers a great deal of flexibility in how they achieve requirements.

I. International policies

Table I-1 International policies

Economy	Product Type	Policy Type	Mandatory/ Voluntary	Policy Status
Argentina	Refrigerator	Label Comparative	Mandatory	Entered into Force - No Activity
Argentina	Freezer	Label Comparative	Mandatory	Entered into Force - No Activity
Argentina	Clothes Washer	Label Comparative	Mandatory	Entered into Force - No Activity
Australia	Freezer	Minimum Energy Performance Standard	Mandatory	Under Revision
Australia	Clothes Washer	Label Comparative	Mandatory	Entered into Force - No Activity
Australia	Refrigerator	Minimum Energy Performance Standard	Mandatory	Under Revision
Australia	Freezer	Label Comparative	Mandatory	Entered into Force - No Activity
Australia	Refrigerator-Freezer	Label Comparative	Mandatory	Entered into Force - No Activity
Australia	Refrigerator	Label Comparative	Mandatory	Entered into Force - No Activity
Australia	Dishwasher	Label Comparative	Mandatory	Entered into Force - No Activity
Australia	Refrigerator-Freezer	Minimum Energy Performance Standard	Mandatory	Under Revision
Bangladesh	Refrigerator-Freezer	Label Comparative	Mandatory	Entered into Force - No Activity
Bangladesh	Refrigerator-Freezer	Minimum Energy Performance Standard	Mandatory	Entered into Force - No Activity
Bangladesh	Clothes Washer	Label Comparative	Voluntary	Under Development
Bangladesh	Refrigerator	Minimum Energy Performance Standard	Mandatory	Entered into Force - No Activity
Bangladesh	Clothes Washer	Minimum Energy Performance Standard	Mandatory	Under Consideration for Development
Bangladesh	Refrigerator	Label Comparative	Mandatory	Entered into Force - No Activity
Brazil	Refrigerator	Label Comparative	Mandatory	Entered into Force - No Activity
Brazil	Clothes Washer	Label Comparative	Mandatory	Entered into Force - No Activity
Brazil	Refrigerator	Minimum Energy Performance Standard	Mandatory	Entered into Force - No Activity
Brazil	Refrigerator	Label Endorsement	Voluntary	Entered into Force - No Activity
Brazil	Clothes Washer	Label Endorsement	Voluntary	Entered into Force - No Activity
Brazil	Refrigerator-Freezer	Minimum Energy Performance Standard	Mandatory	Entered into Force - No Activity
Brazil	Freezer	Minimum Energy Performance Standard	Mandatory	Entered into Force - No Activity
Brunei Darussalam	Refrigerator-Freezer	Label Comparative	Voluntary	Under Consideration for Development
Canada	Clothes Washer	Minimum Energy Performance Standard	Mandatory	Entered into Force - No Activity
Canada	Refrigerator-Freezer	Minimum Energy Performance Standard	Mandatory	Entered into Force - No Activity

Canada	Dishwasher	Label Comparative	Mandatory	Entered into Force - No Activity
Canada	Wine Chiller	Label Comparative	Mandatory	Entered into Force - No Activity
Canada	Clothes Washer	Label Comparative	Mandatory	Entered into Force - No Activity
Canada	Combination Clothes Washer/Dryer	Minimum Energy Performance Standard	Mandatory	Entered into Force - No Activity
Canada	Refrigerator-Freezer	Label Endorsement	Voluntary	Entered into Force - No Activity
Canada	Clothes Washer	Label Endorsement	Voluntary	Entered into Force - No Activity
Canada	Freezer	Label Comparative	Mandatory	Entered into Force - No Activity
Canada	Freezer	Minimum Energy Performance Standard	Mandatory	Entered into Force - No Activity
Canada	Refrigerator-Freezer	Label Comparative	Mandatory	Entered into Force - No Activity
Canada	Dishwasher	Minimum Energy Performance Standard	Mandatory	Entered into Force - No Activity
Canada	Freezer	Label Endorsement	Voluntary	Entered into Force - No Activity
Canada	Dishwasher	Label Endorsement	Voluntary	Entered into Force - No Activity
Canada	Wine Chiller	Minimum Energy Performance Standard	Mandatory	Entered into Force - No Activity
Canada	Refrigerator	Label Comparative	Mandatory	Entered into Force - No Activity
Canada	Refrigerator	Minimum Energy Performance Standard	Mandatory	Entered into Force - No Activity
Canada	Combination Clothes Washer/Dryer	Label Comparative	Mandatory	Entered into Force - No Activity
Canada	Refrigerator	Label Endorsement	Voluntary	Entered into Force - No Activity
Chile	Refrigerator-Freezer	Label Comparative	Mandatory	Entered into Force - No Activity
Chile	Refrigerator	Minimum Energy Performance Standard	Mandatory	Under Development
Chile	Refrigerator	Label Comparative	Mandatory	Entered into Force - No Activity
Chile	Clothes Washer	Label Comparative	Mandatory	Development Completed - Pending Implementation
Chile	Freezer	Label Comparative	Mandatory	Entered into Force - No Activity
China (PRC)	Clothes Washer	Label Comparative	Mandatory	Entered into Force - No Activity
China (PRC)	Refrigerator-Freezer	Label Endorsement	Voluntary	Entered into Force - No Activity
China (PRC)	Refrigerator	Label Comparative	Mandatory	Entered into Force - No Activity
China (PRC)	Refrigerator	Minimum Energy Performance Standard	Mandatory	Entered into Force - No Activity
China (PRC)	Clothes Washer	Minimum Energy Performance Standard	Mandatory	Entered into Force - No Activity
Egypt	Refrigerator	Minimum Energy Performance Standard	Mandatory	Entered into Force - No Activity
Egypt	Freezer	Label Comparative	Mandatory	Entered into Force - No Activity
Egypt	Refrigerator-Freezer	Minimum Energy Performance Standard	Mandatory	Under Revision
Egypt	Clothes Washer	Minimum Energy	Mandator	Under Revision

		Performance Standard	y	
Egypt	Refrigerator	Label Comparative	Mandatory	Entered into Force - No Activity
Egypt	Clothes Washer	Label Comparative	Mandatory	Entered into Force - No Activity
Egypt	Freezer	Minimum Energy Performance Standard	Mandatory	Under Revision
Egypt	Refrigerator	Minimum Energy Performance Standard	Mandatory	Under Revision
Egypt	Refrigerator	Minimum Energy Performance Standard	Mandatory	Entered into Force - No Activity
European Union	Clothes Washer	Label Comparative	Mandatory	Entered into Force - No Activity
European Union	Dishwasher	Label Comparative	Mandatory	Entered into Force - No Activity
European Union	Refrigerator-Freezer	Minimum Energy Performance Standard	Mandatory	Entered into Force - No Activity
European Union	Freezer	Label Comparative	Mandatory	Entered into Force - No Activity
European Union	Dishwasher	Minimum Energy Performance Standard	Mandatory	Entered into Force - No Activity
European Union	Combination Clothes Washer/Dryer	Label Comparative	Mandatory	Entered into Force - No Activity
European Union	Refrigerator-Freezer	Label Comparative	Mandatory	Entered into Force - No Activity
European Union	Refrigerator	Minimum Energy Performance Standard	Mandatory	Entered into Force - No Activity
European Union	Clothes Washer	Minimum Energy Performance Standard	Mandatory	Entered into Force - No Activity
European Union	Wine Chiller	Label Comparative	Mandatory	Entered into Force - No Activity
European Union	Refrigerator	Label Comparative	Mandatory	Entered into Force - No Activity
Germany	Refrigerator	Label Endorsement	Voluntary	Under Consideration for Revision
Germany	Clothes Washer	Label Endorsement	Voluntary	Entered into Force - No Activity
Germany	Refrigerator-Freezer	Label Endorsement	Voluntary	Under Consideration for Revision
Germany	Freezer	Label Endorsement	Voluntary	Under Consideration for Revision
Germany	Dishwasher	Label Endorsement	Voluntary	Under Consideration for Revision
Ghana	Refrigerator-Freezer	Minimum Energy Performance Standard	Mandatory	Entered into Force - No Activity
Ghana	Refrigerator-Freezer	Label Comparative	Mandatory	Entered into Force - No Activity
Hong Kong	Refrigerator	Label Comparative	Voluntary	Entered into Force - No Activity
Hong Kong	Clothes Washer	Label Comparative	Mandatory	Entered into Force - No Activity
Hong Kong	Refrigerator	Label Comparative	Mandatory	Entered into Force - No Activity
Hong Kong	Clothes Washer	Label Comparative	Voluntary	Entered into Force - No Activity
India	Clothes Washer	Label Comparative	Voluntary	Entered into Force - No Activity
Indonesia	Refrigerator-Freezer	Label Comparative	Voluntary	Entered into Force - No Activity
Indonesia	Refrigerator	Label Comparative	Voluntary	Entered into Force - No Activity
Indonesia	Refrigerator	Minimum Energy	Mandator	Under Consideration for

		Performance Standard	y	Revision
Indonesia	Clothes Washer	Label Comparative	Voluntary	Under Development
Indonesia	Refrigerator-Freezer	Minimum Energy Performance Standard	Mandatory	Under Development
Iran	Clothes Washer	Minimum Energy Performance Standard	Mandatory	Entered into Force - No Activity
Iran	Refrigerator-Freezer	Minimum Energy Performance Standard	Mandatory	Entered into Force - No Activity
Iran	Refrigerator-Freezer	Label Comparative	Mandatory	Entered into Force - No Activity
Iran	Refrigerator	Minimum Energy Performance Standard	Mandatory	Entered into Force - No Activity
Iran	Clothes Washer	Label Comparative	Mandatory	Entered into Force - No Activity
Iran	Refrigerator	Label Comparative	Mandatory	Entered into Force - No Activity
Israel	Clothes Washer	Label Comparative	Mandatory	Under Revision
Israel	Dishwasher	Minimum Energy Performance Standard	Mandatory	Entered into Force - No Activity
Israel	Freezer	Minimum Energy Performance Standard	Mandatory	Entered into Force - No Activity
Israel	Refrigerator	Label Comparative	Mandatory	Entered into Force - No Activity
Israel	Refrigerator-Freezer	Label Comparative	Mandatory	Entered into Force - No Activity
Israel	Refrigerator-Freezer	Minimum Energy Performance Standard	Mandatory	Entered into Force - No Activity
Israel	Freezer	Label Comparative	Mandatory	Entered into Force - No Activity
Israel	Refrigerator	Minimum Energy Performance Standard	Mandatory	Entered into Force - No Activity
Israel	Clothes Washer	Minimum Energy Performance Standard	Mandatory	Entered into Force - No Activity
Israel	Dishwasher	Label Comparative	Mandatory	Under Revision
Jamaica	Refrigerator	Label Comparative	Mandatory	Entered into Force - No Activity
Jamaica	Freezer	Label Comparative	Mandatory	Entered into Force - No Activity
Japan	Refrigerator	Label Comparative	Mandatory	Entered into Force - No Activity
Japan	Freezer	Label Comparative	Voluntary	Entered into Force - No Activity
Japan	Refrigerator	Label Comparative	Voluntary	Entered into Force - No Activity
Japan	Refrigerator-Freezer	Label Comparative	Voluntary	Entered into Force - No Activity
Japan	Refrigerator	Minimum Energy Performance Standard	Mandatory	Entered into Force - No Activity
Japan	Refrigerator-Freezer	Minimum Energy Performance Standard	Mandatory	Entered into Force - No Activity
Japan	Freezer	Minimum Energy Performance Standard	Mandatory	Entered into Force - No Activity
Jordan	Dishwasher	Label Comparative	Mandatory	Development Completed - Pending Implementation
Jordan	Refrigerator	Label Comparative	Mandatory	Revision Completed - Pending Implementation
Jordan	Refrigerator	Minimum Energy Performance Standard	Mandatory	Development Completed - Pending Implementation
Jordan	Clothes Washer	Label Comparative	Mandator	Under Revision

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Jordan	Refrigerator-Freezer	Minimum Energy Performance Standard	Mandatory	Development Completed - Pending Implementation
Jordan	Freezer	Minimum Energy Performance Standard	Mandatory	Development Completed - Pending Implementation
Jordan	Refrigerator-Freezer	Label Comparative	Mandatory	Revision Completed - Pending Implementation
Jordan	Clothes Washer	Minimum Energy Performance Standard	Mandatory	Under Development
Jordan	Dishwasher	Minimum Energy Performance Standard	Mandatory	Under Development
Jordan	Freezer	Label Comparative	Mandatory	Revision Completed - Pending Implementation
Jordan	Combination Clothes Washer/Dryer	Label Comparative	Mandatory	Development Completed - Pending Implementation
Kenya	Refrigerator	Label Comparative	Mandatory	Under Development
Kenya	Refrigerator	Minimum Energy Performance Standard	Mandatory	Under Development
Korea (ROK)	Refrigerator-Freezer	Label Comparative	Mandatory	Entered into Force - No Activity
Korea (ROK)	Clothes Washer	Minimum Energy Performance Standard	Mandatory	Entered into Force - No Activity
Korea (ROK)	Dishwasher	Minimum Energy Performance Standard	Mandatory	Entered into Force - No Activity
Korea (ROK)	Clothes Washer	Label Endorsement	Voluntary	Entered into Force - No Activity
Korea (ROK)	Freezer	Label Comparative	Mandatory	Entered into Force - No Activity
Korea (ROK)	Clothes Washer	Label Comparative	Mandatory	Entered into Force - No Activity
Korea (ROK)	Refrigerator-Freezer	Minimum Energy Performance Standard	Mandatory	Entered into Force - No Activity
Korea (ROK)	Freezer	Minimum Energy Performance Standard	Mandatory	Entered into Force - No Activity
Korea (ROK)	Dishwasher	Label Comparative	Mandatory	Entered into Force - No Activity
Korea (ROK)	Refrigerator	Label Endorsement	Voluntary	Entered into Force - No Activity
Korea (ROK)	Refrigerator	Minimum Energy Performance Standard	Mandatory	Entered into Force - No Activity
Korea (ROK)	Clothes Washer	Minimum Energy Performance Standard	Mandatory	Entered into Force - No Activity
Korea (ROK)	Refrigerator	Label Comparative	Mandatory	Entered into Force - No Activity
Korea (ROK)	Clothes Washer	Label Comparative	Mandatory	Entered into Force - No Activity
Malaysia	Clothes Washer	Label Comparative	Voluntary	Under Consideration for Development
Malaysia	Refrigerator-Freezer	Minimum Energy Performance Standard	Mandatory	Under Development
Malaysia	Refrigerator-Freezer	Label Endorsement	Voluntary	Entered into Force - No Activity
Malaysia	Refrigerator	Minimum Energy Performance Standard	Mandatory	Under Development
Malaysia	Dishwasher	Label Comparative	Voluntary	Under Consideration for Development
Malaysia	Clothes Washer	Minimum Energy Performance Standard	Mandatory	Under Consideration for Development
Malaysia	Freezer	Label Comparative	Voluntary	Entered into Force - No Activity

Malaysia	Refrigerator-Freezer	Label Comparative	Voluntary	Entered into Force - No Activity
Malaysia	Refrigerator	Label Comparative	Voluntary	Entered into Force - No Activity
Mexico	Refrigerator-Freezer	Label Endorsement	Voluntary	Entered into Force - No Activity
Mexico	Clothes Washer	Label Endorsement	Voluntary	Entered into Force - No Activity
Mexico	Clothes Washer	Label Comparative	Mandatory	Entered into Force - No Activity
Mexico	Refrigerator-Freezer	Minimum Energy Performance Standard	Mandatory	Entered into Force - No Activity
Mexico	Clothes Washer	Minimum Energy Performance Standard	Mandatory	Entered into Force - No Activity
Mexico	Refrigerator-Freezer	Label Comparative	Mandatory	Entered into Force - No Activity
New Zealand	Refrigerator-Freezer	Label Endorsement	Voluntary	Entered into Force - No Activity
New Zealand	Freezer	Label Comparative	Mandatory	Entered into Force - No Activity
New Zealand	Refrigerator	Minimum Energy Performance Standard	Mandatory	Under Revision
New Zealand	Refrigerator-Freezer	Minimum Energy Performance Standard	Mandatory	Under Revision
New Zealand	Dishwasher	Label Endorsement	Voluntary	Entered into Force - No Activity
New Zealand	Refrigerator	Label Comparative	Mandatory	Entered into Force - No Activity
New Zealand	Refrigerator-Freezer	Label Comparative	Mandatory	Entered into Force - No Activity
New Zealand	Clothes Washer	Label Endorsement	Voluntary	Entered into Force - No Activity
New Zealand	Clothes Washer	Label Comparative	Mandatory	Entered into Force - No Activity
New Zealand	Dishwasher	Label Comparative	Mandatory	Entered into Force - No Activity
New Zealand	Freezer	Minimum Energy Performance Standard	Mandatory	Under Revision
New Zealand	Refrigerator-Freezer	Label Comparative	Mandatory	Entered into Force - No Activity
Peru	Refrigerator-Freezer	Minimum Energy Performance Standard	Voluntary	Entered into Force - No Activity
Peru	Refrigerator	Label Comparative	Voluntary	Under Development
Peru	Refrigerator-Freezer	Label Comparative	Voluntary	Under Development
Peru	Freezer	Label Comparative	Voluntary	Under Development
Peru	Freezer	Minimum Energy Performance Standard	Voluntary	Entered into Force - No Activity
Peru	Refrigerator	Minimum Energy Performance Standard	Voluntary	Entered into Force - No Activity
Philippines	Clothes Washer	Minimum Energy Performance Standard	Mandatory	Under Consideration for Development
Philippines	Clothes Washer	Label Endorsement	Mandatory	Under Consideration for Development
Philippines	Clothes Washer	Label Comparative	Mandatory	Under Consideration for Development
Philippines	Freezer	Label Comparative	Mandatory	Entered into Force - No Activity
Philippines	Refrigerator-Freezer	Label Comparative	Mandatory	Entered into Force - No Activity
Philippines	Refrigerator	Label Comparative	Mandator	Entered into Force - No Activity

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Russia	Clothes Washer	Minimum Energy Performance Standard	Voluntary	Under Consideration for Development
Russia	Refrigerator	Label Comparative	Mandatory	Entered into Force - No Activity
Russia	Dishwasher	Label Comparative	Mandatory	Entered into Force - No Activity
Russia	Freezer	Minimum Energy Performance Standard	Voluntary	Under Consideration for Revision
Russia	Combination Clothes Washer/Dryer	Label Comparative	Mandatory	Entered into Force - No Activity
Russia	Dishwasher	Minimum Energy Performance Standard	Voluntary	Entered into Force - No Activity
Russia	Refrigerator-Freezer	Minimum Energy Performance Standard	Voluntary	Under Consideration for Revision
Russia	Freezer	Label Comparative	Mandatory	Entered into Force - No Activity
Singapore	Refrigerator	Label Comparative	Mandatory	Entered into Force - No Activity
Singapore	Refrigerator-Freezer	Label Comparative	Mandatory	Entered into Force - No Activity
Singapore	Refrigerator-Freezer	Minimum Energy Performance Standard	Mandatory	Entered into Force - No Activity
Singapore	Refrigerator	Minimum Energy Performance Standard	Mandatory	Entered into Force - No Activity
South Africa	Refrigerator	Minimum Energy Performance Standard	Mandatory	Under Development
South Africa	Refrigerator-Freezer	Label Comparative	Mandatory	Entered into Force - No Activity
South Africa	Combination Clothes Washer/Dryer	Label Comparative	Mandatory	Under Development
South Africa	Clothes Washer	Label Comparative	Mandatory	Under Development
South Africa	Dishwasher	Label Comparative	Mandatory	Under Development
South Africa	Refrigerator	Label Comparative	Mandatory	Entered into Force - No Activity
South Africa	Clothes Washer	Minimum Energy Performance Standard	Mandatory	Under Development
South Africa	Refrigerator-Freezer	Minimum Energy Performance Standard	Mandatory	Under Development
Sweden	Clothes Washer	Label Endorsement	Voluntary	Entered into Force - No Activity
Sweden	Freezer	Label Endorsement	Voluntary	Entered into Force - No Activity
Sweden	Refrigerator-Freezer	Label Endorsement	Voluntary	Entered into Force - No Activity
Sweden	Refrigerator	Label Endorsement	Voluntary	Entered into Force - No Activity
Sweden	Dishwasher	Label Endorsement	Voluntary	Entered into Force - No Activity
Switzerland	Refrigerator-Freezer	Minimum Energy Performance Standard	Mandatory	Entered into Force - No Activity
Switzerland	Freezer	Label Comparative	Mandatory	Entered into Force - No Activity
Switzerland	Refrigerator	Label Comparative	Mandatory	Entered into Force - No Activity
Switzerland	Refrigerator	Minimum Energy Performance Standard	Mandatory	Entered into Force - No Activity
Switzerland	Clothes Washer	Minimum Energy Performance Standard	Mandatory	Entered into Force - No Activity

Switzerland	Clothes Washer	Label Comparative	Mandatory	Entered into Force - No Activity
Switzerland	Freezer	Minimum Energy Performance Standard	Mandatory	Entered into Force - No Activity
Switzerland	Dishwasher	Label Comparative	Mandatory	Entered into Force - No Activity
Switzerland	Refrigerator-Freezer	Label Comparative	Mandatory	Entered into Force - No Activity
Thailand	Refrigerator-Freezer	Minimum Energy Performance Standard	Mandatory	Entered into Force - No Activity
Thailand	Refrigerator-Freezer	Label Comparative	Voluntary	Entered into Force - No Activity
Thailand	Refrigerator	Label Endorsement	Voluntary	Entered into Force - No Activity
Thailand	Refrigerator-Freezer	Label Endorsement	Voluntary	Entered into Force - No Activity
Thailand	Refrigerator	Label Comparative	Voluntary	Entered into Force - No Activity
Thailand	Clothes Washer	Label Endorsement	Voluntary	Entered into Force - No Activity
Tunisia	Freezer	Minimum Energy Performance Standard	Mandatory	Entered into Force - No Activity
Tunisia	Refrigerator	Label Comparative	Mandatory	Entered into Force - No Activity
Tunisia	Freezer	Label Comparative	Mandatory	Entered into Force - No Activity
Tunisia	Clothes Washer	Label Comparative	Mandatory	Under Consideration for Development
Tunisia	Refrigerator	Minimum Energy Performance Standard	Mandatory	Entered into Force - No Activity
Turkey	Refrigerator-Freezer	Minimum Energy Performance Standard	Mandatory	Entered into Force - No Activity
Turkey	Combination Clothes Washer/Dryer	Label Comparative	Mandatory	Entered into Force - No Activity
Turkey	Dishwasher	Minimum Energy Performance Standard	Mandatory	Entered into Force - No Activity
Turkey	Clothes Washer	Label Comparative	Mandatory	Entered into Force - No Activity
Turkey	Dishwasher	Label Comparative	Mandatory	Entered into Force - No Activity
Turkey	Clothes Washer	Minimum Energy Performance Standard	Mandatory	Entered into Force - No Activity
Turkey	Freezer	Label Comparative	Mandatory	Entered into Force - No Activity
Turkey	Refrigerator-Freezer	Label Comparative	Mandatory	Entered into Force - No Activity
Turkey	Refrigerator	Minimum Energy Performance Standard	Mandatory	Entered into Force - No Activity
Turkey	Freezer	Minimum Energy Performance Standard	Mandatory	Entered into Force - No Activity
Turkey	Refrigerator	Label Comparative	Mandatory	Entered into Force - No Activity
Turkey	Refrigerator	Label Comparative	Mandatory	Entered into Force - No Activity
United Arab Emirates	Clothes Washer	Label Comparative	Mandatory	Under Development
United Arab Emirates	Refrigerator	Label Comparative	Mandatory	Under Development
United Kingdom	Freezer	Label Endorsement	Voluntary	Under Consideration for Revision
United Kingdom	Dishwasher	Label Endorsement	Voluntary	Under Consideration for Revision

United Kingdom	Refrigerator-Freezer	Label Endorsement	Voluntary	Under Consideration for Revision
United Kingdom	Clothes Washer	Label Endorsement	Voluntary	Under Consideration for Revision
United Kingdom	Refrigerator	Label Endorsement	Voluntary	Under Consideration for Revision
United States	Freezer	Minimum Energy Performance Standard	Mandatory	Revision Completed - Pending Implementation
United States	Refrigerator-Freezer	Label Endorsement	Voluntary	Under Revision
United States	Dishwasher	Label Endorsement	Voluntary	Entered into Force - No Activity
United States	Clothes Washer	Label Comparative	Mandatory	Under Revision
United States	Clothes Washer	Label Endorsement	Voluntary	Under Revision
United States	Freezer	Label Endorsement	Voluntary	Under Revision
United States	Dishwasher	Minimum Energy Performance Standard	Mandatory	Revision Completed - Pending Implementation
United States	Refrigerator	Minimum Energy Performance Standard	Mandatory	Revision Completed - Pending Implementation
United States	Refrigerator	Label Comparative	Mandatory	Under Revision
United States	Refrigerator-Freezer	Label Comparative	Mandatory	Under Revision
United States	Clothes Washer	Minimum Energy Performance Standard	Mandatory	Revision Completed - Pending Implementation
United States	Refrigerator-Freezer	Minimum Energy Performance Standard	Mandatory	Revision Completed - Pending Implementation
United States	Refrigerator	Label Endorsement	Voluntary	Under Revision
United States	Dishwasher	Label Comparative	Mandatory	Under Revision
United States	Freezer	Label Comparative	Mandatory	Under Revision
United States	Combination Clothes Washer/Dryer	Label Endorsement	Voluntary	Under Revision
Vietnam	Refrigerator	Label Endorsement	Voluntary	Under Consideration for Development
Vietnam	Clothes Washer	Minimum Energy Performance Standard	Mandatory	Development Completed - Pending Implementation
Vietnam	Refrigerator	Minimum Energy Performance Standard	Mandatory	Development Completed - Pending Implementation
Vietnam	Refrigerator	Label Comparative	Mandatory	Entered into Force - No Activity
Vietnam	Clothes Washer	Label Comparative	Mandatory	Entered into Force - No Activity
Vietnam	Clothes Washer	Label Endorsement	Voluntary	Under Consideration for Development