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Foreword

BIO by Deloitte is pleased to submit this draft final Task 4 report for the project “Preparatory study to establish the Ecodesign Working Plan 2015-2017 implementing Directive 2009/125/EC”, on behalf of the project team composed of Oeko-Institut, BIO by Deloitte, and ERA Technology.

The report is structured as follows: Chapter 1 gives an introduction, explaining goals and approach. Chapters 2 to 4 provide general overviews of the relevant topics discussed in this report: Other environmental impacts, policy coverage, and industrial competitiveness. After an introduction to the product groups (PGs) in Chapter 5, Chapters 6 to 21 deal with individual PGs. Chapter 22 provides our conclusions.
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1. Introduction

1.1 Purpose of Task 4
The purpose of Task 4 is to elaborate further aspects of selected product groups. The product groups have been selected at the end of Task 3 because they look interesting from an energy and/or resource savings perspective. In Task 4, the following additional aspects will be investigated:

- **Main other environmental impacts.** From the following list of potential environmental impacts or aspects, the analysis will cover those that are relevant for the respective product group:
  - Water consumption in use phase;
  - Consumables (e.g. detergents);
  - Presence of critical raw materials (according to EU list\(^1\));
  - Presence of flame retardants (halogenated, etc.);
  - Presence of plasticizers (phthalates);
  - Presence of other toxic substances;
  - Presence of F-gases;
  - Radiation;
  - Safety (fuel leakage, vibrations, etc.);
  - Health (hygiene, noise levels, etc.);
  - Durability (reusability, upgradability, reparability, etc.); and
  - End-of-life (recyclability, recycled content)\(^2\).
  - Direct emissions to air;
  - Direct emissions to water; and
  - Direct emissions to soil.

- **Policy coverage.** This includes, if applicable
  - EU policies;
  - Selected Member State policies;
  - Industry self-regulatory initiatives;
  - Selected third country policies; and

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\(^2\) The aspects “durability” and “end of life” have partly already been investigated in Task 3, because they are related to resource efficiency and resource savings potential. However, for most product groups no quantitative resource savings potential could be deducted in Task 3. Therefore, these aspects have been taken up again in Task 4 in order to allow for a qualitative assessment to be included in the final assessment of the product group.
Test standards.

- **Appropriateness of Ecodesign or Energy Labelling.** This section deals with the question whether Ecodesign, and maybe Energy Labelling, is an appropriate instrument to deal with the issues identified. It may include considerations such as: existence of BAT (Best Available Technologies), variability of the product, speed of technological progress, market surveillance issues, etc.
  
  One aspect is the question whether excessive cost occurs. A cost calculation has partly already been done in Task 3. For product groups that have been carried over to Task 4, it has been shifted to the Task 4 report and refined with new data and an improved presentation. The idea is to make a rough estimate of potential savings in energy cost, and relate them to possible increases of the product price.

- **Industrial competitiveness.** The following aspects will be explored, if relevant:
  - Market structure (and possible impact of Ecodesign regulations on it);
  - Innovation;
  - Macroeconomic effects; and
  - International competition.

The overarching goal is to identify further arguments that might speak in favour of or against Ecodesign and Energy Labelling Regulations. The result will be a refined product matrix that sums up, for each product group, the data gathered in Task 3 (sales and stock, energy and other resource consumption, improvement potential) as well as the results of the additional analysis done in Task 4.

### 1.2 Product groups covered

The following 16 product groups have been identified at the end of Task 3 for further study, and will be covered in Task 4 (in alphabetical order):

- Base stations;
- Building automation control systems in non-residential buildings (the focus would be on the role of Ecodesign in the interplay with other Directives such as EPBD and EED);
- Domestic toasters;
- Electric Kettles;
- Free-standing hot beverage vending machines;
- Gateways (considering those excluding and those including ONTs);\(^3\)
- Greenhouse covers (the focus would be on possible information requirements on the different energy performance of cover materials);
- Hair dryers;
- Hand dryers;
- High pressure cleaners;
- Lifts (the focus would be on the interplay with other regulation);

---

\(^3\) Optical Network Terminal, i.e. gateways using optical fibre.
• Mobile phones (the focus would be on resource use; issues to be explored in Task 4 include business models that currently prohibit longer lifetimes, as well as applicability of other legislation with respect to end-of-life treatment);
• PV inverters;
• Refrigerated containers (the focus would be on relation to transport-related regulation);
• Signage displays (currently discussed in the framework of the review of Reg. 642/2009; but might be excluded because they form a distinct subgroup with a different technology for commercial purposes only); and
• Wireless chargers for consumer electronics.

1.3 Approach

1.3.1 Approaches to subtopics

The subtopics listed in chapter 1.1 have been taken as a checklist in order to have a comparable analysis framework for each product group, and to make sure that no relevant aspect is overlooked. However, only the aspects that have proven relevant for each specific product group have been pursued further.

For data collection purposes, questionnaires have been sent out to relevant stakeholders who have actively participated in the study so far and are knowledgeable for specific product groups. Care has been taken to contact relevant industries as well as environmental and consumer NGOs.

Information received from stakeholders has been completed by information from other sources, such as published LCAs, PCF (Product Carbon Footprint) studies, and other documents.

For other environmental impacts, each potential impact has been ranked, based on the information received from stakeholders and other sources, on a scale from 0 (not identified\(^4\)) to +++ (very relevant). Furthermore, the issue is described in more detail, if available, and possibilities for improvement are highlighted. This step focuses on the presence and nature of the impacts – it does not yet consider policy coverage or the appropriateness of Ecodesign or Energy Labelling to deal with the issue, which will be additional steps.

For policy coverage, the aspects presented in chapter 1.1 are qualitatively discussed. It is considered that there can be a case for Ecodesign (and/or Energy Labelling) Regulation mainly if other existing policies are insufficient to generate the envisaged environmental benefits for the product group. Another additional argument could be the presence of standards, labels or third country legislation that could serve as a model and facilitate the development of Ecodesign Implementing Measures.

For appropriateness of Ecodesign or Energy Labelling Regulation, again the aspects presented in chapter 1.1 are qualitatively discussed. It is considered that there is a case for such regulation if BAT exists, if there is sufficient product diversity in the market, and if technological development is slow enough that it can be estimated over various years and tiers designed accordingly. On the other hand, aspects that speak rather against Ecodesign Regulation are market surveillance problems, the fact that BAT is proprietary technology, or a high variability across Member States in infrastructural and climatic conditions related to the product group rather speak against this instrument. Also, the assessment of excessive cost was included into this step. For cost calculation, projected energy

\(^4\) A “0” must not necessarily mean that the respective aspect is not present. However it means that no evidence has been found for this aspect to be present.
savings across the product life cycle have been converted into cost savings using EU average energy prices as provided by Eurostat for EU-27 2013.

<table>
<thead>
<tr>
<th>Table 1: EU-27 average energy prices, 2013. Source: Eurostat</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Unit</strong></td>
</tr>
<tr>
<td>---------</td>
</tr>
<tr>
<td>Electricity</td>
</tr>
<tr>
<td>Natural Gas</td>
</tr>
</tbody>
</table>

As escalation rates and discount rates are similar (4% by default according to the European Commission), energy costs are, in a simplified way computed as: lifetime x energy tariff x annual energy consumption. Cost savings thanks to improvement options are calculate as: energy costs x improvement potential (%). These cost savings are then related to the average product price. Stakeholders have been asked whether they think the potential increase in average product price is likely to outweigh the calculated energy savings. Their answer is presented, where available.

For industrial competitiveness, also the aspects mentioned in chapter 1.1 have been discussed. Positive impacts on innovation, on macroeconomic aspects such as purchasing power, employment or balance of trade, on the market structure (maintenance or increase of the diversity of firms) and international competitiveness have been regarded as favourable for Ecodesign Regulation, negative effects as unfavourable.

1.3.2 Final scoring

To arrive at an overall assessment of the product groups, a scoring system has been developed in order to convert the individual discussions into a comparable format. The main question for the scoring is: How favourable is the respective aspect to Ecodesign or Energy Labelling policies? Therefore, the aspects discussed above have been slightly reformulated. The scoring system covers the following criteria:

- Other environmental impacts (including resource efficiency).
- Policy gaps (deducted from the discussion of policy coverage);
- Appropriateness of Ecodesign;
- Appropriateness of Energy Labelling; and
- Industrial competitiveness.

For each criterion, 1-3 stars are assigned. The “direction” of the scoring is the same across all product groups and criteria:

- +: aspect is not very favourable to Ecodesign or Energy Labelling policies;
- ++: aspect is somewhat favourable; and
- +++: aspect is very favourable.

The guidelines for assigning the stars are laid down in Table 2.
### Table 2: Scoring system for the summary score

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Star rating</th>
<th>Meaning</th>
<th>Considerations / Examples</th>
</tr>
</thead>
</table>
| Other environmental impacts| +           | There are no important environmental impacts for which an improvement potential exists that can be addressed by Ecodesign or Energy Labelling measures. | This criterion includes two sub-criteria. In a first step, it is checked whether there are important (two- or three-star rated) environmental issues. In a second step, it is verified whether they could in principle be addressed by Ecodesign or Energy Labelling. This is deemed necessary, because the presence of important environmental impacts would, on its own, not be an argument for or against Ecodesign requirements, if they cannot be addressed by this instrument. Examples:  
  - Ground water pollution by HPC cannot be reduced by ED / ELD because it stems from its intended use (cleaning). In contrast, water consumption by HPC can be reduced by using an appropriate nozzle.  
  - Energy consumption by greenhouses can be addressed by information requirements which help the consumer to choose the appropriate greenhouse cover for the purpose. |
|                            | ++          | There are environmental impacts of some importance where improvement potentials exist that can be addressed by Ecodesign or Energy Labelling. | Examples for few gaps:  
  - RoHS/REACH: All relevant hazardous substances in the product are included in RoHS Annex II or subject to REACH restrictions.  
  - EPBD: Product is a building element or technical building system for which requirements have been set in most / major MS.  
Examples for some gaps:  
  - WEEE: Product is in scope of WEEE (as in Art.4, MS are required to “encourage” EoL-friendly design options).  
  - RoHS/REACH: Some hazardous substances in the product are not yet included in RoHS Annex II or subject to REACH restriction, but could in principle be included.  
  - Product is a building element or technical building system but requirements have not been set in most / major Member States.  
  - Ecolabels or GPP rules exist.  
Examples for important gaps:  
  - WEEE: PGs that are exempted from scope, such as NRMM.  
  - RoHS: PG out of RoHS scope.  
  - REACH: PG contains a substance for which information to private end users or recyclers should be provided (on the product), which cannot be provided by REACH.  
  - EPBD: Product out of scope.  
  - No ecolabels or GPP rules exist. |
|                            | +++         | There are important environmental impacts where improvement potentials exist that can be addressed by Ecodesign or Energy Labelling. |                                                                                           |
| Policy gaps                 | +           | Few gaps: (Almost) all important environmental impacts (including energy efficiency and resource efficiency) are already fully covered by other policies. |                                                                                           |
|                            | ++          | Some gaps: Important environmental impacts (including energy efficiency and resource efficiency) are partially covered or could potentially be covered by other policies. |                                                                                           |
|                            | +++         | Important gaps: At least one important environmental impacts is not and cannot (or only with great difficulty) be covered by other policies. |                                                                                           |

Appropriate: + Ecodesign is not a very Aspects to consider (not exhaustive):
### Appropriate-ness Ecodesign

<table>
<thead>
<tr>
<th>Star rating</th>
<th>Meaning</th>
<th>Considerations / Examples</th>
</tr>
</thead>
</table>
| ness        | appropriate policy tool for regulating the issues at stake in this PG. | • Are products in this group generally standardized mass market products?  
• Do design-related improvement options exist, or are there information requirements imaginable that could improve the situation?  
• Is there sufficient spread of performance to cut off the lower end of the market?  
• Are Ecodesign requirements can be imagined that are verifiable for Market Surveillance Authorities?  
• Would Ecodesign improvement options create excessive cost?  
• Are the products in this group strongly integrated into a system? |
| ++          | Ecodesign is a somewhat appropriate policy tool for regulating the issues at stake in this PG. |     |
| +++         | Ecodesign is a very appropriate policy tool for regulating the issues at stake in this PG. |     |

### Appropriate-ness Energy Labelling

<table>
<thead>
<tr>
<th>Star rating</th>
<th>Meaning</th>
<th>Considerations / Examples</th>
</tr>
</thead>
</table>
| +           | Energy Labelling is not a very appropriate policy tool for regulating the issues at stake in this PG. | • Is energy consumption in use phase the dominant environmental aspect of the product?  
• Are products in this group standardized mass market products?  
• Is the energy performance of the products mainly determined by their system environment (would be unfavourable)?  
• Is there sufficient spread of performance to form various energy classes?  
• Is there generally an information deficit of users about the energy performance of the product?  
Guideline: Do negative or positive aspects prevail? |
| ++          | Energy Labelling is a somewhat appropriate policy tool for regulating the issues at stake in this PG. |     |
| +++         | Energy Labelling is a very appropriate policy tool for regulating the issues at stake in this PG. |     |

### Industrial competitiveness

<table>
<thead>
<tr>
<th>Star rating</th>
<th>Meaning</th>
<th>Considerations / Examples</th>
</tr>
</thead>
</table>
| +           | Ecodesign requirements would adversely affect industrial competitiveness. | • Potential requirements would provide strong barriers to SMEs (if any are active in the field).  
• Potential requirements would entail consistently high implementation costs (meaning that they are not likely to be mitigated by learning curves in the short term).  
• Potential requirements could only be implemented by a few producers, increasing market concentration.  
Guideline: Do negative or positive aspects prevail? |
| ++          | Impact of Ecodesign requirements on industrial competitiveness is indecisive. |     |
| +++         | Ecodesign requirements would improve industrial competitiveness. |     |
The scores for all subsections are summarized together with the Task 3 results on sales, stock, energy consumption and improvement potential in a final overview table. Product groups are ranked by energy savings potential in 2020. For some product groups with rapidly evolving technologies and markets, no savings estimates for 2030 have been provided in this table as they would not be reliable enough. No aggregate score over all criteria is created for each product group, as the various aspects are qualitatively different and a separate presentation allows for the setting of different political priorities.

1.4 Structure of the report

In the following chapters 2 to 4, general overviews of cross-cutting topics are given. Chapter 2 presents an introduction to our approach to other environmental impacts, with a special focus on hazardous substances. Chapter 3 deals with the policy coverage. Overviews are given of policies that are relevant for many product groups, and of the system of market surveillance. In chapter 4, our understanding of industrial competitiveness is developed.

Chapter 5 provides an introduction to the analysis of the individual product groups. Chapters 6 to 21 are dedicated to this analysis according to the methodology described above. The product groups are presented in alphabetical order. Chapter 22 presents our conclusions.
2. Overview of other environmental impacts

Environmental impacts can be structured in different ways. In the “LCA type”, they are structured according to the effects they have on the environmental media, such as acidification, eutrophication, or climate change. A different perspective is the “environmental aspects” perspective. It highlights properties of the product that can be harmful to the environment. In this study, an “environmental aspects” perspective has been chosen, because it is especially suitable for product policies: it highlights which properties of the product itself are problematic and might have to be changed.

On the impact side, the environmental aspects that have been chosen cover all important types of impacts:

- The use of non-renewable and renewable resources (energy, water, consumables, critical raw materials\(^5\), durability, end-of-life);
- Negative impacts on environmental media (climate change by way of energy consumption, ozone depletion by way of presence of F-gases, emissions to air, water and soil);
- Human- and ecotoxicity (flame retardants, plasticizers, other toxic substances); and
- Other negative impacts on human health and well-being (radiation, health, safety).

The discussion focuses on those impacts that are most relevant for each product group.

While most aspects are self-explaining, some explanations will be given on the more complex issues of flame retardants, plasticisers, and critical raw materials.

Flame retardants, plasticisers and critical raw materials are used in many types of energy-using and energy-related products and Ecodesign Preparatory Studies are opportunities to consider reducing the impacts from these materials.

2.1 Flame retardants

Flame retardants (FRs) are added to plastics, rubbers, fabrics and other materials to inhibit fires and it is clear that their use has saved many thousands of lives. Fire retardants are only required if there is a risk of fire and this occurs where heat or arcing may occur due to a fault or from normal use. For example, enclosures of mains powered electrical equipment must be “fire enclosures” and as such are required by European safety standards to comply with fire retardancy standards. This can be achieved by metal enclosures or plastics that do not burn, but often plastic enclosures are used that need flame retardants. There are many types of fire retardants based on halogens, phosphorous, mineral types, etc. but only some types can achieve the optimum fire resistance. When plastics burn, all types of plastics emit toxic and carcinogenic by-products. The emitted substances depend on the flame temperature, access to oxygen and the plastics’ composition. Polyurethanes for example can emit

\(^5\) Although “criticality” is not an environmental criterion but reflects a scarcity that can also be due to political, technical or economic reasons, it is still suited for the purpose of promoting a considerate use of resources that are scarce for whatever reason.
cyanide which is extremely dangerous, but these are very useful polymers. Therefore, inhibiting fire is clearly a benefit that needs to be weighed against possible environmental impacts of FRs. However, in some cases, fire retardancy can be established by constructional measures instead of using flame retardants, for example by replacing plastic enclosures by metal enclosures.

It has been widely reported that halogenated plastics such as PVC and brominated flame retardants emit toxic and carcinogenic by-products known as dioxins and furans when they burn by unsafe recycling processes. The extent of the formation of these substances depends on the chemical structure of the halogenated substance, flame temperature and other additives in the plastic material and is very variable. Possible alternatives are plastics with halogen-free flame retardants such as phosphorous-based retardants and inorganics such as alumina trihydrate. Halogen-free substitutes have to be systematically assessed regarding their hazardous properties, too. Replacement of persistent halogenated flame retardants by less problematic halogen-free flame retardants is an important step to reduce the long-term contamination of the environment and critical exposures of man and the environment. Besides this, uncontrolled burning of all plastics (including those with halogen-free flame retardants emit a different range of toxic and carcinogenic by-products known as polycyclic aromatic hydrocarbons (PAH). Therefore, a further important step is to prevent unsafe recycling processes as it is impossible to avoid plastics completely.

### 2.2 Plasticisers

Many parts and cables are required to be flexible and this can be achieved by adding plasticisers to rigid plastics such as PVC or by using flexible plastics such as silicone or polyethylene. Flexible plastics have different properties to plasticised materials and are not always ideally suited. There are many tens of different plasticisers available. The most commonly used are phthalates and there are essentially two classes: short alkyl chain and longer alkyl chain. Short alkyl chain phthalates are reproductive toxins whereas most long chain phthalates are not classified in the EU as being hazardous. There are also many non-phthalate plasticisers available. These all have different properties and so drop-in replacements are rarely available so that the plastic material needs to be fully reformulated and tested. Unfortunately, many long chain phthalates and most of the non-phthalate plasticisers are relatively new substances which have not yet been as extensively studied as the most common short chain phthalates. A few years ago, several were thought to be safe to use and not hazardous, but recent research has indicated that several may be PBTs and some could be endocrine disruptors. Therefore, it is very difficult for manufacturers to choose a safe substitute.

A number of phthalates have already been subjected to regulatory restrictions (e.g. placed on the REACH Candidate list as substances of very high concern). They should not been further used – neither phthalates which have a similar structure like these. Inclusion in the candidate list is not a restriction but industry has replaced phthalates in many products as a result. Some of the phthalate SVHCs have been added to Annex XIV so require authorisation for use in the EU but this does not prevent them in imported products made outside of the EU. However, four phthalates are likely to be banned by RoHS. Other short chain phthalates with similar structures should be avoided as these are likely to be regulated in the same way as those that are in Annex XIV.

### 2.3 Critical Raw Materials

The EU has classified 20 materials as critical raw materials (CRM), due to the fact that there is a risk that their future supply may be insufficient for the demand in the EU. This includes individual elements,
such as antimony or cobalt, etc.; and also groups of materials such as platinum group metals, light rare earth elements and heavy rare earth elements. Those materials have been listed based on the combination of their economic importance to the European industry, and their risk of supply shortage (because of rarity or monopoly situation of their production). For example, China holds 87% of the reserves of Rare Earth Elements.

Demand for many of these materials is increasing, but this will not always be matched by supply. The EU is considering what industrial and material policies will be needed to prevent EU industry from being negatively affected by supply shortage (loss of competitiveness, loss of jobs, delocalisation, etc.). Options to reduce the European dependency to those CRM include among others increasing collection and functional recycling of post-consumer scrap; or substitution of these materials by less critical alternatives. However, most of these materials are used in very economically important applications such as electrical equipment. For example, antimony oxide is used as a flame retardant in plastics, fabrics and foams and these are used in electrical equipment, cables, clothes, vehicles, carpets, curtains, etc. Fluorspar is also the critical raw material that is used to produce fluorinated gases SF₆ in switchgear and circuit-breakers of electrical equipment. Those CRM will be technically difficult to replace without impairing the application efficiency or characteristics of the application. Therefore Ecodesign options that reduce the quantities needed, such as from improved durability and longer lifetimes will help to alleviate the pressure on critical raw materials demand in Europe.
3. Overview of policy coverage

3.1 Introduction

The goal of Ecodesign or Energy Labelling Regulations is to generate energy and resource savings and improve the environmental performance of products. In order to assess whether, in a specific case, they are the appropriate instruments to achieve this, the broader policy environment has to be taken into account. Aspects to investigate are: Are the relevant environmental aspects already covered by other Community or Member State policies? Is there a risk of double regulation, or in contrast, a potential for Ecodesign or Energy Labelling to produce synergies with such policies? Do third country policies exist that have, in some way, an impact on the respective product groups and environmental aspects (for example, by regulating products that are imported into the EU, or by serving as an example for possible EU policies). Do appropriate test standards, or even substantial standards regulating the performance of the product group exist? Is effective market surveillance possible?

These questions will be investigated in detail in the individual product group chapters (chapter 1 ff). The purpose of the present chapter is an introduction to some cross-cutting Community policies that affect many product groups and may interact with Ecodesign or Energy Labelling, as well as the system of market surveillance.

3.2 Introduction to Community legislation

Products are subject to many different policies in the EU. Figure 1 and Table 3 give an overview of relevant policies and their scope (in terms of product groups covered). The footnotes in the figure relate to the numbers in the table. It becomes clear that the product scope of Ecodesign (and Energy Labelling) (dark orange circle) overlaps with the product scope of many other policies. It is however important to note that the figure shows the theoretical, not the actual overlap because several of these policies are framework policies that have to be implemented for actual product groups by other legal acts (e.g. delegated acts).
Table 3: Product scope of selected EU policies

<table>
<thead>
<tr>
<th>No.</th>
<th>Short name</th>
<th>Product scope</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ecolabel Regulation (66/20120)</td>
<td>“Any goods or services which are supplied for distribution, consumption or use on the Community market whether in return for payment or free of charge (Article 2.1)”</td>
</tr>
<tr>
<td>2</td>
<td>REACH Regulation (1907/2006 and 1272/2008)</td>
<td>Although this is substance-related legislation, it also has obligations on substances in articles. As it applies in principle to all chemical substances and mixtures with certain exemptions (Art. 1.2 – 1.5), it can be deducted that all products containing these substances and mixtures are affected.</td>
</tr>
</tbody>
</table>
| 3   | Energy Label and Ecodesign Directives (2010/30/EU and 2009/125/EC) | Energy Label: “This Directive shall apply to energy-related products which have a significant direct or indirect impact on the consumption of energy and, where relevant, on other essential resources during use. (…) This Directive shall not apply to: (a) second-hand products; (b) any means of transport for persons or goods; (c) the rating plate or its equivalent affixed for safety purposes to products.” (Art. 1.2 und 1.3) 

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<table>
<thead>
<tr>
<th>No.</th>
<th>Short name</th>
<th>Product scope</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>4</strong></td>
<td>Energy Efficiency Directive (2012/27/EC)</td>
<td>Not product-related legislation. From various places in the legislation, it can be deduced that it affects (a) buildings (Art. 4,5), (b) any product that can be &quot;energy-efficient&quot; and the object of public procurement (Art. 6), (c) appliances in a household (as part of an consumer-oriented energy savings programme) (Art. 7,12) (d) heating and cooling co-generation plants, (Art. 14) (e) equipment for energy transformation, transmission, and distribution (Art. 14,15).</td>
</tr>
<tr>
<td><strong>5</strong></td>
<td>Energy Performance of Buildings Directive (2010/31/EC)</td>
<td>“(i) existing buildings, building units and building elements that are subject to major renovation; (ii) building elements that form part of the building envelope and that have a significant impact on the energy performance of the building envelope when they are retrofitted or replaced; and (iii) technical building systems whenever they are installed, replaced or upgraded (Art. 1.2c).”</td>
</tr>
<tr>
<td><strong>6</strong></td>
<td>Public Procurement: Procurement Directive (2004/18/EC)</td>
<td>No explicit product scope mentioned. From the context, it is clear that it affects all products and services that can be the object of public procurement. Green Public Procurement rules are also laid down in the Energy Efficiency Directive.</td>
</tr>
<tr>
<td><strong>7</strong></td>
<td>F-Gas Regulation (842/2006)</td>
<td>“refrigeration, air conditioning and heat pump equipment, including their circuits, as well as fire protection systems, which contain fluorinated greenhouse gases listed in Annex I” (Art. 3); plus in addition “(b) equipment containing fluorinated greenhouse gas-based solvents; (c) (…) fire extinguishers; and (d) high-voltage switchgear (…) other products and equipment, including mobile equipment unless it is serving military operations (…) to the extent that it is technically feasible and does not entail disproportionate cost” (Art. 4); and “all fluorinated greenhouse gas containers.” (Art. 7).</td>
</tr>
<tr>
<td><strong>8</strong></td>
<td>RoHS (2011/65/EU)</td>
<td>1. Large household appliances. 2. Small household appliances. 3. IT and telecommunications equipment. 4. Consumer equipment. 5. Lighting equipment. 6. Electrical and electronic tools. 7. Toys, leisure and sports equipment. 8. Medical devices. 9. Monitoring and control instruments including industrial monitoring and control instruments. 10. Automatic dispensers. 11. Other EEE not covered by any of the categories above” (ANNEX I) (with a number of exemptions, such as photovoltaic panels).</td>
</tr>
<tr>
<td><strong>8</strong></td>
<td>WEEE (2012/19/EC)</td>
<td>During a transitional period: “1. Large household appliances, 2. Small household appliances, 3. IT and telecommunications equipment, 4. Consumer equipment and photovoltaic panels, 5. Lighting equipment, 6. Electrical and electronic tools (with the exception of large-scale stationary industrial tools), 7. Toys, leisure and sports equipment, 8. Medical devices (with the exception of all implanted and infected products), 9. Monitoring and control instruments, 10. Automatic dispensers” (Article 2.1a, ANNEX 1).</td>
</tr>
<tr>
<td>No.</td>
<td>Short name</td>
<td>Product scope</td>
</tr>
<tr>
<td>-----</td>
<td>---------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>9</td>
<td>Construction Products Regulation (305/2011)</td>
<td>Later to be extended to all EEE, with certain exemptions.</td>
</tr>
<tr>
<td>10</td>
<td>European Energy Star (Regulation No. 106/2008; Decision 2006/1005)</td>
<td>Office equipment.</td>
</tr>
</tbody>
</table>

In order to understand the interaction of those policies with Ecodesign or the Energy Label, it is important to know which aspects and life cycle phases of a product the policies cover (thematic scope), which mechanisms are used and on which regulatory level (EU or Member States) they operate. For example, there can be synergies between policies:

- If they cover different aspects of a product (e.g. one policy covering energy efficiency and another one hazardous substances);
- If they use complementary and mutually enforcing mechanisms (e.g. Ecodesign banning the least efficient products, Energy Labelling providing incentives for buying the most efficient products, and Green Public Procurement using the Energy Label information for the same purpose). Generally, minimum standards provide good synergies with information and procurement (“push and pull” mechanisms); and / or
- If they reflect an appropriate task sharing between different political levels (e.g. Ecodesign setting community-wide minimum standards for components of (new) heating systems while EPBD allows for measures for integrating these systems optimally into the whole building in a way that is adapted to local climatic and infrastructural conditions).

On the other hand, double regulation would occur if different policies regulated the same aspect on the same level using the same mechanism (e.g. if bans on hazardous substances were introduced under Ecodesign, there would be an overlap with RoHS).

To facilitate the analysis in the individual product chapters, Table 4 provides an overview of the thematic scope, mechanisms and regulatory level of the policies mentioned above. A more detailed discussion of the interaction of various policies dealing with hazardous substances can be found in the Supplementary Report “Identification of product groups and horizontal issues related to material use”.

### Table 4: Thematic scope, policy mechanisms and regulatory level of selected Community policies

<table>
<thead>
<tr>
<th>Thematic scope</th>
<th>Policy mechanisms</th>
<th>Regulatory level</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Environmental aspects</strong></td>
<td><strong>Life cycle phases</strong></td>
<td><strong>Other aspects</strong></td>
</tr>
<tr>
<td><strong>Ecolabel Regulation (66/2010)</strong></td>
<td>The most significant environmental impacts, in particular the impact on climate change, the impact on nature and biodiversity, energy and resource consumption, generation of waste, emissions to all environmental media, pollution through physical effects and use and release of hazardous substances (Article 6.3a).</td>
<td>Whole life cycle (Article 6.3).</td>
</tr>
<tr>
<td><strong>REACH Regulation (1907/2006)</strong></td>
<td>Health and environmental effects of substances</td>
<td>Production, placing on the market</td>
</tr>
<tr>
<td><strong>Ecodesign Directive (2009/125/EC)</strong></td>
<td>&quot;Significant environmental aspects&quot;: including: (a) weight and volume of the product; (b) recycled content (c) consumption of energy, water and other resources (d) use of hazardous substances (e) quantity and nature of consumables (f) ease for reuse and recycling</td>
<td>(a) raw material selection and use; (b) manufacturing; (c) packaging, transport, and distribution; (d) installation and maintenance; (e) use; and (f) end-of-life (ANNEX I)</td>
</tr>
<tr>
<td>Thematic scope</td>
<td>Policy mechanisms</td>
<td>Regulatory level</td>
</tr>
<tr>
<td>------------------------</td>
<td>-----------------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Environmental aspects</td>
<td>Life cycle phases</td>
<td>Other aspects</td>
</tr>
<tr>
<td></td>
<td>Information / Labelling</td>
<td>Minimum requirements</td>
</tr>
<tr>
<td></td>
<td>Public Procurement</td>
<td>Others</td>
</tr>
<tr>
<td></td>
<td>(g) incorporation of used components;</td>
<td>EU and MS authorities encouraged to procure only products of the highest class(es) (Art. 9).</td>
</tr>
<tr>
<td></td>
<td>(h) avoidance of technical solutions detrimental to reuse and recycling</td>
<td>EU level: Delegated acts, public procurement</td>
</tr>
<tr>
<td></td>
<td>(i) extension of lifetime</td>
<td>MS: implementation, market surveillance, public procurement</td>
</tr>
<tr>
<td></td>
<td>(j) amounts of waste and hazardous waste generated;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(k) emissions to air</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(l) emissions to water and</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(m) emissions to soil (Annex I)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Consumption of energy and where relevant other essential resources (Article 4)</td>
<td>Mandatory labelling (Article 10)</td>
</tr>
<tr>
<td></td>
<td>Only use phase (Article 4)</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>- MS shall implement consumer information programmes (Art.12)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Accurate metering (Art. 9)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Billing information (Art. 10)</td>
<td></td>
</tr>
<tr>
<td>Energy Labelling Directive (2010/30/EU)</td>
<td>Energy efficiency Use phase, transformation, transmission</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>- MS required to set up various policy measures, such as national plans or financial incentives, energy audits and energy management systems</td>
<td>Various (national energy efficiency targets, long-term strategies, financial incentives, exemplary role of public authorities, energy efficiency obligation schemes, energy audits and energy management systems</td>
</tr>
<tr>
<td>Thematic scope</td>
<td>Policy mechanisms</td>
<td>Regulatory level</td>
</tr>
<tr>
<td>-----------------------</td>
<td>-----------------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Environmental aspects</td>
<td>Building elements and technical building systems (Article 1.2b and c, 4,6,7,8,9)</td>
<td>EU level: sets certain minimum requirements, e.g. dates when all new buildings have to be zero-energy</td>
</tr>
<tr>
<td>Life cycle phases</td>
<td>- Minimum requirements for inspection and control (Art. 1.2 f and g, 14,15,16)</td>
<td>Delegated acts: power transferred to COM for a period of 5 years.</td>
</tr>
<tr>
<td>Other aspects</td>
<td>in order to improve energy performance of buildings and promote near-zero energy buildings (Art. 9,10)</td>
<td></td>
</tr>
<tr>
<td>Information / Labelling</td>
<td>- MS must guarantee regular inspection of heating and air-conditioning systems in buildings</td>
<td></td>
</tr>
<tr>
<td>Minimum requirements</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Public Procurement</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Thematic scope</th>
<th>Policy mechanisms</th>
<th>Regulatory level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental aspects</td>
<td>No specification</td>
<td>EU and MS level</td>
</tr>
<tr>
<td>Life cycle phases</td>
<td>No specification</td>
<td></td>
</tr>
<tr>
<td>Other aspects</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Information / Labelling</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Minimum requirements</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Public Procurement</td>
<td>Allows public purchasers to include environmental criteria into procurement procedures and tender specification; lays down rules for doing so.</td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**F-Gas-Regulation (842/2006)**

<table>
<thead>
<tr>
<th>Thematic scope</th>
<th>Policy mechanisms</th>
<th>Regulatory level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental aspects</td>
<td>- Reporting requirements for producers, importers and exporters of F-gases (Art. 6).</td>
<td>Mainly EU level, MS to adapt training programmes.</td>
</tr>
<tr>
<td>Life cycle phases</td>
<td>- Chemical names of the F-gases must be identified by way of a label using the accepted industry nomenclature (Art. 7(1))</td>
<td></td>
</tr>
<tr>
<td>Other aspects</td>
<td>- Product-related requirements: prevent leakage, repair leaks, install leakage detection systems (Art.3); prohibition of certain substances (Art. 8, 9)</td>
<td></td>
</tr>
<tr>
<td>Information / Labelling</td>
<td>- Process-related requirements: check for leakages, keep track of gases used (Art. 3), requirements for recovery (Art. 4)</td>
<td></td>
</tr>
<tr>
<td>Minimum requirements</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Public Procurement</td>
<td>Training and certification: Commission shall develop minimum standards for personnel dealing with F-gases, and MS shall adapt their training programmes (Art. 5)</td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thematic scope</td>
<td>Policy mechanisms</td>
<td>Regulatory level</td>
</tr>
<tr>
<td>------------------------</td>
<td>---------------------------</td>
<td>-----------------------------------</td>
</tr>
<tr>
<td>Environmental aspects</td>
<td>Life cycle phases</td>
<td>Other aspects</td>
</tr>
<tr>
<td>WEEE Directive (2012/19/EU)</td>
<td>Waste reduction; efficient use of resources; reducing adverse impacts of waste on human health and the environment</td>
<td>Production and end-of-life</td>
</tr>
<tr>
<td>Thematic scope</td>
<td>Life cycle phases</td>
<td>Other aspects</td>
</tr>
<tr>
<td>----------------</td>
<td>------------------</td>
<td>---------------</td>
</tr>
<tr>
<td>Environmental aspects</td>
<td>Life cycle phases</td>
<td>Other aspects</td>
</tr>
<tr>
<td>Construction Products Regulation (305/2011)</td>
<td>Giving off of toxic gas; emissions of dangerous substances, greenhouse gases, radiation; release of dangerous substances into water; faulty discharge of waste water, emission of flue gases or faulty disposal of solid or liquid waste; dampness in parts of the construction works; noise protection; energy performance; durability; recyclability; environmentally compatible materials (Annex I)</td>
<td>Whole life cycle</td>
</tr>
<tr>
<td>EU Energy Star (106/2008; Council Decision 2006/1005/EC of 18 December 2006)</td>
<td>Energy consumption / energy efficiency</td>
<td>Use phase</td>
</tr>
</tbody>
</table>
3.3 Introduction to market surveillance

The Ecodesign Directive is a New Approach Directive. This means that the manufacturer or importer is responsible for verifying that a product being placed on the market complies with the minimum requirements. This is done by following a conformity assessment procedure specified in the individual Implementing Measures. The manufacturer confirms compliance by affixing the CE mark to the product and issuing a declaration of conformity.

The role of market surveillance is to detect and punish possible violations. To this effect, information must be acquired from manufacturers or importers, and selected products must be tested for compliance. According to Art.3 of the Ecodesign Directive, market surveillance is the responsibility of the Member State authorities. It has to be performed in accordance with Regulation No. 765/2008 setting out the requirements for accreditation and market surveillance relating to the marketing of products. It foresees, among other things, that Member States assign appropriate powers and resources to their Market Surveillance Authorities, that they develop and update market surveillance programs, and that they cooperate with each other and with the Commission. The forum for cooperation is the so-called Administrative Co-operation Working Group (ADCO).

In practice, various problems have emerged with respect to market surveillance. Resources assigned to Market Surveillance Authorities by Member States are often insufficient. A lack of funds and skilled personnel impairs the carrying out of market surveillance activities at an appropriate scale. Exchange between national authorities is hampered, for example, by differing model names that prevent the identification of products that have been found noncompliant in one Member State in other markets. EU-funded projects such as ATLETE have shown that a substantial number of tested products are noncompliant.10

While such problems can in principle be overcome, certain requirements are more demanding to verify than others, because they may require more complex tests or the purchasing of expensive products. Also, there are more categorical limits to market surveillance. Compliance with certain types of (possible) requirements cannot, by means of inspection or testing, be verified on the product itself. This is for example true for criteria such as recycled content or origin of materials. In order to verify compliance with such criteria, reliable certification systems need to be in place.

Therefore, when discussing whether Ecodesign requirements are appropriate for a product group, one must also take into account whether possible requirements can actually be verified by Market Surveillance Authorities, whether additional systems need to be put in place to allow for such verification, and how costly or demanding it would be.

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10 For example, Atlete II performed tests of 51 washing machines. Of those, 7 were noncompliant with specific Ecodesign requirements and 34 were noncompliant with generic requirements. After remedy action had been taken, 6 machines were still non-compliant, http://www.atlete.eu/2/doc/ATLETE%20II_Test_Results_PRINT_OUTS_25_06_2014.
4. Overview of industrial competitiveness

This generic section aims at describing the various effects that Ecodesign requirements may have on industrial competitiveness. It is named an overview, since it is intended to serve as a global introduction to the product groups in scope of Task 4. Indeed, in the specific analysis of each product group, a dedicated section related to industrial competitiveness is included — they will embody the generic effects that are described in this section.

“Industrial competitiveness” generally refers to the economic performance and balance of European companies, both on the internal market and abroad. This section is mostly based on evidence gathered following Ecodesign Regulations already adopted. It is split into four sub-sections:

- Market structure;
- Innovation;
- Macroeconomic benefits; and
- International competition.

In each sub-section, text boxes are displayed to illustrate arguments with examples of product groups from this Working Plan study. These text boxes are not intended to be exhaustive and shall only redirect to the specific section for more information. Moreover, the specific analysis of industrial competitiveness for each product group has always be done on the basis of available information, including input for stakeholders, which can vary from one product group to the other.

4.1 Market structure

The overall objective of the European Commission is to ensure efficient markets and fair competition, so that consumers finally benefit from low prices and reliable and performing products. Even if imperfect itself, the framework of “perfect competition” remains useful to assess the level of competition. It may still be regarded as a model that European markets should come closer to.

To this extent, it is interesting to note that Ecodesign requirements strengthen at least two major conditions of perfect competition:

- **Perfect information.** Ecodesign information requirements, as their name indicates, do make information better — but even such Ecodesign specific requirements like plastic marking would contribute to it; and
- **Homogenous products.** As minimum performance standards are set through Ecodesign Regulation, products get closer to one another: the range of available products is reduced as a share of less efficient products is cut.

Ecodesign information requirements are suggested for the following product groups in scope: Greenhouse covers; Lifts. As far as plastic marking is concerned, please read the Supplementary Task 2 report on materials to check which kind of requirements could be set up.
Finally, we may say that Ecodesign Regulation sets out favourable conditions for a more competitive market. The framework of perfect competition, however, includes other conditions regarding market structure. The two most prominent of them are the number of buyers and sellers (on the one hand) and the barriers to entry and exit of the market (on the other hand). It remains to be seen which effects do have Ecodesign requirements on those features.

Before dealing with it, a specific sub-section will observe the generic effects of Ecodesign requirements on products’ purchase prices.

### 4.1.1 Purchase prices of products

An increase in purchase price may be a consequence of an Ecodesign Regulation. This price effect would be mainly due to the following two mechanisms:

- First of all, firms can be expected to pass at least a part of their incurred R&D costs on to consumers; and
- This might also be directly related to additional costs arising from the replacement of existing components or materials with more environmental-friendly ones, which thus gets reflected in a higher purchase price.

Higher costs do not always result into higher prices: if competition is tight, manufacturers are rather expected to cut off their margins. This is why the “price effect” is not equal across product groups in scope. Such product groups like Hand dryers or Toasters may show a stronger price effect (due to loose competition and/or costly improvement options).

A DEFRA study\(^{11}\) which undertook a review of 18 product groups, covering a wide range of products in both the domestic and industrial sectors, revealed a clear and consistent picture regarding the price effect. Relying on both theoretical and empirical analysis (with UK market data), the authors found a positive correlation between environmental improvement and price in 15 out of the 18 product groups; even if it was only incremental in some of the cases. Nonetheless, the price effect of new, more environmental-friendly technologies seems to diminish over time due to the learning effect before price stabilisation occurs once the transition in the economy is completed\(^{11, 12}\).

However, it should be clear that any increase in purchase price will be balanced, on the consumer’s side, with a lower cost in use phase (reduction of energy bill).

For each product group, a section on “Excessive cost” indicates how much money would be saved in use phase by a consumer, thanks to lower energy consumption.

### 4.1.2 Number of buyers and sellers

Obviously, the implementation of an Ecodesign Regulation will have different effects, depending on the number of companies on the market. Possible market structures of interest include monopoly, oligopoly or “perfect competition”. One encounters a few large producers in an oligopoly, whereas competitive markets are characterized by a substantial share of Small and Medium-sized Enterprises (SMEs).

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Experience shows that since the introduction of the Ecodesign Directive different market structures were encountered depending on the product group. Examples are the market for white goods, especially for cooling appliances, which has a large number of producers, whereas for lighting until recently only three firms could be identified making it effectively an oligopoly, namely Philips, Osram and General Electric.  

In theory, the more producers there are on the market, the more perfect the competition is – and the lower the prices (for consumers) and profits (for manufacturers), since manufacturers margins are limited by the presence of competitors. How would this be linked to Ecodesign Regulation? Table 5 provides a basic theoretical assessment of Ecodesign effects, depending on the number of sellers on the market.

### Table 5: Effects of Ecodesign requirements depending on the number of manufacturers on the market

<table>
<thead>
<tr>
<th>Effects</th>
<th>Large number of small manufacturers</th>
<th>Small number of large manufacturers</th>
</tr>
</thead>
<tbody>
<tr>
<td>...on profit and prices</td>
<td>If Ecodesign requirements generate an increase in production cost, it might not be passed on sale prices. In this case, the sellers' profits would be reduced (this will depend on the size of the prices increase if large, manufacturers will have to pass this on).</td>
<td>If Ecodesign requirements generate an increase in production cost, it might be passed on sale prices. In this case, the sellers' profits would stay the same</td>
</tr>
<tr>
<td>...on innovation activity</td>
<td>A smaller scale of production allows only for limited experience gains. In this case, companies might find it difficult to comply with the Ecodesign requirements</td>
<td>A larger production allows to profit from increased learning, facilitating the environmental improvement of the product</td>
</tr>
<tr>
<td>...on implementation costs</td>
<td>• For companies to comply to Ecodesign / Energy labelling: Higher costs, as smaller companies may not have dedicated staff to take care of legal / technical compliance</td>
<td>• For public authorities to check up compliance: Lower costs, as only a few companies have to implement Ecodesign requirements</td>
</tr>
<tr>
<td></td>
<td>• Higher costs, as many companies have to implement Ecodesign requirements</td>
<td>• Lower costs, as bigger companies do already have dedicated staff for compliance issues / purposes</td>
</tr>
</tbody>
</table>

In regard to the number of buyers, one can note that they are simply price-takers if the number is large enough. In this case, it is relatively easy for firms to put an additional mark-up, increasing the price of the product.

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13 Ecofys (2014), Impact of Ecodesign and Energy/Tyre Labelling on R&D and Technological Innovation. Study prepared for the European Commission, DG ENER.

In the hypothetical case, in which there are only a few buyers, they possess a certain degree of market power, which makes it more difficult for companies to increase prices. However, this case is not of a great relevance given the fact that for a product to be considered for regulation under the Ecodesign Directive a significant number of sales (indicative mark of 200,000 units per year) has to take place. In reality, it is unlikely that only a few buyers will purchase such an important number of such a good.

Those theoretical effects may be applied to product groups in scope of this Working Plan study in a way that is summed up in table below. Please note that this classification is only indicative.

<table>
<thead>
<tr>
<th>Large number of small manufacturers</th>
<th>Small number of large manufacturers</th>
<th>Large number of small manufacturers AND Small number of large manufacturers (market split)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hair dryers</td>
<td>Base stations</td>
<td>Lifts</td>
</tr>
<tr>
<td>Toasters</td>
<td>Gateways</td>
<td>Hand dryers (?)</td>
</tr>
<tr>
<td>Kettles</td>
<td>Mobile phones</td>
<td>BACS</td>
</tr>
<tr>
<td>Greenhouse covers</td>
<td>Signage displays</td>
<td>High pressure cleaners</td>
</tr>
<tr>
<td>Hot vending machines</td>
<td></td>
<td>Refrigerated containers (?)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wireless chargers (?)</td>
</tr>
</tbody>
</table>

A description of market structure for each product group is available in the respective chapters. The interrogation mark refers to the uncertainty about some product groups, for which market structure could not be analysed in details. For instance, for wireless chargers, a clear market structure is not yet established.

4.1.3 Entry and exit barriers

Ecodesign may exert another important impact on the market structure in that it may create barriers to entry for new firms and induce the market exit of established companies. This section is of course linked to the above, as effects on entry or exit would affect the number of companies.

**Barriers to entry**

Market entry may be deterred following the entry into force of an Ecodesign Regulation as prior knowledge is often needed to manufacture more environmentally performing products: Research and Development (R&D) may be an objective brake to market entrance. Thus, an early paper by Mueller and Tilton\(^\text{15}\) showed that the learning curve from which established companies profit creates barriers to entry and protection from competitors given the falling average cost curves. Intuitively, it seems that the highest learning rates in an industry should result in the least number of market entries. However, Mueller and Tilton found in their study that barriers to entry would be actually highest for intermediate learning rates\(^\text{16}\).


\(^\text{16}\) This could be further explained by the effect that new, innovative companies may enter the market in a period where framework conditions change and rapid learning is required, while incumbents are too slow to react in order to established procedures.
Furthermore, learning effects contribute to a reduction in the incremental costs of new technologies and product upgrades over time. The positive correlation between cumulative production and average unit costs is described by the learning rate and, with UK market data, it was found to be averaging around 18\% for a wide range of energy-using products.\textsuperscript{12} While there is some variation in the learning rates between different technologies, these differences were not found to be statistically significant for most of the products analysed. Other evidence suggested even higher learning rates related to product energy efficiency in the range of 13 to 35\% in the Netherlands over the past forty years, averaging around 20\%.\textsuperscript{12}

| Barriers to market entry, and possibly slower learning rate, may be found for the following product groups: Gateways; Hand dryers; High Pressure Cleaners. Dedicated Preparatory Study, if any, would have to pay some attention to this topic of market entry. |

All in all, Ecodesign requirements call for more technical expertise, which is only acquired thanks to R\&D efforts and learning effects. R\&D efforts tend to increase costs, while learning effects tend to reduce them. Then we can assert that the prevention of market entry exerts a negative impact on competition, and might possibly damage the European consumers if R\&D efforts are not compensated through learning effects.

**Barriers to exit**

Ecodesign may not only have an impact on market entry, but also on market exit. As a matter of fact, companies that produce energy-efficient products at a competitive cost will adapt better to Ecodesign Regulation than those which manufacture less efficient products. The level of environmental performance that companies already achieve may be linked to their size, but not necessarily.

However, it seems that the risk consists especially in the exclusion of smaller companies given the following two reasons:

- First of all, it is unlikely that they are able to profit to the same extent as their larger competitors from learning effects given the smaller scale of their productions; and
- Furthermore, smaller companies might also face difficulties in obtaining the necessary investments for R\&D in order to render their products more energy efficient and to comply with the requirements set out by the Ecodesign Regulation.

| Cases of market exit are especially difficult to predict, as they also depend on the level at which Ecodesign requirements are set (whether they are ambitious or not). Among the product groups in scope of this Working Plan study, market exit may happen in the following ones: Lifts (where smaller component manufacturers may not be able to comply with Ecodesign requirements); Building Automation Control Systems in non-residential buildings (BACS). |

In both cases, this would result in the firm exiting the market. Once again, the occurrence of market exit will also depend on the size of the company. There might be, for instance, smaller companies engaged only in the production of a limited number of different product groups. In this case, the introduction of Ecodesign requirements for one of the product groups and the related capital investments required might lead to the sale of the entire business if the share of the product group to be regulated is important enough.

One also has to keep in mind that it is unlikely that the adoption of an Ecodesign Regulation is the sole factor driving a firm to exit the market. It is more likely to exert an additional (marginal) impact on a firm’s considering the exit and its influence will also be highly dependent on the product group.
4.1.4 Upstream firms

Not only will the firms producing the final product be impacted by an Ecodesign Regulation, but also supplier industries. This could be the case for instance if parts of the product have to be replaced by new components and materials, forcing suppliers to adopt new technologies in order to comply with the requirements. Another potential impact is if a manufacturer in the EU exits the market and its competitors are all located in other geographic regions (e.g. Asia): in this case, this manufacturer’s suppliers will be adversely affected as a result.

All effects of Ecodesign on prices, profits or innovation activity are then likely to be shared between the main company and its suppliers, depending on the market power owned by each party.

\[
\text{This notion of some shared efforts for the implementation of Ecodesign requirements may be found in some product groups of this Working Plan study, including: Base stations; Gateways; Lifts; Mobile phones; Signage displays.}
\]

4.2 Innovation

Innovation plays an important role for companies’ successes. In the context of product and process innovations, an evolution with eco-innovations contributing to a sustainable development increasingly gained importance over the recent years\(^{17}\).

4.2.1 Innovation drivers

**Innovation Impact of Ecodesign**

The innovation impact from Ecodesign Regulations has been investigated rather extensively in a study conducted by Fraunhofer ISI, Ecofys, Triple E Consulting, Sea Green Tree and SoWatt, based on number of funding demands and patents as well as company case studies. While the number of funding demands somewhat correlates with the introduction of Ecodesign Regulations, the findings for number of patents are inconclusive. The authors state for the company case studies:

“The case study results show that the innovation impact differs for the various sectors. In sectors where the Ecodesign requirements and Labelling class levels were set in a rather ambitious way, the companies conducted a significant restructuring of production processes and product lines. The directives have supported market transformation towards more efficient technologies, mainly by facilitating the wider market introduction of existing high-efficiency technologies. Both for Ecodesign and Energy Labelling, most of the companies interviewed stated that the legislations have an influence on their innovation behaviour. The innovation impact is stronger in the deployment, commercialisation and diffusion of innovative energy efficiency technologies and is rather limited in the earlier R&D stages. For both Ecodesign and Labelling, a rather direct relationship between the ambition of the requirements and the innovation impact was observed.”\(^{18}\)

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\(^{17}\) DG ENER finances the Eco-Innovation Observatory (EIO) aiming to provide integrated information on eco-innovation for companies and policy-makers. From 2010 to 2013, the EOI published eco-innovation scoreboard rankings and country briefs for the 28 Member States of the European Union. The ranking is based on 16 indicators which are aggregated into the following five components: eco-innovation inputs, eco-innovation activities, eco-innovation outputs, environmental and socio-economic outcomes [Eco-Innovation Observatory (2013), Country Profile 2013: Sweden].

Innovation stemming from Ecodesign requirements is expected in almost all product groups in scope of this Working Plan study – please have a look to the specific chapter to get information about which innovation (or technical improvement) could be implemented.

However, even though regulation may serve as one driver for innovation, it is not the only one, and certainly not the most prominent one. Other possible drivers of innovation include demand- and supply-side, as well as third party drivers, all of which will be elaborated on here below.

**Demand-side**

Demand, or consumers, can be divided into three groups, namely households (business-to-consumer activities), other businesses (business-to-business activities), and public procurement. For all groups, lifetime and the energy-use of the product during the use phase may be among the top criteria at the time of purchase. Nonetheless, businesses can be expected to be more careful with regard to energy-use as compared to households. This is due to the fact that the energy-use in households is more evenly distributed between larger numbers of products, whereas businesses might have a few appliances with highly significant energy-use.

Depending on the product group, the energy consumption can represent a significant cost during use phase. Obviously, the stronger the price signal, the more customers will consider energy-efficiency before they buy the product. Base stations have been identified as such product group where consideration to energy consumption is high, due to the operational expenses related to energy consumption. To the contrary, such product groups like gateways present a feature known as “split incentive”. Gateways are leased or loaned nearly free of charge by service providers to their customers, and customers finally pay the electricity bills – so that Internet service providers, when setting out technical specifications for manufacturers, do not have any incentive to supply energy and cost-efficient gateways.

That households might be a driver of innovation is also suggested by the fact that 95% of the respondents to a recent Eurobarometer\(^\text{19}\) indicated that buying environmentally-friendly products would be “the right thing to do”. However, only 54% of consumers said to buy the environmentally-friendly products occasionally and 26% buy them often. Another study conducted by a team of researchers at the Centre for Energy Policy and Economics (CEPE) of the Swiss Federal Institute of Technology showed that consumers are willing to pay more for a more energy-efficient product. Thus, they found, among others, that individual’s willingness to pay for new windows as compared to medium old ones was of 13% of the rental price of a flat or the purchase price of a single family house, while the willingness to pay for an enhanced facade isolation was still of 3%\(^\text{20}\).

Environmental-friendly products may be used a means of product differentiation by the companies as response to consumers who are increasingly aware of climate change. As a result, companies try to stand out against their competitors by differentiating their products. To this extent, Energy labelling requirements would be more appealing to consumers than Ecodesign requirements, since labels directly convey this information at the time of purchase. While Ecodesign requirements are hardly visible to consumers, this is not the case for Energy labelling, where the consumer is, among others, given information on appliance’s details, energy class, consumption clearly on the label.

\(^{19}\) TNS Political & Social (2013), Flash Eurobarometer 367 – Attitudes of Europeans towards building the single markets for green products. Prepared for: European Commission DG COMM.

Energy labelling may be especially relevant for the following product groups of this Working Plan study, where it would drive up a demand for greener product: Kettles; Greenhouse covers; Hair dryers; Wireless chargers for consumer electronics.

Newell and Siikamaeki\(^\text{21}\) showed that consumer’s decisions are easier guided through “simple” signals like energy labelling, as compared to more complex information (on CO\(_2\) emissions for instance). Studies of the EU Energy Label show with a high level of reliability that up to 80 and 95% of European consumers recognize the Energy Label, and a large majority use it in their purchasing decisions\(^\text{22}\).

Furthermore, public procurement may also have a significant impact on manufacturers if a large share of their product is bought by public authorities. This factor explains, for example, the success of Energy Star-labelled office appliances. The Fraunhofer et al. study found public procurement to be an important driver for innovation\(^\text{23}\).

Dealing with public procurement, it is suggested in this Working Plan study that Hand dryers could be a fair candidate for criteria development. None of the sixteen product groups in scope are currently covered by the Green Public Procurement scheme.

Supply-side

The Ecodesign Directive gives firms the opportunity to sustain their businesses in the long-run. If products (or processes) consist in substantial innovations, this will help companies, not only to secure their competitiveness, but it can result in a first-mover advantage allowing them to obtain a significant share of the market. Energy efficiency or durability of products, for example, help to promote the reputation of companies and strengthen a brand. If identified as maker of efficient and reliable products, a company will be able to take a competitive advantage over its competitors.

This is almost true for all product groups in scope. Brand reputation is equally valid for business-to-consumer products (like Toasters or Kettles) and business-to-business products (like Greenhouse covers or Reefers). The competitive advantage that the brand / manufacturer will earn is all the more important than energy consumption (and related costs) is high and accurately perceived by the customers.

Third parties

Innovation towards more energy-efficient products may be driven either by demand and supply, or by “third-party drivers”. The latter category includes all private initiatives that are beyond companies’ individual strategies, but below legislation. Indeed, Industry Self-Regulatory Initiatives (SRI) are one (third) way to achieve savings in energy consumption.

One example for this is the VDI 4707 standard, an energy efficiency classification guideline for lifts, which was established by the Association of German Engineers. This standard is thus already widely applied in Europe and is “gaining popularity in other parts of the world\(^\text{24}\). The development of a


\(^{24}\) Schindler, VDI 4707: Energy Efficiency Label for Elevators.
voluntary initiative to measure and order energy consumption may well result in a market push, inciting others to stick to the standard as well.

In this case, one may think that there is no need for additional Ecodesign requirements. On the other hand, if there are only standards in place, one cannot be sure about the penetration rate and no central monitoring and verification system exists. Anyway, the question whether energy consumption would also be cut in the absence of regulation is a legitimate one.

4.2.2 Innovation barriers

While the Ecodesign Directive may, in general, seem favourable to innovation, there might be some cases in which it might be a hindrance to it. For instance, private companies might focus more on the reduction of energy and resources consumption and consequently lose sight of opportunities for more business-oriented innovations (not related to any environmental performance). To this extent, the Ecodesign Directive might be perceived as a “blinker” by companies and could result in a misallocation of time and money by the companies. Design, for instance, would be energy-focused rather than or on top of being appealing to customers – when energy consumption measurement standards are used as the basis for energy labelling, manufacturers design appliances in such a way that they can achieve the best possible energy rating.

This relates to the (fundamental) point that the Ecodesign Directive only aims at removing the least-efficient products from the market. Therefore, it sets minimal requirements, which can thus hardly serve as incentive for firms to come up with breakthrough innovations. However energy labelling can encourage the development of more energy efficient designs.

Potential barriers to innovation have been identified for the following product groups of this Working Plan study: Base stations; PV inverters; Wireless chargers for consumer electronics.

4.2.3 Innovation rhythms

One has to see the Ecodesign Directive also in the light of innovation pace in order to be able to fully analyse its impacts on the various industries. Here the fact that innovation speed differs between sectors has to be taken into consideration during the analysis.

Taking first the case, in which product development cycles are short, this makes it much harder for regulatory processes to keep pace with industries’ developments. It takes several years for the specific Ecodesign Directive to enter into force, starting from the preparatory study to its adoption; a time during which substantial technological advances can independently be achieved by the companies. Energy savings estimates at a longer term are tricky to do for fast evolving products. Consequently, companies’ own fast-paced Ecodesign innovations risk rendering the Ecodesign Directive of limited usefulness at its time of adoption.

All ICT products in scope of this Working Plan study fall into this first category of quick innovation rhythms: Base stations; Gateways; Mobile phones; Wireless chargers for consumer electronics. PV inverters, as well as Signage displays, would lie somehow at the fringe of this category (according to a slightly slower innovation pace).

As for the second case, in which innovation only happens steadily, the Ecodesign Directive can be a driver for innovation and achieve its foreseen effect. Nonetheless, an Ecofys study dealing with the

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economic benefits of the Ecodesign Directive highlights that it would be important to set future efficiency targets ahead of time so as to allow the companies to prepare for the entry into force of the Regulation. This lead time would then tend to minimize cost implications from regulations aiming at increasing the environmental performance of the products. However, in the context of the Ecodesign Directive this lead time does not seem to present a major difficulty given that the requirements are often applicable in two or more tiers. Moreover, firms have the possibility to get involved as early as during the Preparatory Study, which is thus several years in advance before the adoption and entry into force. Past experience also showed that firms seize this opportunity to get involved in the process, as far as consumer products are concerned. Thus, in this case, the Ecodesign Directive can, on one hand, exert a positive effect on companies’ competitiveness, while, on the other hand, guaranteeing the environmental improvements of the products.

All product groups of this Working Plan study, to the exception of ICT products, would fall into this second category of slower innovation rhythms. However, this does not mean at all that innovation is missing: Hair dryers, for instance, have been experiencing significant technical breakthroughs in the recent years, but at a slower pace than ICT products.

### 4.3 Macroeconomic benefits

The implementation of the Ecodesign Directive will not only have direct microeconomic effect (on companies), but also indirect macroeconomic effects (on European economy and beyond).

#### 4.3.1 Direct income effect – Consumers’ purchasing power

In a first step, households’ disposable income may decline in the short-term, given the higher purchase price of the “greener” product. In the long-run, however, households will be able to profit from the energy savings (assuming that Ecodesign requirements will, amongst others, address energy consumption) of the environmentally-improved products leading to the reduction in households’ energy bills. This, in turn, will exert a positive impact on households’ incomes if the monetary savings from reduced energy use outweigh the additional costs at the time of purchase. The same holds eventually true for businesses in that the additional capital expenditure for a more energy-efficient good may be compensated for by reduced operating expenditures over the lifetime. Furthermore, in the medium to long term, reduced energy costs can reduce production costs and so make EU industry more competitive. Even if these savings will probably be limited by the increase in energy prices, the Ecodesign Directive will at least serve to mitigate the effects of such price rises. However, one also has to deduct from these positive impacts the costs related to the design, implementation and enforcement of the Ecodesign Regulation.

An assessment of any direct income effect is more relevant at EU level. However, we may say that this effect will be more and more significant as 1°) energy savings are considerable; 2°) sales are consequent (in euros). The few product groups of this Working Plan study that fill both conditions are: Building Automation Control Systems in non-residential buildings (BACS); Kettles; Hand dryers; Signage displays.

#### 4.3.2 Indirect income effect – Employment and households consumption

The change of income brought about by the Ecodesign Regulation will also induce second round effects, in the case in which households decide to spend the savings from reduced energy
consumption on other goods of the economy. This increase in the demand of other goods will, in turn, induce a change in the production plans of the affected companies to satisfy consumers' demands in order to reap the additional profits. This production increase, thus, requires additional workers resulting in the creation of new jobs in other sectors of the economy. And jobs could also be created through the reinvestments of companies.

On the negative side however, the savings could be spent on additional electrical equipment, causing an increase in electricity consumption in the EU, or more expenditure on leisure and vacations so increased GHG emissions from flights, etc. To this extent, the decisive point is the shape of households’ consumption structure in Europe.

Few employment effects could be tracked down at product group's level. For Free-standing hot vending machines, some 3,000-5,000 people would be employed today for manufacturing; and for Lifts, about 150,000 workers would be involved in the lift sector in the EU (thereof 60% of them in the field of installation, renovation and maintenance). Additionally, the following product groups seem promising in terms of employment, with possible job-relocation effect: Building Automation Control Systems in non-residential buildings (BACS); Kettles; Hand dryers; Toasters; PV inverters.

4.3.3 Efficiency effect – Balance of trade

The most significant efficiency impact, following the entry into force of any Ecodesign Regulation, is likely to be for the energy used by the product, reflecting its improvement in energy efficiency. This diminished energy consumption may then reduce the dependency on energy imports, such as natural gas or coal imports. Furthermore, this reduction in energy consumption will directly influence the companies operating in the European energy sector, since they will sell less. However, it is by no means certain that (employment and) profit among energy companies will decline, given the expected rise of energy prices in the future years and decades.

4.4 International competition

4.4.1 At companies’ level

A distinction between European exporters and importers is made.

Starting with the companies exporting their goods from the EU, it has to be noted that these exporters will probably be reluctant to differentiate their products according to different markets, e.g. producing one more expensive but environmental-friendly good for their domestic market, and a second, cheaper, non-compliant one for export outside of the EU (although this will occur in some sectors, e.g. industrial furnaces). Therefore, domestic EU companies will face the decision whether to produce for the domestic or the foreign market, which will directly influence their competitiveness at international level.

- In the first case, in which the European manufacturer decides to serve its domestic market and to produce a product complying with the Ecodesign requirements, this implies a higher price in the initial phase following the product introduction, as was already elaborated on earlier. Consequently, this product might not be competitive on the international market given the higher price associated with it as compared to the extra-EU produced products. This does not necessarily have to be the case, since there may be third country requirements (which would echo EU Ecodesign requirements worldwide);

- In the second case, which does not seem very realistic, the firm decides to compete solely on the international market outside of the EU. This could be for various reasons, such as market size, if the firm realizes a major share of turnover abroad, or others. Here, the firm cannot be
expected to lose any of its competitiveness with regard to its international competitors. However, its products would be banned from the EU market (in case of Ecodesign Regulations) or experience a loss of sales (in case of Energy Labelling, if the firm’s products are rated a “G” or “F” and there are many “A” rated products on the market).

The implementation of the Ecodesign Directive does not only affect European exporters, but also importers. Thus, importers might face difficulties when the third countries’ requirements are less strict. As a consequence, this will result in importers’ inability to introduce the product to the European market given its non-compliance, thereby reducing the quantity available in the EU market. If these imports constitute a significant share of the market this will result in increased costs to consumers given the higher purchase prices of the available goods. There may also be a reduced choice of products available, although this is likely only to be temporary as manufacturers design more products to replace those lost from the market.

Product groups for which manufacturers are world leaders and in a position to export are: Base Stations; Free-standing hot vending machines; High Pressure Cleaners. Depending on the customers’ awareness to energy-efficiency and the environment, Ecodesign requirements may either strengthen the competitive advantage of those manufacturers, or reversely damage it (if an increase in price is also induced by the setting of Ecodesign requirements).

Importation is high for the following product groups in scope of this Working Plan study: Kettles; Gateways; Hair dryers; Signage displays; Toasters; Wireless chargers for consumer electronics. Manufacturers abroad would have to adapt and meet European Ecodesign requirements (at least for the share of products that they export to Europe).

4.4.2 At EU level

The Ecodesign Directive might serve as an example to third countries outside of the EU. Given the increased number of energy policies worldwide, the EU may become a front runner and prominent driving force. As a matter of fact, it is quite common for many third countries to adopt either voluntary or mandatory Ecodesign standards for electrical appliances that match EU standards. This, in turn, would result in the competitive advantage of EU exporters since they would be able to deliver their compliant and cost-effective products also to third countries.

Moreover, if energy production capacities are stagnating, it is highly probable that the share of fossil fuels in the European energy mix will diminish as a consequence of the implementation of the Ecodesign Directive. First of all, the development of new fossil fuel sites will be rendered less urgent given the reduction in energy consumption and secondly, old sites are mainly replaced by renewable energies. Thus, the Ecodesign Directive might result in a virtuous circle: on one hand, the Directive is directly driving energy efficiency and, on the other hand, it is indirectly promoting the use of renewable energies.
5. Introduction to the product groups

The following chapters contain analyses of selected aspects for 16 product groups. They are not complete assessments of the respective groups. Rather, they contain additional information to the Task 3 report which deals with market data, energy and resource consumption and improvement potential. For a more complete overview of the product groups, please consult the latter.

The sixteen product groups have been chosen from a set of 28 that have been investigated in Task 3 of this study. The process of choice is described in further detail in Chapter 32 of the Task 3 report and is summarized here:

A “preliminary product matrix” was created that allowed for comparing various criteria. The core criteria were:

- Improvement potential with respect to aggregate EU-27 energy savings in 2020 and / or 203027;
- Improvement potential with respect to other resources; and
- Possibility that the energy and / or resource savings could be reaped by using the instruments of Ecodesign or Energy Labelling28.

The following criteria were used as additional (supporting) criteria:

- Sales and anticipated market development;
- Need for in-depth study of the policy environment;
- Confidence in the savings estimates; and
- Any other specific considerations where applicable.

The criteria were applied in the following way:

The first and second step of the analysis led to the establishment of a preliminary list of product groups that presented either energy savings above a threshold of 7 PJ (first step) or quantitatively demonstrable relevant resource savings (second step). In a third step, some groups were excluded from this preliminary list, based on supplementary criteria: difficulty to reap the potential savings by design-related measures; potential to cover the product groups in reviews of existing legislations or self-regulation initiatives; low sales (partly in combination with a low reliability of the energy saving estimates); high uncertainty with respect to data and future technological developments. On the other hand, two product groups were added due to specific considerations.29

27 2030 savings have been considered in this stage of the analysis in order not to lose any potentially relevant product group. Finally, for the Task 4 ranking though, it was decided to not consider 2030 savings for product groups with fast evolving technologies and markets because estimates would be too unreliable.

28 A detailed analysis of the regulatory coverage is the object of Task 4. However, it often emerged already in the course of Task 3 whether Ecodesign or Energy Labelling could at all be relevant.

29 Free-standing hot beverage vending machines were added because an Ecodesign regulation might be adopted soon for free-standing cold vending machines and manufacturers usually produce both cold and hot appliances. Signage displays were added late in the process (they had not previously been assessed in Task 3) because the study team had been alerted to them in the context of the ongoing revision of Regulation 642/2009 which was about to exclude them.
Each product group is, in the following, analysed according to the following aspects:

- Main other environmental impacts;
- Policy coverage;
- Appropriateness of Ecodesign or Energy Labelling; and
- Industrial competitiveness.

Details of these aspects are explained in chapter 1.1.
6. Base stations

6.1 Main other environmental issues

Table 6 below provides an overview of the relevant environmental aspects of the “base stations” product group, and possible improvement options linked to them. Energy consumption and material efficiency have been discussed in Task 3. Hence the table and the paragraphs below focus on the main other environmental impacts of the product group.

Table 6: Overview of relevant direct environmental issues and potential for improvement – Base stations

<table>
<thead>
<tr>
<th>Environmental issue categories</th>
<th>Scoring</th>
<th>Description of the environmental issue</th>
<th>Description of related improvement potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water consumption in use phase</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consumables (detergents, etc.)</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Presence of critical raw materials (see the EU list(^\text{30}))</td>
<td>+</td>
<td>Presence of critical raw materials at low concentration levels.</td>
<td>Non-halogenated flame retardants exist. A dedicated preparatory study would have to determine whether they can be used for base stations and would be environmentally preferable</td>
</tr>
<tr>
<td>Presence of flame retardants (halogenated, etc.)</td>
<td>+</td>
<td>Low levels of halogenated and non-halogenated flame retardants can be present in cables, Printed Circuit Board (PCB) and other electronic components. Flame retardants are used for technical and safety reasons.</td>
<td></td>
</tr>
<tr>
<td>Presence of plasticisers (phthalates)</td>
<td>+</td>
<td>Phase-out is ongoing but phthalates are still used in cables.</td>
<td>A shift is ongoing and the less toxic, high-molecular-weight phthalates are becoming more common.</td>
</tr>
<tr>
<td>Presence of other toxic substances</td>
<td>+</td>
<td>Very low presence of other toxic substances. Minimum quantities for dedicated applications (e.g. beryllium as a component to spring material) could occur, depending to technical requirements.</td>
<td></td>
</tr>
<tr>
<td>Presence of F-gases</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiation levels</td>
<td>++</td>
<td>It is the basic functionality of EU Directives and</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Environmental issue categories</th>
<th>Scoring</th>
<th>Description of the environmental issue</th>
<th>Description of related improvement potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety (fuel leakage, vibrations, etc.)</td>
<td>0</td>
<td>Base stations to generate electromagnetic fields.</td>
<td>International standards (ITU-T) already cover safety aspects of EMF (Electro Magnetic Field) and EMC (Electro Magnetic Compatibility).</td>
</tr>
<tr>
<td>Health (hygiene, noise level, etc.)</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Durability (reusability, upgradability, reparability, etc.)</td>
<td>+</td>
<td>Longer lifetime (up to 20 years) Reuse practices are not well documented.</td>
<td></td>
</tr>
<tr>
<td>End-of-life (recyclability, recycled content)</td>
<td>++</td>
<td>Materials used for base stations are mainly recyclable (metals).</td>
<td>Not easily recyclable materials (like electronic components) could be addressed at horizontal level.</td>
</tr>
<tr>
<td>Direct emissions to air</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct emissions to water</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct emissions to soil</td>
<td>0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Scoring: “0” if not an issue for the product group. If this is an issue, the indicative importance of the environmental issue is provided from + (low) to +++ (high).

### 6.1.1 Presence of critical raw materials

As any ICT equipment, base stations include some critical raw materials. However, only low concentrations of critical raw materials are incorporated into some electronic components. Below figures are approximate figures of critical raw material content in a 100 kg outdoor base station:

- Sum of Other Critical Metals, such as Be, Ta, Sb, Co, Ga, In, W: <1 g;
- Sum of Platinum Group Metals: <0.0005 g; and
- Sum of Rare Earth Elements: <0.0001g.

### 6.1.2 Emission of radio waves

Base stations emit radio waves as basic part of their operation: the generation of electromagnetic fields by antennas is the intended use. It can be noted that the intensity of the radio waves is drastically reduced as the distance increases from the base station antenna. On the ground, in...
houses, and other places where people reside, the exposure levels from radio base stations are normally below 1 percent of the limits\textsuperscript{32}.

However, the fact that electro-magnetic levels are below current regulation limits may be considered as some insufficient proof of safety. Indeed, there are many ongoing studies trying to assess the effects of radio waves as emitted by base stations. As examples, the three following studies can be mentioned (without doing a critical analysis of them):

- One by the INERIS French institute, named “The chronic exposure to radiofrequency electromagnetic fields modified the thermopreferendum during sleep in juvenile rats”. The study focuses on sleep disturbances by radiofrequency electromagnetic fields (RF-EMF) emitted by mobile phone base stations;

- Another by two German scientists, entitled “Changes of clinically important neurotransmitters under the influence of modulated RF fields – A long-term study under real-life conditions”. This follow-up of 60 participants over one and a half years shows a significant effect on the adrenergic system after the installation of a new cell phone base station in the village of Rimbach (Bavaria);

- One last study by staff members of the University of Vienna, with the title “Mobile telephone base stations: effects on health and well-being”. The study suggests a significant relation to measured power-density was found for cardiovascular symptoms and perceptual speed.

The ongoing scientific research, and sometimes public protest\textsuperscript{33}, shows that the topic of radio waves emissions is controversial.

### 6.1.3 End-of-life

With the change to the next technology (e.g. LTE), the existing equipment is normally processed as explained in the following scenarios:

- Aside installation. A new equipment is added to support the new technology; the existing equipment is kept to serve earlier generations of mobile telephony;

- Software upgrade. Base stations can be software upgraded to the new technology (e.g. 4G), thus reusing the existing hardware; and

- Replacement. In a full modernisation process, the existing equipment is replaced by new software and hardware. According to the industry, it is common that the existing equipment is reused in other areas\textsuperscript{31}. It is not known, however, how much of a base station is indeed reused.

If not reused, base station modules have to be discarded. As they consist in a large fraction of metals with higher value, they are likely to be recycled. The reasoning is that the scrap value of a base station is too high to be ignored and dumped by the operators.

However, the question remains of recycling of other materials, like plastics, electronic components, etc. This may be considered as a generic issue for all electronic products and not a specific to base stations. Therefore, ICT and electronic device recycling could be treated at horizontal level\textsuperscript{34}. Moreover, major telecommunication companies often report recycling targets in their yearly sustainability reports\textsuperscript{31}.


\textsuperscript{33} See for instance one paper of two Taiwanese researchers with the following title “Public attitude towards mobile base station siting: beyond NIMBY [Not In My BackYard]”

\textsuperscript{34} Nokia Networks, stakeholder’s input to Task 4.
6.1.4 Conclusion for Ecodesign

The bigger environmental impact of base stations much probably remains energy consumption. However, studies are ongoing on electro-magnetic fields and any health impairment that could occur.

6.2 Policy coverage

This section is dedicated to the regulatory coverage of the product groups addressed, be it through legislation, within the EU or in third countries, through voluntary agreements and environmental labels or standards. The goal is to identify where Ecodesign or Energy Labelling regulations could have added value beyond the existing legislation, and, in the case of third country legislation, whether there is successful legislation that could serve as a model for Ecodesign or Energy Labelling legislation.

6.2.1 Overview of EU policies

Currently, base stations are regulated under the EU WEEE and RoHS Directives and REACH Regulation. One FAQ document developed by the European Commission confirms that telecommunication networks are in scope of RoHS 2.

<table>
<thead>
<tr>
<th>Product group</th>
<th>WEEE</th>
<th>RoHS</th>
<th>REACH</th>
<th>EPBD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base station</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>-</td>
</tr>
</tbody>
</table>

Table 7: Main EU legislation applicable to the “base stations” product group

EMF (Electro Magnetic Field) and EMC (Electro Magnetic Compatibility) are fully covered by existing legislation. For EMF, safety and health requirements of Directive 1999/5 on the Radio and Telecommunications Terminal Equipment (RTTE) apply to base stations. In order to show compliance, there is a Harmonised Standard EN 50401 (from CENELEC).

EMC is covered by the same legal framework (RTTE Directive). The objective is that non-intentionally emitted signals (i.e. not the intended signal from a radio transmitter) should be reduced to a level that they do not interfere with the receiving function of a radio device thus degrading the communication. The main Harmonised Standards for the type of base stations relevant for this study are in the EN 301489 series (from ETSI). Directive 1999/5 will be repealed in June 2016 and replaced by Directive 2014/53/EU (on health and safety) and Directive 2014/30/EU (on Electro Magnetic Compatibility).

Also the EU Energy Efficiency Directive (EED) may be taken into account. As it will make it mandatory for large companies to carry out “energy audits” every four years (with a first deadline falling in December 2015), it may turn out to be a significant driver for operators and suppliers to keep on improving energy performance. According to one stakeholder, “these audits will have to be done on network level, which we believe is a more accurate and relevant level”.

This echoes a recent study by Oeko-Institut for the European Commission, which explored the option of increased energy and GHG reporting from ICT organisations. The scenario named Telecommunication Networks – 2 is a “comprehensive scenario with mandatory monitoring and

36 Ericsson, stakeholder’s input to Task 4.

reporting with a larger number of elements”; it includes such elements as the number of base stations (per technology).

Finally, those two European standards do apply to base stations:

- EN 50401: “Product standard to demonstrate the compliance of fixed equipment for radio transmission (110 MHz - 40 GHz) intended for use in wireless telecommunication networks with the basic restrictions or the reference levels related to general public exposure to radio frequency electromagnetic fields, when put into service”; and

- EN 50385: Product standard to demonstrate the compliances of radio base stations and fixed terminal stations for wireless telecommunication systems with the basic restrictions or the reference levels related to human exposure to radio frequency electromagnetic fields (110 MHz - 40 GHz).

6.2.2 Selected Member States policies

Not any Member State policy could be identified regarding base stations.

6.2.3 Industry Self-Regulatory Initiative

The European Code of Conduct on Energy Consumption of Broadband Equipment38 has been already mentioned and described in Task 3. Furthermore, its target values have been taken as a basis for assuming energy consumption from 2020 onwards.

The Code of Conduct (CoC) gathered the commitment from 19 service providers and manufacturers across the EU-27. However, their global market share within the European market remains unknown39. It would be a helpful figure though to assess the relevance of Ecodesign requirements: obviously, the higher the market share, the less Ecodesign is needed (assuming the CoC sets out ambitious enough targets, what is generally considered to be the case by stakeholders). With a figure of typically 90% or above, this CoC could be considered as a kind of voluntary agreement.

6.2.4 Existing third country legislation and labels

No third country legislation or labels could be identified.

6.2.5 Test standards

A relevant test standard to measure energy consumption of base stations has been developed by the European Telecommunications Standards Institute (ETSI). Technical Specifications (TS) 102 706 were last updated in July 2013, with the release of version 1.3.140. This standard allows to measure certain base station configurations under laboratory conditions, and thus helps operators to estimate the energy consumption of their network across products from different suppliers41.

The document defines a method to analyse the energy efficiency of wireless access network equipment; it covers the following radio access technologies41:


39 The list of participants to the CoC shows a fair amount of big players: http://iet.jrc.ec.europa.eu/energyefficiency/ict-codes-conduct/energy-consumption-broadband-communication-equipment

40 This test standard has just been revised and a new version (ES 202 607 v1.4.1) is to be published end of 2014.

41 ETSI TS 102 706 v. 1.3.1 (2013), Environmental Engineering (EE) – Measurement method for energy efficiency of wireless access network equipment
• GSM [2G];
• WCDMA [3G];
• WiMAX [4G]; and
• LTE [4G].

The ETSI standard is currently used to assess and compare the efficiency of mobile radio network equipment from different vendors: it provides energy-efficiency values which are delivered to the customers. It is not intended to provide target values for the energy efficiency of equipment or networks.

The ETSI standard defines reference equipment configurations for Base Stations (BS) and reference load levels to be used when measuring BS power consumption. Then basically, the standard provides two different levels to assess energy efficiency of BS:

**Static measurement** encompasses “BS under static load and without radio network features activated”. This is equivalent to power consumption at site level. The following parameters must be listed and reported:

• Reference configurations (Number of sectors and carriers, Power input, Radio Frequency output power level, etc.);
• Frequency bands; and
• Load levels.

**Dynamic measurement** encompasses “BS with dynamic load and with radio network features activated, i.e. including the functionalities located in the radio network controller”. This is equivalent to power consumption at network level. The following parameters must be listed and reported:

• Reference configuration;
• Frequency bands;
• Traffic load levels; and
• Traffic case.

All parameters are further defined in the annexes of the standard, with specific sections for each technology in scope.

Last but not least, ETSI (together with ITU-T) is currently developing a test standard to measure efficiency of networks in operation. This additional standard for network energy efficiency test, ES 203 228, is to be released during spring 2015. It will allow to measure efficiency of complete networks under real operating conditions and shall help operators to analyse their networks³⁴.

### 6.2.6 Conclusion for Ecodesign

The current policy coverage of base stations in Europe is low. However, the Code of Conduct developed for European broadband equipment (on the one hand) and the ETSI test standard (on the other hand) are significant initiatives to tackle the issue of energy consumption. Ecodesign requirements would go one step forward in the same direction.
6.3 Appropriateness of Ecodesign or Energy labelling

6.3.1 Excessive cost

Base stations are Business-to-Business products (B2B), as they are bought by professionals or experts. According to the industry, energy consumption is today an essential part of any base station purchase negotiation. Relevant information is related both to purchase price (CAPEX) and the cost in use phase (OPEX), including energy and other maintenance costs.

According to one stakeholder, CAPEX calculation is based on:

- Number of subscribers;
- Amount of served data broadband capacity;
- Number of handled frequencies; and
- Feature based fees, like: carrier aggregation, load balancing, optimisation and surveillance features, etc. There are up to several hundreds of parameters / technologies.

An average calculation of the purchase price is often very difficult. This depends mainly on the maturity of the mobile network. Hardware prices are often less than the additional software packages. Hardware without mast, steel, feeder cables often are around 5,000 – 15,000 Euro per sector and frequency band.

OPEX calculation would be based on:

- Licenses for use of base station;
- Operation and maintenance;
- Repair service on site;
- Backhaul and transport leasing;
- Real estate rental fee; and
- Energy costs.

It is being said that energy represents a 15%-share of operational expenses (OPEX) among mobile operator networks in developed countries. As these operators are buying base stations actually, it is claimed by the industry that customers are already much sensitive to power consumption. To this extent, they say, Ecodesign requirements would be redundant with a major economic concern they already have. The main challenge for the Telecom industry is to provide the rapidly growing capacity to match Telecom services demand without increasing energy consumption and OPEX.

6.3.2 Suitability of Ecodesign measures or Energy labelling

Energy costs for the operation of base stations are significant, in relative as well as in absolute values. This is a first point that would mitigate the need of Ecodesign measures, as there is already a strong economic incentive to reduce base stations' energy consumption.

Beyond this, at least three points need to be addressed to assess the suitability of Ecodesign requirements for base stations:

- Quick technological change;

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• Integration of base stations into cellular networks; and
• Tailor-made products.

As for energy labelling, it does not seem relevant for base stations, as the market is a pure business-to-business one and models are not standardised.

**Quick technological change**

One issue, which is common among ICT products, is the quick technological change. For every new generation of mobile communication, a new product is developed and used (e.g. change of frequencies, higher data rate, other signal-to-noise ratio). A generic analysis could underline that ICT products in general, and mobile base stations in particular, rely on rapidly developing technologies, with often significant increase in performance and relative stable energy consumption. Compared to mature products like white-ware, ICT products usually achieve better performance for similar energy consumption, whereas mature products achieve a similar performance for smaller energy consumption.

That said, energy consumption of base stations could increase (due to a growth in traffic outweighing the upgrade in capacity – see Task 3), making the case for Ecodesign or Energy labelling. According to some manufacturers, any legal framework should either be focussed on the latest available technology, or encompass all technologies implemented so far. It is also claimed that energy efficiency is one major part of the requirements in the development of the upcoming 5G technology.

**Integration of base stations into cellular networks**

As already highlighted in Task 3, energy consumption of a (mobile) telecommunication network is not easy to handle, as many parameters do account for it. However, if energy consumption of a whole network is difficult to monitor, this is not truly the case of individual equipment. The study by Oeko-Institut identified several points that make it difficult to take policy action cutting energy consumption in the telecommunication networks sector; yet a focus on base stations, at individual product level, removes much of the difficulty.

Obviously, hardware is but a piece of the puzzle, but “the base station power consumption is the dominant part of total power consumption of wireless access network.” It may be a good start, and could pave the way towards lower energy consumption at the broader network level. There is no reason why improvement in base stations’ energy consumption would prevent or even brake any general improvement at network level. Yet, ideally a system approach would be more suitable than optimizing interacting elements independently. Indeed, the latter would lead to a local minimum but not to an absolute system minimum. This is why it is a constant claim of stakeholders that the global network energy performance is more depending on the network structure and features (that cannot be measured and regulated on product level) than on the individual products.

**Tailor-made products**

Another point may be brought forward to play down the relevance of Ecodesign or Energy labelling measures. As a matter of fact, base stations are mainly “tailor-made” products which are adjusted to the architecture of each cellular network. Base stations are less standardised than mass-market, consumer products such as televisions, domestic kitchen appliances, etc. All stakeholders claim that customers need site- or network-specific solutions. Put in a different way, “network design and proper

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43 Kathrein AG, stakeholder’s input to Task 4.
combination of different locations and different base stations open room for improved network efficiency. However, Ecodesign Regulation may be appropriate even for tailor-made products.

6.3.3 Conclusion for Ecodesign

Base stations are encompassed in cellular networks, so that it may be difficult to isolate them from all the other components of the networks. All in all, given the specificities of base stations, an in-depth preparatory study would be needed to ensure adequate requirements.

6.4 Industrial competitiveness

6.4.1 Market structure

The market is pure business-to-business (B2B) and dominated by a few large companies, that sell base stations worldwide: there is nearly no vendor dedicated for the European or any national market.

As reminded by a manufacturer, “the main task of a base station is to distribute the cellular signals over radio frequencies to a dedicated coverage area. A base station is a complex system of several product groups, manufactured by different producers”. To this extent, the implementation of any implementing Measures would require a strong collaboration between the installer and all the component suppliers.

6.4.2 Innovation and employment

Digital Europe issues a warning on the “negative impacts regulatory measures could have on innovation”. The federation expresses the concern that the largest improvement potential for mobile networks may come from different ways of organizing networks: therefore a focus on a product-level may lead to that these potentials are missed. There is a high risk that Ecodesign measures will lock in the industry in less favourable technology solutions. Generally speaking, the industry tends to trust market forces to drive innovation and energy-efficiency, resulting into an adverse position to extensive regulation.

No information could be gathered on the number of jobs in Europe related to the production and sales of base stations.

6.4.3 International competition

European companies are at the forefront and the products are often exported.

One can note, however, that the European CoC includes international participants like Cisco, Huawei, Alcatel-Lucent, etc.

6.4.4 Conclusion for Ecodesign

Even if Ecodesign requirements would probably not have any significant impact on the industrial competitiveness of a few global providers of networks for mobile communication, this is highly uncertain that they would bring any positive effect on industrial competitiveness at all.
6.5 Product group summary and recommendations

Table 8 below presents a simplified scoring of the four main sections above, for the product group “base stations”.

Table 8: Overall scoring of the "base stations" product group

<table>
<thead>
<tr>
<th>Product group</th>
<th>Other environmental impacts</th>
<th>Policy gaps</th>
<th>Appropriateness of Ecodesign</th>
<th>Appropriateness of Energy labelling</th>
<th>Industrial competitiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base stations</td>
<td>+</td>
<td>++</td>
<td>+</td>
<td>+</td>
<td>++</td>
</tr>
</tbody>
</table>

The more “+” there are in the assessment, the more favourable it is for Ecodesign or Energy labelling Regulation to be implemented.

The ++ scoring on “Policy gaps” reflects the uncertainty about the Code of Conduct. Indeed, as the market share of participants in Europe is unknown, we cannot fully assess the completeness of policy coverage. The reasoning is that, if typically 90% or more of the market is covered by the CoC, Ecodesign requirements would be redundant (and scoring on “Policy gaps” then lowered to only +).

In a whole, Ecodesign does not look as a very appropriate policy tool for base stations. Only minimum requirements on energy efficiency could (in principle) be envisaged for base stations. As for the “Gateways” product group, a mandatory compliance with the CoC for Broadband Equipment would be an option.

Energy labelling at first sight is not a relevant policy tool for base stations, since products are rather tailor made and get marketed in very different formats and configurations.
7. Building Automation Control Systems in on-residential buildings (BACS)

7.1 Main other environmental issues

Table 9 below provides an overview of the relevant environmental benefits and environmental issues of the “Building automation control systems” (BACS) product group, and possible improvement options linked to them, based on information provided by stakeholders and gathered in the literature.

BACS functions as a control loop that consists of a sensor, an actor (valves or actuators) and a controller that executes the logics. Therefore, in Table 9, information on “Environmental issues linked to BACS” comes from expert guess and data extracted from 3 Environmental Product Declarations (EPD) provided by the industry. The following components are considered:

- Duct temperature sensors / Immersion temperature sensors;
- Automation stations / Controllers; and
- Valves and actuators.

Energy consumption and material efficiency have been discussed in Task 3. Hence the table and the paragraphs below focus on the main other environmental impacts of the product group.

Table 9: Overview of relevant direct environmental issues and potential for improvement – BACS

<table>
<thead>
<tr>
<th>Environmental categories</th>
<th>issue Scoring</th>
<th>Description of the environmental issue</th>
<th>Description of related improvement potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benefits due to the use of BACS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water consumption in use phase</td>
<td>++</td>
<td>Using BACS helps to control and reduce water consumption.</td>
<td></td>
</tr>
<tr>
<td>Health (hygiene, noise levels, etc.)</td>
<td>+++</td>
<td>Using BACS helps to increase the quality of internal air and the comfort of users by having an adequate humidity and temperature when it is needed.</td>
<td></td>
</tr>
</tbody>
</table>

<p>| Environmental issues linked to BACS | | | |
|-------------------------------------|--------------|---------------------------------------------|
| Water consumption in use phase | 0 | |
| Consumables | 0 | |</p>
<table>
<thead>
<tr>
<th>Environmental categories</th>
<th>issue</th>
<th>Scoring</th>
<th>Description of the environmental issue</th>
<th>Description of related improvement potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>(detergents, etc.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Presence of critical raw materials (see the EU list(^44))</td>
<td>++</td>
<td>Printed Circuit Board (PCB) use gallium which is difficult to collect and recycle.</td>
<td>Separation methods for the recovery of metals from PCBs are available; however, many elements contained in the PCBs, including gallium, are disposed of as slag.(^45)</td>
<td></td>
</tr>
<tr>
<td>Presence of flame retardants (halogenated, etc.)</td>
<td>++</td>
<td>Automation stations/ controllers contain halogens in plastic parts and in TBBA(^46) used as flame retardants in PCB. Valves and actuators also contain halogens in cables, insulation tubing and PCBA (Printed Circuit Board assembled).</td>
<td>Non-halogenated flame retardants exist. A dedicated preparatory study would have to determine whether they can be used for control products</td>
<td></td>
</tr>
<tr>
<td>Presence of plasticisers (phthalates)</td>
<td>+</td>
<td>Possible presence of phthalates in PVC parts.</td>
<td>Less toxic, high-molecular-weight phthalates or other less harmful substances exist. A dedicated preparatory study would have to determine whether they can be used for control products or if phthalate-free plastics can be used</td>
<td></td>
</tr>
<tr>
<td>Presence of other toxic substances</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Presence of F-gases</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiation levels</td>
<td>+</td>
<td>Remote control and other wireless distant control systems send low radiation levels.</td>
<td>Replace wireless distant control systems by manual or wire connected control systems.</td>
<td></td>
</tr>
<tr>
<td>Safety (fuel leakage, vibrations, etc.)</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health (hygiene, noise level, etc.)</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Durability (reusability, upgradability, reparability, etc.)</td>
<td>++</td>
<td>• Considering that some products are connected with several others, compatibility and</td>
<td>• Processors must be updated from time to time and languages used shall be</td>
<td></td>
</tr>
</tbody>
</table>


\(^{46}\) Tetrabromobisphenol A.
### Environmental categories

<table>
<thead>
<tr>
<th>Environmental categories</th>
<th>issue</th>
<th>Scoring</th>
<th>Description of the environmental issue</th>
<th>Description of related improvement potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>End-of-life (recyclability, recycled content)</td>
<td>++</td>
<td>Recyclability of PCBs is difficult. Some products (e.g. Automation stations / controllers) are using Li-based batteries which need to be properly treated at their end-of-life.</td>
<td>Ease access to PCBs to facilitate the extraction and recycling. Appropriate separation collection of batteries.</td>
<td></td>
</tr>
<tr>
<td>Direct emissions to air</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct emissions to water</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct emissions to soil</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Scoring: “0” if not an issue for the product group. If this is an issue, the indicative importance of the environmental issue is provided from + (low) to +++ (high).

As described in Table 9, BACS provides other environmental benefits mainly due to water savings and air quality and comfort. On the other hand, BACS also presents the following environmental issues.

#### 7.1.1 Presence of critical raw materials

Gallium arsenide (GaAs) is a compound of gallium and arsenic used as a fundamental compound semiconductor material and forms the core substrate for semiconductor technology. It is largely used in fibre optic communications and wireless networks. Due to its unique properties, GaAs in integrated circuit boards is hardly substitutable.

#### 7.1.2 Conclusion for Ecodesign

Besides the energy consumption issue (detailed in Task 3), the use of BACS can be beneficial to reduce water consumption and improve indoor air quality. Direct environmental issues related to BACS are quite common to electronic products, i.e. presence of some hazardous substances and critical raw materials in PCBs and other components.

### 7.2 Policy coverage

This section is dedicated to the regulatory coverage of the product groups addressed, be it through legislation, within the EU or in third countries, through voluntary agreements and environmental labels or standards. The goal is to identify where Ecodesign or Energy Labelling regulations could have added value beyond the existing legislation, and, in the case of third country legislation, whether there is successful legislation that could serve as a model for Ecodesign or Energy Labelling legislation.

#### 7.2.1 Overview of EU policies

Currently, BACS are covered by WEEE, RoHS, REACH and EPBD.

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47 Source: European Semiconductor Industry Association.
Table 10: Main EU legislation applicable to the “BACS” product group

<table>
<thead>
<tr>
<th>Product group</th>
<th>WEEE</th>
<th>RoHS</th>
<th>REACH</th>
<th>EPBD</th>
</tr>
</thead>
<tbody>
<tr>
<td>BACS</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

The EPBD aims at maximising the benefits of using BACS, whereas WEEE, RoHS and REACH aim at reducing the environmental impacts of BACS.


On 19 May 2010, a recast of the Energy Performance of Buildings Directive was adopted by the European Parliament and the Council of the European Union in order to strengthen the energy performance requirements and to clarify and streamline some of the provisions from the 2002 Directive it replaces. As of 31 December 2020, new buildings in the EU will have to consume “nearly zero” energy and the energy will be “to a very large extent” from renewable sources. However, there is no specific target set for the renovation of existing building.

The EPBD includes specifications that should stimulate increased demand for BACS. Article 8 mentions that systems requirements to be specified in building codes that address control systems installed in existing buildings and mandates the adoption of intelligent energy metering systems.


The EED imposes an obligation on central government buildings to go through deep renovations. However, Member States can take alternative cost-efficient measures to achieve an equivalent improvement regarding the energy performance of the buildings. This can be seen as an indirect incentive opportunity to promote BACS within central government buildings and pioneer improvement within the sector. However, no specific mention to BACS is made in the EED and the eu.bac is concerned that BACS lack of awareness and may not be considered as a relevant cost-effective measure.

### 7.2.2 Selected Member States policies

Main policies at Member State levels are the decrees transposing the EPBD, such as the **Réglementation Thermique 2012** in France, the **Energieeinsparverordnung** (EnEV) in Germany, or the **Part L of Building Regulations** in UK, defining national targets and actions to reduce the energy consumption of existing and new buildings.

### 7.2.3 Industry Self-Regulatory Initiatives

**Product Certification Scheme from eu.bac**

The European Building Automation Controls Association (eu.bac) has built a product certification scheme for the rated performance of building controls equipment tested under EN 15500/ISO 16484-3. The scheme has been complemented with a voluntary product energy labelling system.

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48 Waide Strategic Efficiency for European Copper Institute (2013), The scope for energy and CO₂ savings in the EU through the use of building automation technology.


Certification of BAC systems and components is based on their potential capability to reduce energy consumption. The Certification is performed in accordance with the rules of the eu.bac mark scheme for products and systems for home and building automation, that includes the conformity testing of the products, checking of the manufacturer's relevant production line quality management system, inspection of the production location, and market surveillance. The certification procedure requires periodic tests of the products and systems and inspection by third parties.

The eu.bac labelling scheme is based on a scoring system and includes 6 classes from AA to E. eu.bac includes on a dedicated website a list of certified products with their energy class (www.eubaccert.eu). An example of product factsheet is displayed in Figure 2.

![Example of fiche for a certified product according to eu.bac scheme](image)

**Figure 2: Example of fiche for a certified product according to eu.bac scheme**

**BAC System certification method from eu.bac**

eu.bac has also developed a Certification Scheme (eu.bac System) that provides certification of the energy performance of BACS for a whole buildings, at the first delivery and throughout its lifetime. This certification based on the EN 15232 standard takes into account the whole control system and estimate its quality and efficiency according to a normalized scale from 0 and 100.

This certification method provides guidelines to energy efficient functionality, provides a mechanism to check that a BACS installation actually includes the expected functionality, and that with periodic inspections the functionality provides equal or better performance over time.

Since 2012, eu.bac has performed around 50 audits of BACS mainly in Germany, France and UK.

**7.2.4 Existing third country legislation and labels**

The Leadership in Energy Efficiency and Design (LEED) certification is a US consensus-based, voluntary certification program created to establish “green building” benchmarks and measure the

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50 IZC stands for Individual Zone Control.


environmental performance during the life cycle of a building. Many of the points needed to obtain LEED certification can be acquired through LEED credits that require or suggest the implementation of control systems for lighting, HVAC, and/or the entire building.

In addition, ASHRAE, the American Society of Heating, Refrigerating and Air-Conditioning Engineers, has developed in 2008 a standard called BACnet® (ANSI/ASHRAE Standard 135-2008) on Data Communication Protocol for Building Automation and Control Networks.

### 7.2.5 Test standards

The following standards refer not only to testing but also to functionalities and communication protocols.

**EN 15232 standard**

The European standard EN 15232: “Energy performance of buildings - Impact of Building Automation, Control and Building Management” aims at supporting the EPBD.

The standard specifies methods to assess the impact of Building Automation and Control System (BACS) and Technical Building Management (TBM) functions on the energy performance of buildings, and a method to define minimum requirements of these functions to be implemented in buildings of different complexities.

This standard specifies:

- A structured list of control, building automation and technical building management functions which have an impact on the energy performance of buildings;
- A method to define minimum requirements regarding the control, building automation and technical building management functions to be implemented in buildings of different complexities;
- Detailed methods to assess the impact of these functions on the energy performance of a given building. These methods enable to introduce the impact of these functions in the calculations of energy performance ratings and indicators calculated by the relevant standards; and
- A simplified method to get a first estimation of the impact of these functions on the energy performance of typical buildings.

**Other European and international standards**

Other relevant European and international standards for building automation, controls and building management, have been developed and are listed below:

- Product standards for electronic control equipment in the field of HVAC applications (e.g. EN 15500);
- EN ISO 16484-3 “Standardisation of BACS functions”, used to assess the impact of BACS on energy efficiency;
- Open data communication protocols for BACS (EN ISO 16484-5), which is necessary for integrated functions with BACS impact on energy efficiency;
- Specification requirements for integrated systems (EN ISO 16484-7); and
KNX Association is the owner of the KNX\(^{52}\) which is an European and international (ISO/IEC 14543-3) approved standard for home- and building. It is a global standard since it covers all applications in home and building control, ranging from lighting and shutter control to various security systems, heating, ventilation, air conditioning, monitoring, alarming, water control, energy management, metering as well as household appliances, audio, etc. According to experts, it covers a significant portion of the market with more than 300 manufacturers and more than 7000 certified products.

In addition, the Commission issued in December 2010 a standardisation mandate to CENELEC (M/480)\(^{53}\) for the “the elaboration and adoption of standards for a methodology calculating the integrated energy performance of buildings and promoting the energy efficiency of buildings, in accordance with the terms set in the recast of the Directive on the energy performance of buildings (2010/31/EU)”. It is also interested to note that in addition to current standards, the EEBus\(^{54}\) Initiative e.V also aims to achieve interoperability over different communication channels and protocols. This initiative could therefore be a useful tool toward further interoperability in control products.

7.2.6 Conclusion for Ecodesign

BACS are covered by WEEE and RoHS Directives, REACH Regulation and the EPBD. The added value of Ecodesign and Energy Labelling Directives should focus on how it can help maximising the environmental benefits from BACS in addition to reducing the environmental impact of BACS.

7.3 Appropriateness of Ecodesign or Energy labelling

7.3.1 Excessive cost

The only data available regarding the cost analysis come from the European Copper Institute study and from the program HOMES, which estimate that the average cost to procure, install and commission BACS, is respectively between 28.7 €/m\(^2\) and 50€/m\(^2\) (to reach nearly 50% of energy savings) for non-residential buildings.

According to the study made by the European Copper Institute, cumulative total additional investments from 2013 to 2035 are estimated to be 44.0 billion € under the Optimal Scenario, and 40.8 billion € under the Recommended Action Scenario. However, maximum annual additional investments for the Optimal and Recommended scenarios are respect. 4.5 billion €, and up to 2.5 billion €. Also, the cumulative economic savings on energy bills have been estimated to be between 15 and 18 times higher than the cumulative additional costs. Using these figures, the average payback period of using BACS were estimated to be less than two years.

In addition, the program HOMES has calculated a 5 years payback period to procure, install and commission BACS.

Once again, these figures must be taken with care because high differences across buildings types were found in the study, and because these economic calculations are based on scenarios that are

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\(^{54}\) http://www.eebus.org/
7.3.2 Suitability of Ecodesign measures or Energy labelling

Ecodesign or Energy Labelling Regulations could be implemented to increase the efficiency of BACS and reduce further the environmental impacts of non-residential buildings.

There are sufficient differences of functionality and performance between different control products on the market to able the use of a label. As an example, the product certification and labelling scheme developed by eu.bac aims to assure the user a high level of performance of the products and systems, and could be used and made compulsory using Energy Labelling to increase its efficiency.

In addition, Ecodesign requirements could help to reduce environmental impacts by:

- Setting minimum requirements on the sensitivity and permitted tolerances of control products (sensors and actuators): according to eu.bac, the accuracy of control products can be quite different from a product to another, with a direct influence on the efficiency of the control system (based on EN 15500);
- Increasing the user friendliness and thus helping BACS to be better installed and operated: for instance working on the display, using alerts related check lists for the installation, or using alerts when extreme energy losses occur (e.g. when the same zone is being heated and cooled). It would also be useful to put within the notice of the control product recommended values in order to avoid the control product stay with the predefined setup from the manufacturer;
- Increasing the re-commissioning of the system: for instance an alarm could alert the user periodically as a reminder that the efficiency of the system should be reassessed; and
- Strengthening the interoperability: communication protocols can be different from one system to another which affects the capability of all systems to work together. The use of open protocols could mitigate this problem (based on EN 16484-5 & 6 and EEBus).

Such requirements through an Ecodesign Regulation would be complementary with other directives such as EPBD and EED. These two Directives aim at increasing the energy performance and energy efficiency which can be achieved using BACS. These Directives can increase the penetration of BACS which would consequently increase the energy savings related to Ecodesign measures and Energy labelling.

7.3.3 Conclusion for Ecodesign

Ecodesign and Energy labelling measures seem to be an adequate and cost-effective tool to reduce environmental impacts related to the use of BACS.

7.4 Industrial competitiveness

7.4.1 Market structure

eu.bac is the “European Building Automation and Controls Association” and represents 27 European manufacturers for Home and Building Automation and Energy Service Companies among which Danfoss, Honeywell, Johnson Controls, Schneider Electric, Siemens, etc.. These companies

represent 85% of the annual market for home and building automation of approximately 4.4 billion euros\(^{56}\). There are also a large number of European SME producers that are not members of eu.bac.

### 7.4.2 Innovation and employment

The configuration and especially the installation of BACS is always done in the markets where the buildings are located. Therefore, increasing even slightly the penetration of BACS would increase local employment.

### 7.4.3 International competition

BACS systems are, like buildings themselves, set up locally. Products might be imported into the EU but the configuration and especially installation is done in the markets where the buildings are located. Therefore, foreign trade is not an important issue for BACS related services.

The share of BACS products sold within EU and coming from abroad is unknown.

### 7.4.4 Conclusion for Ecodesign

The European association for BACS pushes forward the implementation of Ecodesign or Energy Labelling requirements because they assume that this will be a first step toward its inclusion into EPBD and EED, and that all these directives will increase the penetration of BACS. So, from there point of view Ecodesign measures would improve the industrial competitiveness and improve employment in Europe.

On the other hand, some stakeholders are worried that if a new mandatory certification is considered in future regulation of BACS, it might benefit the biggest producers at the expense of SME especially if the certification scheme is not sufficiently transparent and accessible.

### 7.5 Product group summary and recommendations

Table 11 below presents a simplified scoring of the four main sections above, for the product group “BACS”.

<table>
<thead>
<tr>
<th>Product group</th>
<th>Other environmental impacts</th>
<th>Policy gaps</th>
<th>Appropriateness of Ecodesign</th>
<th>Appropriateness of Energy labelling</th>
<th>Industrial competitiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>BACS</td>
<td>++</td>
<td>+++</td>
<td>++</td>
<td>++</td>
<td>+++</td>
</tr>
</tbody>
</table>

The more ‘+’ there are in the assessment, the more favourable it is for Ecodesign Regulation or Energy Labelling to be implemented.

Regarding the other environmental impacts, the scoring reflects the facts that using BACS should provide significant improvement in the quality of internal air and the comfort of users by having an adequate humidity and temperature when it is needed.

The policy gaps refer to the fact that, according to the study conducted by the European Copper Institute, including BACS in EPBD and/or EED policies as well as Ecodesign and Energy Labelling would achieve important additional savings compared to the current scenario.

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As explained above, in the paragraph related to industrial competitiveness, the European association for BACS sees the implementation of Ecodesign measures or Energy Labelling as a useful tool to develop the penetration of BACS but other stakeholders are worried that it might be at the expense of SME. This point should be investigated further within a preparatory study.

The following types of Ecodesign measures could in principle be envisaged for BACS:

- Minimum requirements on the sensitivity and permitted tolerances of control products;
- Information regarding the proper installation and maintenance of the control products; and
- Mandatory use of common languages to ensure interoperability.

Energy labelling could be envisaged (considering that it fulfil the requirements of the Energy Labelling Directive), as sufficient difference seem to exist amongst models regarding accuracy, as demonstrated by the eu.bac voluntary scheme on control products.
8. Domestic toasters

8.1 Main other environmental issues
As singled out from the “Domestic kitchen appliances” product group of Task 3, domestic toasters present an array of environmental concerns (beyond energy consumption), that are summarised in Table 12 below. Energy consumption and material efficiency have been discussed in Task 3. Hence the table and the paragraphs below focus on the main other environmental impacts of the product group.

Table 12: Overview of relevant direct environmental issues and potential for improvement – Domestic toasters

<table>
<thead>
<tr>
<th>Environmental issue categories</th>
<th>Scoring</th>
<th>Description of the environmental issue</th>
<th>Description of related improvement potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water consumption in use phase</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consumables (detergents, etc.)</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Presence of critical raw materials (see the EU list&lt;sup&gt;57&lt;/sup&gt;)</td>
<td>+</td>
<td>Antimony, beryllium, might be used in small quantities electronic components. Cobalt, chromium are present in metal alloys of the product parts&lt;sup&gt;58&lt;/sup&gt;.</td>
<td>The UK food standards agency is currently undertaking a study on the fate and behaviour of brominated flame retardants (BFRs) in domestic kitchens&lt;sup&gt;59&lt;/sup&gt;.</td>
</tr>
<tr>
<td>Presence of flame retardants (halogenated, etc.)</td>
<td>+</td>
<td>Flame retardants are used in cables.</td>
<td></td>
</tr>
<tr>
<td>Presence of plasticisers (phthalates)</td>
<td>+</td>
<td>Plasticizers are present in cabling (e.g. power cords).</td>
<td>Less toxic, high-molecular-weight phthalates or other less harmful substances exist. A dedicated preparatory study would have to determine whether they can be used for toasters or if phthalate-free plastics can be used and be environmentally preferable.</td>
</tr>
</tbody>
</table>


<sup>58</sup> CECED, stakeholder’s input to Task 4.

<table>
<thead>
<tr>
<th>Environmental issue categories</th>
<th>Scoring</th>
<th>Description of the environmental issue</th>
<th>Description of related improvement potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Presence of other toxic substances</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Presence of F-gases</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiation levels</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safety (fuel leakage, vibrations, etc.)</td>
<td>+</td>
<td>The outer material of some toasters may heat up while the toaster is in use. It can be difficult to remove small items from hot toasters. Manufacturers do not recommend using metallic objects to remove items from toasters(^\text{60}).</td>
<td>Insulated sides help to reduce the amount of heat that escapes through the sides of the product.</td>
</tr>
<tr>
<td>Health (hygiene, noise level, etc.)</td>
<td>+</td>
<td>Domestic toasters must comply with EU Food Contact Materials Regulation.</td>
<td></td>
</tr>
<tr>
<td>Durability (reusability, upgradability, reparability, etc.)</td>
<td>++</td>
<td>Considering the low price of usual toasters, when broken down customers might prefer to buy a new model rather than repairing it.</td>
<td>The Blue Angel label for toasters introduced a requirement for a warranty of at least two years.</td>
</tr>
<tr>
<td>End-of-life (recyclability, recycled content)</td>
<td>+</td>
<td>Recyclability may be an issue, as smaller (domestic) appliances tend to be discarded together with households’ common waste.</td>
<td>The WEEE Directive covers toasters and compliant schemes for recycling have been developed throughout Europe. Moreover, the agency of design in the UK has designed different toaster models taking into consideration ‘cradle to cradle’ design and designing waste out of a toaster(^\text{61}).</td>
</tr>
<tr>
<td>Direct emissions to air</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct emissions to water</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct emissions to soil</td>
<td>0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Scoring: “0” if not an issue for the product group. If this is an issue, the indicative importance of the environmental issue is provided from + (low) to +++ (high).

\(^{60}\) Stakeholder’s input to Task 4 (anonymized).

8.1.1 Presence of flame retardants

Toasters are corded products that need to be safe for the end-user and hence have to comply with safety standards. Compliance with the safety standards likely requires the use of flame retardants.

If the use flame retardants are to be regulated, it should be done horizontally under the RoHS Directive (according to the industry).

8.1.2 Durability

The Joint Research Center (JRC) of the European Commission points out that the establishment of durability requirements could be highly suited when taking into account the consumer perspective (reduction of cost at purchasing) for domestic kitchen appliances. Considering the low price of usual toasters, when broken down customers might prefer to buy a new model rather than repairing it – this point is further highlighted by a UK report on domestic kitchen appliances.\(^{62}\) Within the German Blue Angel for toasters (see section 8.2.1), one of the requirements is that the manufacturer offers a warranty of at least two years. As for hair dryers, this echoes the Directive on certain aspects of the sale of consumer goods and associated guarantees, according to which “in the case of a lack of conformity, the consumer shall be entitled to have the goods brought into conformity free of charge by repair or replacement […], or to have an appropriate reduction made in the price or the contract rescinded with regard to those goods […], within two years as from delivery of the goods.”\(^{63}\)

In terms of durability and reliability, data is available from the British consumer organisation Which?. As a matter of fact, the organisation surveys thousands of its members on issues they have encountered with their home appliances, in order to find out which brands are the most reliable. Based on the views of more than 7,000 Which? Members, the most common problems of toasters reported were:\(^{64}\):

- Element stopped working: 64%;
- Inconsistent performance: 15%; and
- Carriage lever stopped working: 11%.

8.1.3 Conclusion for Ecodesign

The main environmental concern regarding toasters is the energy consumed during the use phase. Durability aspects may be worth considered under the Ecodesign Directive (specifically for toasters or as a horizontal measure) even if at this stage, no specific information was shared by manufacturers regarding best practices.

8.2 Policy coverage

This section is dedicated to the regulatory coverage of the product groups addressed, be it through legislation, within the EU or in third countries, through voluntary agreements and environmental labels or standards.

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\(^{64}\) Survey is done each year – see: [http://www.which.co.uk/home-and-garden/small-appliances/reviews/toasters/page/reliability/](http://www.which.co.uk/home-and-garden/small-appliances/reviews/toasters/page/reliability/).
8.2.1 Overview of EU policies

Currently, domestic toasters are regulated under the WEEE and RoHS Directives and REACH Regulation.

**Table 13: Main EU legislation applicable to the “Domestic toasters” product group**

<table>
<thead>
<tr>
<th>Product group</th>
<th>WEEE</th>
<th>RoHS</th>
<th>REACH</th>
<th>EPBD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic toasters</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>-</td>
</tr>
</tbody>
</table>

Furthermore, all electric domestic kitchen appliances have to fulfill specific requirements on materials and articles intended to come into contact with food (Regulations (EC) No 1935/2004 and (EU) No 10/2011). In addition to that, the EDQM Guide (European Directorate for Medicines & Healthcare) that deals with the migration of heavy metal and alloy into food, sets very specific substance restrictions for kitchen utensils.

Regulation (EC) No 1935/2004 on materials and articles intended to come into contact with food requires that “any material or article intended to come into contact directly or indirectly with food must be sufficiently inert to preclude substances from being transferred to food in quantities large enough to endanger human health or to bring about an unacceptable change in the composition of the food or a deterioration in its organoleptic properties”. Regulation (EU) No 10/2011 on plastic materials and articles intended to come into contact with food is a specific measure within Regulation (EC) No 1935/2004 and thus sets detailed requirements in regard to the properties of materials used.

The EDQM Guide foresees specific tests for iron, chromium, zinc and other heavy metals as they are potential contaminants.

8.2.2 Selected Member States policies

The following section is dedicated to Member States policies which are in place inside the EU and of which the following table gives an overview.

**Table 14: Environmental labels at Member States level**

<table>
<thead>
<tr>
<th>Product group</th>
<th>RAL-UZ 167</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic toasters</td>
<td>RAL-UZ 167</td>
<td>-</td>
</tr>
</tbody>
</table>

Thus, only one label could be identified to certify products of the category “toasters”, namely the German Blue Angel label. The criteria for the award of the Blue Angel label for toasters date from January 2012.

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67 European Directorate for Medicines & Healthcare (2003), Comments concerning some revised/corrected texts published in supplement 4.5. PHARMEUROPA Vol. 15, No. 2.
Table 15 shows an extract of the requirements toasters have to comply with in order to obtain the Blue Angel label. However, the requirements listed here below are not exhaustive (there exist various other demands).

### Table 15: Requirements of Blue Angel label with respect to toasters

<table>
<thead>
<tr>
<th>Type of Requirement</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy consumption</td>
<td>0.125 kWh for 2 slice toasters</td>
</tr>
<tr>
<td></td>
<td>0.250 kWh for 4 slice toasters</td>
</tr>
<tr>
<td>Material of touchable surfaces</td>
<td>Compliance with REACH and other regulations</td>
</tr>
<tr>
<td>Safety</td>
<td>There exist requirements in regard to the temperature of the side surfaces, electrical safety and product design</td>
</tr>
<tr>
<td>Warranty (min. in years)</td>
<td>2</td>
</tr>
</tbody>
</table>

No information with respect to certified products could be found on the Blue Angel website. Following a written inquiry, the Blue Angel confirmed that up to date no product of the category toasters has been awarded the environmental label.

#### 8.2.3 Industry Self-Regulatory Initiative

No relevant SRI could be identified.

#### 8.2.4 Existing third country legislation and labels

No existing third country legislation relating to toasters could be identified. There exists only one scoping report on toaster ovens by the ENERGY STAR programme dating from 2011.

#### 8.2.5 Test standards

There are test standards available for toasters. The Blue Angel measurement of energy consumption is based on German norm DIN 60442 (Elektrische Haushalt-Brotröster, Verfahren zur Messung der Gebrauchseigenschaften), which is the equivalent of European norm EN 60442.

The American NSF Protocol P405 could also be identified, which is intended to measure energy consumption of “Toasters & Toaster Ovens for Home Use”. It was not possible to get more details on this standard.

#### 8.2.6 Conclusion for Ecodesign

To the exception of the Blue Angel environmental label, policy coverage of the “toasters” product group appears to be quite low in Europe and worldwide. Only safety requirements apply to this product group on a mandatory basis, and not any requirement related to energy efficiency.

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8.3 Appropriateness of Ecodesign or Energy labelling

8.3.1 Excessive cost

The price of toasters ranges from 32 to 130€, with most models below 70 € according to the survey performed by Oeko-Institut\textsuperscript{15}. This resulted in an average observed price of all 47 models of 60 €.

The discussion about “excessive cost” shall follow a simplified Life-Cycle Cost analysis (LCC), to make sure that savings stemming from lower energy consumption exceed any increase in purchase price. In the case of toasters, Table 16 below sums up the LCC performed.

<table>
<thead>
<tr>
<th>Domestic toaster</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Average purchase price</td>
<td>60 €</td>
</tr>
<tr>
<td>Energy consumption / year</td>
<td>12.8 / 25.6 / 38.3 kWh\textsuperscript{71}</td>
</tr>
<tr>
<td>Lifetime</td>
<td>6 years</td>
</tr>
<tr>
<td>Average EU electricity price (domestic)</td>
<td>0.2 € / kWh</td>
</tr>
<tr>
<td>Energy costs over lifetime</td>
<td>15.3 / 30.7 / 46.0 €</td>
</tr>
<tr>
<td>Energy savings potential in use phase</td>
<td>35 %</td>
</tr>
<tr>
<td>Economic savings potential</td>
<td>5.4 / 10.7 / 16.1 €</td>
</tr>
<tr>
<td>Relation (economic savings / purchase price)</td>
<td>9 / 18 / 27 %</td>
</tr>
</tbody>
</table>

It is difficult to assess in a very precise way the cost increase that would result from the implementation of technological options ensuring energy savings. According to one manufacturer (Morphy Richards), “current consumer understanding suggests that consumers are often reluctant to pay more for an ‘Eco’ product within this product category compared to a lower priced non-Eco alternative. Toasters have been produced before with top covers and Eco Slots but due to price the general public did not buy into the concept.”\textsuperscript{72}

To this extent, the likeliness of excessive cost would need to be looked deeper into during a Preparatory Study. Anyway, the possible available options are described below\textsuperscript{58}:

- Eco-slot, in order to avoid heating a slot that is not required. A 30-35% saving for the one eco-slot working on a two-slot toaster is possible, although there are many single-slot toasters on the market (where an eco-slot is not suitable);
- Covering slot, in order to avoid heat escaping from the top of the toast. Adding automatic mechanisms to close/open the slots will lead to significant cost increases. Moreover, despite warnings on the product and in the product user manual, several incidents occurred related to these coverings resulting in e.g. melted/deformed components;

\textsuperscript{71} Those three different values refer to the three different assumptions for energy consumption at individual product level, as displayed in Task 3 (Low / Medium / High Range).

\textsuperscript{72} Comment received per email.
• Insulated sides, in order to reduce the amount of heat that escapes from the side of the toaster. This has both energy saving and safety benefits; and

• Change to more efficient heating technology, with the use of infrared technology. This technology is said to lead to price increase that does not compensate for the potential energy saving. Furthermore, infrared lamps are made with a glass vessel which has a higher environmental footprint at the manufacturing site compared to technology commonly used nowadays for toasters.

Some options, like the NewGen eco-slot / selector control mentioned in Task 3, which allows the user to heat either one or both slots, seem to be proprietary technologies. However, there are many different options available to enhance energy efficiency of toasters, so that proprietary technologies should not be a major hindrance. For instance, the manufacturer Strix has developed Faster Toaster technology, to create a higher power but more efficient toaster that both speeds up toasting and saves energy (about 30%).

8.3.2 Suitability of Ecodesign measures or Energy labelling

The following characteristics of the “Domestic toasters” product group make it pretty suitable for Regulation:

• Mass market products;

• Only limited product variability and slow technical evolution;

• Best Available Technologies (BAT) exist; and

• Standards and labelling criteria have been developed.

Energy labelling could also be an option, since toasters are mass consumer-products and that, according to stakeholders, there is sufficient differentiation between products on the market. Even if this would have to be confirmed by further study, there seems to be significant differences for energy consumption across various models on the market, what would contribute to make the case for Energy labelling.

Finally, requirements on durability may also be explored; but at the moment, there is a general lack of data on this issue.

8.3.3 Conclusion for Ecodesign

The question on excessive cost is not clear-cut and would need to be further studied by any Preparatory Study taking place. However, the general features of the “toasters” product group make it rather suitable for Ecodesign or Energy labelling Regulation.

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73 Strix (2014), Strix Fast Toaster. This 30%-mark is being challenged by a stakeholder, according to whom this takes a shorter time than indicated to grill bread to the “golden brown level” with a standard (800 W) device, what makes the comparison with the Strix toaster less appealing. Hence the 30%-mark for savings indicated by Strix is deemed too optimistic by this stakeholder.
8.4 Industrial competitiveness

8.4.1 Market structure

The major manufacturers of domestic kitchen appliances include Philips, SEB, Morphy Richards, Bosch und Siemens Hausgeräte GmbH (BSH), Electrolux, Whirlpool, Arçelik AS, Miele. In the toaster market there are some dominant players in terms of energy and resources efficiency, such as the British manufacturer Dualit, which introduced a selector control in the NewGen® model. But there are also other manufacturers engaging in this kind of improvement activities, like Morphy Richards or Russell Hobbs, which both offer toasters with a lid saving energy and time during the use phase.

8.4.2 Innovation and employment

Even though the European production is rather limited, there could be a substantial effect on the European job market deriving from these innovation processes. Indeed, if toasters become more energy-efficient and longer lasting this might result in the opportunity to relocate production to Europe instead of producing less performing products abroad.

In the case in which materials are affected and exchanged, this might influence suppliers’ industries. Innovation in the toaster industry might also impact other sectors if toasters become more and more multi-functional.

8.4.3 International competition

Even if the number of imports into the European market is important (according to Prodcom data), there are major manufacturers such as SEB in France, BSH in Germany or Dualit and Morphy Richards in the UK. As for the comparative average quality of imported as opposed to European manufactured products no important differences could be identified. However, it was not possible to obtain an estimate of the market share of European manufacturers abroad.

On the other hand, the implementation of the Ecodesign Directive will have an important impact on third country manufacturers, given that it is companies from outside the EU which hold the largest market share. Their costs will go up as a consequence of the Regulation in order to guarantee compliance of their products. Some of them may even decide to stop supplying the EU, if it turns out that compliance is too difficult to reach for them.

If European producers managed to better prepare for the possible product and process innovations as compared to their international competitors, this would result in a considerable comparative advantage, at least in the early stages, following the adoption of Implementing Measures of the Directive. In this case, European manufacturers could replace a certain share of imports with their own Ecodesign-compliant products (if they are able to increase their production activities in time), resulting in their reinforced market position (and the creation of additional jobs).

8.4.4 Conclusion for Ecodesign

The (theoretical) impacts of Ecodesign on the European “toaster industry” look rather good, as it could foster innovation and employment. However, as limited information was gathered through manufacturers, such conclusion should not be considered as robust.

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74 Source: Euromonitor International.

75 There are, for instance, toasters on the market, which in addition to their original use were extended to poach eggs at the same time.
8.5 Product group summary and recommendations

Table 17 below presents a simplified scoring of the three main sections above, for the product group “Domestic toasters”.

Table 17: Overall scoring of the "Domestic toasters" product group

<table>
<thead>
<tr>
<th>Product group</th>
<th>Other environmental impacts</th>
<th>Policy gaps</th>
<th>Appropriateness of Ecodesign</th>
<th>Appropriateness of Energy labelling</th>
<th>Industrial competitiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic toasters</td>
<td>+</td>
<td>+++</td>
<td>+++</td>
<td>++</td>
<td>++</td>
</tr>
</tbody>
</table>

The more “+” there are in the assessment, the more favourable it is for Ecodesign or Energy labelling Regulation to be implemented.

The following types of Ecodesign measures could in principle be envisaged for toasters:

- Minimum requirements on energy efficiency; and
- Minimum requirements on durability.

Energy labelling also seems to be a suitable option for this product group even if the distribution of models is not very clear in terms of energy consumption.
# 9. Electric Kettles

## 9.1 Main other environmental issues

Table 18 below provides an overview of the relevant environmental aspects of the “Electric kettles” product group, and possible improvement options linked to them. Task 4 considers domestic electric kettles for heating water for drinks and cooking only. Energy consumption and material efficiency have been discussed in Task 3. Hence, the table and the paragraphs below focus on the main other environmental impacts of the product group.

### Table 18: Overview of relevant direct environmental issues and potential for improvement – Electric kettles

<table>
<thead>
<tr>
<th>Environmental issue categories</th>
<th>Scoring</th>
<th>Description of the environmental issue</th>
<th>Description of related improvement potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water consumption in use phase</td>
<td>++</td>
<td>Users have a tendency to heat more water than necessary.</td>
<td>The main benefit is from the energy saving but a small saving in water use would also be achieved.</td>
</tr>
<tr>
<td>Consumables (detergents, etc.)</td>
<td>+</td>
<td>Descaling chemicals may be used, but are not usually hazardous.</td>
<td>None. Descaling devices(^{76}) can be used in kettles to prevent scale build up. These are sold separately to the kettle but there are reports that they are not fully effective.</td>
</tr>
<tr>
<td>Presence of critical raw materials (see the EU list(^{77}))</td>
<td>+</td>
<td>Chromium is used in stainless steel and in nichrome heating elements. Antimony is used (as a flame retardant), cobalt and beryllium might be used in very small amounts in alloys.</td>
<td>Not a significant issue due to relatively small amount used, but improved durability would reduce consumption.</td>
</tr>
<tr>
<td>Presence of flame retardants (halogenated, etc.)</td>
<td>+</td>
<td>Flame retardants are required by EU safety legislation.</td>
<td>These substances are not an important issue as these do not pose a risk if kettles are recycled according to the requirements of EU waste legislation. Non-halogenated flame retardants exist. A dedicated Preparatory Study would have to determine whether they can be used for kettles and would be environmentally preferable.</td>
</tr>
</tbody>
</table>

---

\(^{76}\) Typically these are balls of stainless steel mesh.

<table>
<thead>
<tr>
<th>Environmental issue categories</th>
<th>Scoring</th>
<th>Description of the environmental issue</th>
<th>Description of related improvement potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Presence of plasticisers (phthalates)</td>
<td>+</td>
<td>May be present in mains cable and a few other parts.</td>
<td>Less toxic, high-molecular-weight phthalates or other less harmful substances exist. A dedicated preparatory study would have to determine whether they can be used for kettles or if phthalate-free plastics can be used and be environmentally preferable.</td>
</tr>
<tr>
<td>Presence of other toxic substances</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Presence of F-gases</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiation levels</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safety (fuel leakage, vibrations, etc.)</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health (hygiene, noise level, etc.)</td>
<td>+</td>
<td>Some designs are noisier than others but the level is annoying but not harmful. Materials in contact with water must comply with EU Food Contact Materials Regulation. Users may expect boiling to sterilise contaminated water</td>
<td>Boiling will not kill some types of bacteria or most types of fungal spores and so is not an effective means of sterilisation</td>
</tr>
<tr>
<td>Durability (reusability, upgradability, reparability, etc.)</td>
<td>++</td>
<td>Some evidence that durability is an issue. Kettles are usually impossible to repair. Reparability is not cost effective due to low price of new kettles.</td>
<td>Improved durability would reduce resource consumption.</td>
</tr>
<tr>
<td>End-of-life (recyclability, recycled content)</td>
<td>+</td>
<td>Not all kettles are collected at end-of-life whereas made of recyclable materials.</td>
<td>In scope of WEEE Directive so should be collected and recycled.</td>
</tr>
<tr>
<td>Direct emissions to air</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct emissions to water</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct emissions to soil</td>
<td>0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Scoring: “0” if not an issue for the product group. If this is an issue, the indicative importance of the environmental issue is provided from + (low) to +++ (high).

### 9.1.1 Noise

Although some users complain that some kettles are noisy, the noise level is not thought to cause harm. The result of unusually noisy kettles is that some users return them to suppliers or discard them prematurely.
9.1.2 Durability
This is extensively described in Task 3 with all available data. This is however not conclusive and further research will be needed to establish the true extent of this issue. One kettle manufacturer tests kettles obtained from Chinese manufacturers that are widely sold in the EU and finds that lifetime seem too short in many cases. They state that durability and reusability is important given the variance in lifespans, which occur.

9.1.3 End-of-life
Kettles are relatively simple products that are easily recyclable. In principal, the metals and plastics can be recovered for reuse. Kettles are in scope of the WEEE Directive.

9.1.4 Conclusion for Ecodesign
No significant issues have been identified apart from those described in task 3. Based on published data, there appears to be a significant potential energy saving. Manufacturers have claimed that electric kettles are already very energy efficient; this is correct, their life cycle primary energy consumption is lower than heating water on electric hobs (and similar to gas hobs), however, the aim of this assessment is to identify product groups where the potential energy saving is significant and this appears to be the case. Further indications are available from the Blue Angel and Energy Saving Trust standards that are described below.

The issue of durability is less clear with contradictory evidence available. It is clear that early kettle failures occur but the percentage in years 1 and 2 may not always be a large percentage and data for subsequent years is not available apart from data from Which? that suggests that most kettles last 3 or less years whereas they can be designed to last for 7 without an excessive increase in production cost. Some stakeholders have claimed that users’ failure to descale is a primary cause of early failure. There is contradictory evidence to support this as many of the types of fault discussed in review sites are not due to scale issues. Perhaps more clear information as required by the Blue Angel standard would reduce this problem.

9.2 Policy coverage
This section is dedicated to the regulatory coverage of the product groups addressed, be it through legislation, within the EU or in third countries, through voluntary agreements and environmental labels or standards. The goal is to identify where Ecodesign or Energy Labelling regulations could have added value beyond the existing legislation, and, in the case of third country legislation, whether there is successful legislation that could serve as a model for Ecodesign or Energy Labelling legislation.

9.2.1 Overview of EU policies
Currently, kettles are regulated under the EU WEEE, RoHS and REACH.

| Table 19: Main EU legislation applicable to the “Electric kettles” product group |
|-----------------------|---|---|---|---|
| Product group        | WEEE | RoHS | REACH | EPBD |
| Electric kettles     | X    | X    | X     | -    |
There is an ecolabel for water heaters that are used for central heating systems, but kettles are not in scope and no ecolabel exists.

- **WEEE** – Kettles should be collected at end of life and treated and recycled according to the obligations of the WEEE Directive and EU waste legislation. Kettles consist mainly of plastics and metals; however, it is the metals content that has a sufficiently high value to encourage recycling. Ecodesign obligations are unlikely to benefit end of life except by improving durability so that fewer kettles reach end of life each year.

- **RoHS** – This Directive currently restricts the use of six substances in kettles and it is likely that more substances will be restricted in the future (e.g. phthalates). It is therefore not necessary for any future ecodesign legislation to consider hazardous substance restrictions.

- **REACH** – This legislation either discourages use of hazardous substances (by inclusion in the SVHC candidate list) or by imposing restrictions. This is effective legislation that should not be duplicated by ecodesign.

- **Ecodesign** – in scope of standby and off-mode Regulation which limits standby energy consumption to 0.5W. In practice, most kettles have 0W consumption when not used.

- **Food contact materials Regulation** – this is applicable for parts that are in contact with water that is consumed by the user.

### 9.2.2 Selected Member States policies

The following section is dedicated to Member States policies and standards which are in place inside the EU and of which the following table gives an overview.

**Table 20: Environmental labels at Member States level**

<table>
<thead>
<tr>
<th>Product group</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Electric kettles</td>
<td>X</td>
<td>-</td>
</tr>
</tbody>
</table>

There is a Blue Angel standard for kettles; “Wasserkocher für den Hausgebrauch RAL-UZ 133”, published September 2013. The main requirements are described in Table 21.

**Table 21: Requirements of Blue Angel label with respect to kettles**

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scope</td>
<td>Domestic cordless kettles</td>
</tr>
<tr>
<td>Minimum energy efficiency</td>
<td>20°C to auto-switch off &lt;0.115kWh/litre</td>
</tr>
<tr>
<td></td>
<td>15°C to auto-switch off &lt;0.122kWh/litre</td>
</tr>
<tr>
<td>Water level indicator</td>
<td>Must have marks that start at least at 0.5 litres with 0.25 litre increments and be visible from at least 0.3 litre</td>
</tr>
<tr>
<td>Manufacturer's warranty</td>
<td>Two years</td>
</tr>
<tr>
<td>Information</td>
<td>Information for users on energy efficient use such as not boiling more water than needed and providing descaling instructions</td>
</tr>
</tbody>
</table>
The minimum energy efficiency value is noteworthy because two studies reported in task 3 indicated that average kettles in the EU are used to boil 1000 litres per year and so for 15°C to auto-shut off, would consume <122 kWh which is significantly less than the 167kWh annual consumption measured in the UK and in the Netherlands.

The UK Energy Saving Trust (EST) has also published a standard for kettles “ESTR003 Product Performance Requirements”. The requirements of this standard are:

- Products should demonstrate a 20% reduction in energy consumption over that consumed by an average kettle. This may be verified, for example, either through consumer trials in the home or through laboratory tests; the results from either method should be conducted and assessed by an independent third party test house, accredited to ISO/IEC 17025 by a member of ILAC;
- Products must consume ≤1W in passive standby (0.5W is now required by the EU standby Regulation);
- Products must have a minimum boiling volume of ≤250ml;
- Applicants should demonstrate due diligence in considering design and usability of the product; and
- Products must conform to the relevant British Standards applicable to this class of product, including:
  - BS EN 60335-1:2002 Household and similar appliances. Safety. General requirements; and

The EST standard requires minimum volume of 0.25 l which is different to the Blue Angel standard and should help avoid over-filling. The requirement that kettles consume 20% less energy than “average” kettles is consistent with the improvement potential discussed in Task 3 but the EST does not publish details of how this should be measured.

## 9.2.3 Industry Self-Regulatory Initiative

No relevant SRI could be identified.

## 9.2.4 Existing third country legislation and labels

None identified.

## 9.2.5 Test standards

The British Standards Institute published BSI BS 3999-1 “Methods of Measuring the Performance of Household Electrical Appliances Part 1: Electric Kettles and Jugs” in 1993. This is a performance standard which does not include energy efficiency or energy consumption.

There is no specific standard for measurement of energy consumption although safety standards exist for domestic appliances. Development of an energy consumption measurement method would be straightforward; it would need to measure energy from a predefined temperature (e.g. 10°C) until the

---

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Others</td>
<td>Hazardous substances, safety and design features that aid usability</td>
</tr>
</tbody>
</table>
kettle automatically switches off. The standard would need to define the amount of water used and this may vary depending on the kettle’s capacity.

Standards for noise also exist, namely the EN 60704-3 standard for “Household and similar electrical appliances – Test code for the determination of airborne acoustical noise”. This gives a test method which is suitable for household appliances including kettles.

9.2.6 Conclusion for Ecodesign
Kettles are already regulated by EU legislation such as RoHS, REACH, WEEE, food contact materials and standby and off-mode but energy consumption is not regulated in the EU or elsewhere.

9.3 Appropriateness of Ecodesign or Energy labelling
Task 3 showed that the potential energy saving in the use phase may be significant, based on the published data described in task 3. There is evidence that durability may be an issue with potential for improvement, but this is not conclusive as extensive independent data is not available. It is also unclear whether the savings in resource consumption would be sufficiently large to warrant regulation.

9.3.1 Excessive cost
The price of kettles varies considerably in the EU, but this does not appear to depend on energy efficiency or durability. Good design requires a good understanding of kettle technology which some manufacturers may not possess (hence the poor durability of some models). Life testing of new designs will identify any fatal flaws in design that can be corrected but this will incur a cost which may be significant if only small numbers of a model are manufactured but will be negligible if large numbers are produced. Currently, thick film heater elements are more expensive that heating coils but this is mainly due to the relatively small numbers produced. There will be economies of scale if these were to be much more commonly used. Large scale manufacture is straightforward and so costs would come down and may not be very different to the cost of heating coils. Thick film circuits are common in many other industry sectors, e.g. automotive and IT, and are made in extremely large numbers so that production cost are very low. It would appear that improvement in durability and energy efficiency should be achievable without significant costs increases to consumers. Available cost information is as follows:

**Lifetime**: domestic electric kettle lifetime is estimated by the UK MTP at 4.4 years. Manufacturers expect concealed “underfloor” element kettles to survive 20,000 hours use (ca. 7 years), whereas immersed coil element kettles have shorter lifetimes of about 3 years.

**Average price**: Not known, retail prices vary typically from €6 to €120. One stakeholder has indicated that manufacturing costs of electric kettles are typically from €6.20. They also provided information that thick film heaters are 30% more expensive than underfloor heating elements which is enough to discourage their use by kettle manufacturers. However this only adds €0.60 to production costs so should not discourage consumers. Most of the other potential energy savings described here are attained by good design expertise and so R&D is required but production costs should not be significantly affected.

**Value of energy saving**: An annual primary use phase energy saving of 366MJ has been calculated above, which is equivalent to 40kWh electricity per year. If the EU average electricity price is €0.195/kWh, annual savings on energy costs would be €7.80 per year and for a 7 year lifetime would be €54.6. This should easily exceed any additional costs due to improved design. Although this energy
saving may be over-optimistic, if it were only half of this value, the electricity cost saving is still more than the minimum kettle manufacture cost.

**Impact on consumers:** Retail prices vary from €6 to €120 although production costs can be as little as €6.2, so a small increase in production costs would not significantly impact consumers, although may affect manufacturers of kettles that sell for the lowest prices. The Ecodesign issues discussed in Task 3 will mainly require R&D and design changes with minimal impact on production costs, apart from use of thick film elements which currently are more expensive than resistance coil heaters. Consumers would benefit from reduced energy consumption as the value of savings on electricity bills will be larger than any likely price increases, even if the Task 3 estimates are over-optimistic and are only half those predicted from published data.

In the case of kettles, Table 22 below sums up the LCC performed.

### Table 22: Detailed cost calculation for the “kettles” product group

<table>
<thead>
<tr>
<th></th>
<th>Kettle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average purchase price</td>
<td>€40</td>
</tr>
<tr>
<td>Energy consumption / year</td>
<td>167kWh</td>
</tr>
<tr>
<td>Lifetime</td>
<td>Up to 7 years</td>
</tr>
<tr>
<td>Average EU electricity price (domestic)</td>
<td>0.2 €/kWh</td>
</tr>
<tr>
<td>Energy costs over lifetime</td>
<td>233 €</td>
</tr>
<tr>
<td>Energy savings potential in use phase</td>
<td>Up to 24%</td>
</tr>
<tr>
<td>Economic savings potential</td>
<td>56 €</td>
</tr>
<tr>
<td>Relation (economic savings / purchase price)</td>
<td>140%</td>
</tr>
</tbody>
</table>

#### 9.3.2 Suitability of Ecodesign measures or Energy labelling

There seems to be no major hindrance to the implementation of Ecodesign requirements to the “kettles” product group. Indeed, the following characteristics of the product group make it suitable for Regulation:

- Mass market products (23 to 60 million annual sales, based on two different data sources). It is not known why this large difference exists. A third source, Gfk indicates 24 million annual sales. Sales in EU Member States vary considerably with a very high proportion of households owning a kettle in some countries such as the UK\(^78\) whereas kettles are much less common some countries.;

- Published data indicates a significant potential energy saving, although this is disputed by manufacturers;

- Best Available Technologies (BAT) exists as described in Task 3;

---

\(^78\) 96% in 2013, Mintel (2013) website Small kitchen appliances, ownership - Figure 51: September 2013
• No excessive cost would occur; and
• Products are homogenous, also between EU Member States with many manufacturers on this market.

Kettles are a consumer product so would benefit from an Energy label if this can show a significant difference in energy consumption between products. If the size of the resource consumption saving from improved durability is seen as being significant, then Ecodesign obligations would be required to achieve this.

9.3.3 Conclusion for Ecodesign
The impact of ecodesign requirements should not result in excessive costs to manufacturers or consumers. Most additional manufacturer costs will be for R&D and for testing and so will have a larger impact on SMEs who sell relatively few kettles of each model than on large enterprises who sell large numbers of each model.

9.4 Industrial competitiveness

9.4.1 Market structure
The market for kettles is highly competitive with many manufacturers on the EU market. Most are large enterprises. Differentiation of products is limited, which makes kettles a rather homogenous product group. Competition in this product category is fierce and regulation under the Ecodesign Directive may not result in a big increase in prices.

9.4.2 Innovation and employment
Kettles are relatively mature products and so Ecodesign requirements are unlikely to significantly affect innovation. Although kettles appear to be relatively simple designs, achieving good performance, low energy consumption and durability all require a high level of expertise and good production quality. Ecodesign requirements will encourage reputable EU brands of manufacturers to continue to invest in achieving good performance, low energy consumption and durability and would also encourage cheaper brands and retailer brands to ensure that they can also achieve good performance, low energy consumption and durability.

The majority of kettles sold in the EU are manufactured in factories in Asia although there are a few EU factories that make kettles. Ecodesign requirements could benefit EU employment if it encouraged more production in the EU as control of good design and product quality is easier if manufacturing is located in the EU.

9.4.3 International competition
Although most kettles sold in the EU are imported into the EU, these are mostly EU owned brands that are made by sub-contractors in Asia. One Chinese factory may for example make kettles for several EU brands. The more well established EU brands design their own products and ensure that the kettles produced meet their quality requirements whereas some smaller EU suppliers let the Asian manufacturer also design the product. It is possible that non-EU brands could take a larger proportion of the EU market as has occurred with other electrical products whereas Ecodesign requirements could assist established EU manufacturers by restricting unreliable low priced products.
9.4.4 Conclusion for Ecodesign

Ecodesign Regulation should not affect EU competitiveness and may assist with EU jobs. Most manufacturer costs will be for R&D and for testing and so will have a larger impact on SMEs than on large enterprises. Kettle manufacturers in the EU are mostly large companies, but there are a few SMEs. The improvement options described in Task 3 are mostly not proprietary technology. One stakeholder has stated that to encourage better (more reliable and energy efficient) designs and maintain good competition could be achieved by restricting low priced poor quality and badly designed products.

9.5 Product group summary and recommendations

Table 23 below presents a simplified scoring of the three main sections above, for the product group “Kettles”.

<table>
<thead>
<tr>
<th>Product group</th>
<th>Other environmental impacts</th>
<th>Policy gaps</th>
<th>Appropriateness of Ecodesign</th>
<th>Appropriateness of Energy labelling</th>
<th>Industrial competitiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electric Kettles</td>
<td>++</td>
<td>++</td>
<td>+++</td>
<td>+++</td>
<td>++</td>
</tr>
</tbody>
</table>

The more “+” there are in the assessment, the more favourable it is for Ecodesign or Energy Labelling Regulation to be implemented.

Overall, therefore:

- Only use phase energy consumption is significant as the size of resource consumption saving is uncertain and may not be significant;
- Kettles are regulated by RoHS, REACH, WEEE, Food contact materials legislation as well as standby and off-mode energy consumption;
- Ecodesign and Energy labelling seem to be applicable options; and
- Ecodesign or Energy Labelling Regulation would not have a negative impact on EU industrial competitiveness.
10. Free-standing hot beverage vending machines

10.1 Main other environmental issues

Table 24 below provides an overview of the relevant environmental aspects of the “Free-standing hot beverage vending machines” product group, and possible improvement options linked to them. Energy consumption and material efficiency have been discussed in Task 3. Hence the table and the paragraphs below focus on the main other environmental impacts of the product group.

Table 24: Overview of relevant direct environmental issues and potential for improvement – Free-standing hot beverage vending machines

<table>
<thead>
<tr>
<th>Environmental issue categories</th>
<th>Scoring</th>
<th>Description of the environmental issue</th>
<th>Description of related improvement potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water consumption in use phase</td>
<td>0</td>
<td>Water used to produce the beverage is considered not wasted.</td>
<td></td>
</tr>
<tr>
<td>Consumables (detergents, etc.)</td>
<td>0</td>
<td>Cups, coffee or other ingredients required to produce and deliver the beverage are required to fulfil the function and do not impact the environmental performance of the product.</td>
<td></td>
</tr>
<tr>
<td>Presence of critical raw materials (see the EU list(^{80}))</td>
<td>+</td>
<td>Some CRM and precious metals contained in printed circuit boards and in screens (e.g. indium).</td>
<td>Extractability of PCBs and of screens would ease the recycling of CRM.</td>
</tr>
<tr>
<td>Presence of flame retardants (halogenated, etc.)</td>
<td>+</td>
<td>It is unlikely that flame retardants in the plastics in the ingredient canisters are used.</td>
<td>Non-halogenated flame retardants exist. A dedicated Preparatory Study would have to determine whether they can be used for hot beverage vending machines and would be environmentally preferable.</td>
</tr>
<tr>
<td>Presence of plasticisers (phthalates)</td>
<td>+</td>
<td>Some plasticisers may be used in the silicone tubing inside the machines.</td>
<td>Less toxic, high-molecular-weight phthalates or other less harmful substances exist. A dedicated</td>
</tr>
</tbody>
</table>

\(^{79}\) EEB and ECOS suggested to make mandatory the possibility for the consumer to use its own mug instead of automatically providing a plastic or paper cup. EVA indicated that more and more machines do already have a button that allows the consumer to use their own cup. However, a precise assessment of the environmental benefits would require to carry out a comparative LCA.

<table>
<thead>
<tr>
<th>Environmental issue categories</th>
<th>Scoring</th>
<th>Description of the environmental issue</th>
<th>Description of related improvement potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Presence of other toxic substances</td>
<td>0</td>
<td>Materials in contact with water must comply with EU Food Contact Materials Regulation. Cleaning of machines is essential to comply with health requirement and ensure “right” taste.</td>
<td>The industry strongly recommends hygiene quality training and controls for machine operators.</td>
</tr>
<tr>
<td>Presence of F-gases</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiation levels</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safety (fuel leakage, vibrations, etc.)</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health (hygiene, noise level, etc.)</td>
<td>++</td>
<td>Vending machines might be replaced while still functioning and thus second hand market may be important.</td>
<td>Manufacturing machines on a modular basis, so parts can be substituted and replaced easily by an operator. This practice is already quite popular according to the industry.</td>
</tr>
<tr>
<td>Durability (reusability, upgradability, reparability, etc.)</td>
<td>++</td>
<td></td>
<td></td>
</tr>
<tr>
<td>End-of-life (recyclability, recycled content)</td>
<td>+</td>
<td>Besides some CRM that worth being recycled, vending machines are mainly made of steel, iron, copper, aluminium and plastics which are recyclable.</td>
<td>As vending machines are in the scope of WEEE, good design practices might already be applied.</td>
</tr>
<tr>
<td>Direct emissions to air</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct emissions to water</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct emissions to soil</td>
<td>0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Scoring: “0” if not an issue for the product group. If this is an issue, the indicative importance of the environmental issue is provided from + (low) to +++ (high).

10.1.1 Hygiene

The purpose of a hot beverage vending machine is to prepare the desired hot beverage (coffee, tea, etc.) that will be drunk by the customer. Therefore, it is important that the beverage does not present any risk of contamination for him that could lead to complains, in the best case.

Manufacturers of vending machines dedicate particular attention to potential health to meet customers’ expectations and to comply with existing legislation. Indeed, the European Vending Association (EVA) has developed a guide for vending “The Essentials of Hygiene”, that describes the basic principles to
which a route filler must abide when dealing with a machine (how to clean one’s hands, how to handle
the cups, etc.). EVA has also developed guidance on “Food Safety Management For Vending”, to help
operators establish a HACCP (Hazard Analysis Critical Control Point) plan.

Operators should follow such documents and be trained.

10.1.2 Durability

Vending machines are most of the time owned by the operator who put it in companies, airports,
railway stations, etc. Operators also have maintenance contracts and shall ensure the proper
functioning of the machines. Thus, machines shall be designed to be solid and to be easily and quickly
repaired by the operator or the manufacturer. In this context, most of manufacturers use a modular
approach when designing their products.

In addition, the second hand market is quite popular for vending machines considering their purchase
price and that replacement may occur while the machine is still functioning, for various reasons:
change of operator, new models proposed by the operator, moving of the company, etc. In that case,
machines could be refurbished and used in other places, or sold to other operators (in or outside EU).

10.1.3 Conclusion for Ecodesign

Health and hygiene concerns are already addressed by the industry and we do not consider that
ecodesign could handle such aspect. However, if Ecodesign requirements are defined for this product
group, it will be important to ensure that they do not affect health requirements.

10.2 Policy coverage

This section is dedicated to the regulatory coverage of the product groups addressed, be it through
legislation, within the EU or in third countries, through voluntary agreements and environmental labels
or standards. The goal is to identify where Ecodesign or Energy Labelling regulations could have
added value beyond the existing legislation, and, in the case of third country legislation, whether there
is successful legislation that could serve as a model for Ecodesign or Energy Labelling legislation.

10.2.1 Overview of EU policies

Currently, free-standing hot beverage vending machines are regulated under the EU WEEE (category
10), RoHS and REACH.

Table 25: Main EU legislation applicable to the “Free-standing hot beverage vending
machines” product group

<table>
<thead>
<tr>
<th>Product group</th>
<th>WEEE</th>
<th>RoHS</th>
<th>REACH</th>
<th>EPBD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Free-standing hot beverage vending machines</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>-</td>
</tr>
</tbody>
</table>

Regarding health and hygiene issues, vending machines should comply with Regulation 852/2004 on
the hygiene of foodstuffs, and with Regulation 1935/2004 on food contact materials.
10.2.2 Selected Member States policies
No policies at Member State level could be identified.

10.2.3 Industry Self-Regulatory Initiative
As indicated in Task 3, EVA has developed an Energy Measurement Protocol (EVA EMP), which describes a uniform method to measure the energy consumption of vending machines. The latest version of EVA EMP is 3.0B (see more detailed in section 10.2.5), targeted at hot and hot & cold drinks machines. The EVA EMP 3.0B calculation sheet provides an energy labelling scale for tertiary hot beverage vending equipment.\(^{81}\)

10.2.4 Existing third country legislation and labels
It is worth mentioning the Japanese Top Runner programme. This programme is intended to improve energy efficiency of end-use products and to develop “world's most energy-efficient products”\(^{82}\), and vending machines are covered by specific minimum energy performance standards. This product group includes those for canned/bottled beverages, those for beverage in paper containers, and those for beverage served in cups (however compact table-top models used on tables are excluded). It is important to note that hot only machine are not in the scope, as only cold and cold/hot machines are considered (this is due to the fact that on the Japanese market, there are few hot beverage vending machines). The programme establishes a measurement method for energy consumption and a maximum energy consumption value (based on the hot water tank capacity).

Last version of the specifications of the Top Runner Programme was published in June 2007.

10.2.5 Test standards
Within the EVA EMP standard, the energy consumption is measured in stand-by situation and vending situation. In details, there are seven test phases:

- Machine Heat Up phase;
- Machine Idle phase;
- Machine Vending phase;
- Energy Saving Mode phase;
- Heat Up phase from Energy Saving Mode to Idle;
- Machine Idle phase – Cold drinks only; and
- Machine Vending phase – Cold drinks only.

The EVA-EMP is a self-declaration standard. EVA asks his members that use the EVA EMP standard to send him the test report.

In addition, as also mentioned in Task 3, A DIN standard exists for measuring of the energy use of commercial coffee machines, which is identical to the EFCEM Energy Efficiency Standard for Commercial Coffee Makers. It was not specifically developed for vending machines, and actually it seems that is not currently used for such products. In addition, even if applied to a same product,

\(^{81}\) EVA indicated that the scale is just a visual facility for people filling in the test and that E VA has never pretended to use this scale as an energy label.

\(^{82}\) [http://www.eccj.or.jp/top_runner/](http://www.eccj.or.jp/top_runner/)

results of measurements using both EVA EMP and DIN/EFCEM standard would not be comparable as the DIN/EFCEM standard is measuring energy losses, i.e. not considering energy required to produce the beverage.

10.2.6 Conclusion for Ecodesign

Regarding the energy consumption of free-standing hot beverage vending machines, no EU or Member State policy is tackling this issue.

The EU main industry association has already developed a measurement standard and an energy scale allowing benchmarking models. EVA considers that this voluntary initiative has been effective in driving the market into more energy efficient products.

10.3 Appropriateness of Ecodesign or Energy labelling

Whereas the “regulatory coverage” section addressed the question of current mandatory and voluntary instruments (are they enough to cover this specific product group?), the section on “relevance of Ecodesign requirements” will address the question of future regulation (would Ecodesign or Energy labelling adequately cover this specific product group?).

10.3.1 Excessive cost

The discussion about “excessive cost” shall follow a simplified Life-Cycle Cost analysis (LCC), to make sure that savings stemming from lower energy consumption exceed any increase in purchase price. In the case of free-standing hot vending machines, Table 26 below sums up the LCC performed.

Table 26: Detailed cost calculation for the “Free-standing hot beverage vending machine” product group

<table>
<thead>
<tr>
<th></th>
<th>Free-standing vending machine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average purchase price</td>
<td>4,500 €</td>
</tr>
<tr>
<td>Energy consumption / year</td>
<td>2,350 kWh</td>
</tr>
<tr>
<td>Lifetime</td>
<td>7.25 years</td>
</tr>
<tr>
<td>Average EU electricity price</td>
<td>0.12 €/kWh</td>
</tr>
<tr>
<td>(non-domestic)</td>
<td></td>
</tr>
<tr>
<td>Energy costs over lifetime</td>
<td>2,045 €</td>
</tr>
<tr>
<td>Energy savings potential in use phase</td>
<td>15%</td>
</tr>
<tr>
<td>Economic savings potential</td>
<td>307 €</td>
</tr>
<tr>
<td>Relation (economic savings / purchase price)</td>
<td>7%</td>
</tr>
</tbody>
</table>

As long the average sales price does not increase more than 7%, the average product life cycle is likely to remain cost-neutral.
It has to be noted that this product group may be subject in some cases to split incentives, i.e. when the purchaser of the equipment is not the user. It is a quite popular situation in the vending machines industry where the machine is leased or put into service for free in enterprises for example. In such case, the purchaser may be more interested in a low product price instead of a low life cycle cost as he will not have to pay the energy bill.

10.3.2 Suitability of Ecodesign measures or Energy labelling

EVA indicates that amongst European manufacturers, the difference in terms of environmental performance of models is limited what would not favour an Energy label scheme (considering that most of sales come from EU manufacturers). The relevance of the EVA energy scale, even if not presented as an energy labelling scheme, is however questionable if only marginal variations between models exist.

Even if challenged by EVA, improvement options are available (as claimed by some manufacturers) and are not proprietary technologies. However, no information allows indicating that such options could be implemented at affordable cost. As mentioned in Task 3, the Working Document related to ENER Lot 12 on refrigerated commercial display cabinets, including cold vending machines, includes requirements related to durability and end-of-life aspects (e.g. PCBs larger than 10 cm², LCD screens larger than 100 cm² and gas discharged lamps shall be easily identified, easily accessed, and extracted for recycling using only standard tools). As about half of manufacturers produce both cold and hot vending machines, we could suppose that such types of requirements could also be set for hot vending machines.

10.3.3 Conclusion for Ecodesign

- Energy labelling does not seem to be a suitable option due to a limited variety of energy consumption amongst models. The example of cold vending machines would indicate that ecodesign requirements could be developed for hot vending machines, not only in terms of energy efficiency but also to ease the repair and recycling of the product. Minimum energy performance standards may be appropriate to limit the split incentive issue.

10.4 Industrial competitiveness

10.4.1 Market structure

The European market is dominated by a lot of SMEs. EVA includes about 25 machine manufacturers and represents the majority of sales. The 6 biggest markets, for the vending machines industry as a whole, in Europe are Italy, France, United Kingdom, Germany, Spain and the Netherlands, which in total make up around 80% of the total European market.

10.4.2 Innovation and employment

EVA indicates that between 3,000 and 5,000 people are employed for the production of hot beverage vending machines in Europe. Innovation is a necessary to produce products meeting evolving customers’ expectations.

10.4.3 International competition

According to EVA, almost 100% of hot beverage vending machines sold in Europe are manufactured in Europe (plants principally located in Italy, Germany, the Netherlands, Spain, and the United Kingdom). In addition, EVA claims that European vending machines are much more energy efficient than foreign vending machines.

10.4.4 Conclusion for Ecodesign

Based on available information, any Ecodesign Regulation would mostly affect European manufacturers mainly made of SMEs. However, the EU industry seems to have already integrated environmental concerns in their design principles, e.g. as demonstrated by the EVA energy measurement protocol.

10.5 Product group summary and recommendations

Table 27 below presents a simplified scoring of the four main sections above, for the product group “Free-standing hot beverage vending machines”.

Table 27: Overall scoring of the "Free-standing hot beverage vending machine" product group

<table>
<thead>
<tr>
<th>Product group</th>
<th>Other environmental impacts</th>
<th>Policy gaps</th>
<th>Appropriateness of Ecodesign</th>
<th>Appropriateness of Energy labelling</th>
<th>Industrial competitiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Free-standing hot beverage vending machines</td>
<td>+</td>
<td>++</td>
<td>++</td>
<td>+</td>
<td>++</td>
</tr>
</tbody>
</table>

The more “+” there are in the assessment, the more favourable it is for Ecodesign or Energy Labelling Regulation to be implemented.

The following types of Ecodesign measures could in principle be envisaged for free-standing hot beverage vending machines:

- Minimum requirements on energy efficiency; and
- Requirements to ease the access, extract for repair and recycling of key components such as PCBs and LCD screens.

Energy labelling does not seem to be a relevant option due to limited variation between models in terms of energy consumption.
11. Gateways

11.1 Main other environmental issues

Gateways have been singled out from the “In-house networking equipment” product group analysed in Task 3. As a reminder, gateways are made up of at least a modem and a router, but they also tend to integrate a growing number of functionalities, including Ethernet switch, WiFi 802.11xx access point, VoIP, etc.

Table 28 below provides an overview of the relevant environmental aspects of the “gateways” product group, and possible improvement options linked to them. Energy consumption and material efficiency have been discussed in Task 3. Hence the table and the paragraphs below focus on the main other environmental impacts of the product group.

<table>
<thead>
<tr>
<th>Environmental issue categories</th>
<th>Scoring</th>
<th>Description of the environmental issue</th>
<th>Description of related improvement potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water consumption in use phase</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consumables (detergents, etc.)</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Presence of critical raw materials (see the EU list(^{84}))</td>
<td>++</td>
<td>Presence of critical raw materials at low concentration levels.</td>
<td>Non-halogenated flame retardants exist. A dedicated preparatory study would have to determine whether they can be used for gateways and would be environmentally preferable.</td>
</tr>
<tr>
<td>Presence of flame retardants (halogenated, etc.)</td>
<td>+</td>
<td>Halogenated flame retardants are used mainly in cables, PCBs and connectors.</td>
<td></td>
</tr>
<tr>
<td>Presence of plasticisers (phthalates)</td>
<td>+</td>
<td>The various cables of in home networking equipment (AC/DC power, phone line, Ethernet external jacketing, etc.) are using PVC with phthalates as plasticiser(^{85}).</td>
<td>Alternative solutions are available on the market, with comparable performance.</td>
</tr>
<tr>
<td>Presence of other toxic substances</td>
<td>0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


\(^{85}\) Digital Europe, stakeholder’s input to Task 4.
<table>
<thead>
<tr>
<th>Environmental issue categories</th>
<th>Scoring</th>
<th>Description of the environmental issue</th>
<th>Description of related improvement potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Presence of F-gases</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiation levels</td>
<td>+</td>
<td>Gateways generate limited electromagnetic fields.</td>
<td></td>
</tr>
<tr>
<td>Safety (fuel leakage, vibrations, etc.)</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health (hygiene, noise level, etc.)</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Durability (reusability, upgradability, reparability, etc.)</td>
<td>++</td>
<td>Even if they have an incentive to manufacture durable products, manufacturers of gateways also commit to a constant evolution of their products.</td>
<td>Software update does not always require a change in hardware.</td>
</tr>
<tr>
<td>End-of-life (recyclability, recycled content)</td>
<td>+++</td>
<td>Recyclability is an issue and could much probably be improved.</td>
<td>Manufacture easy-to-disassemble gateways and increase the recycling rate of electronic components.</td>
</tr>
<tr>
<td>Direct emissions to air</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct emissions to water</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct emissions to soil</td>
<td>0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Scoring: “0” if not an issue for the product group. If this is an issue, the indicative importance of the environmental issue is provided from + (low) to +++ (high).

11.1.1 Material efficiency

Material efficiency was partly covered in Task 3 – yet additional information, under the form of a case study, was deemed to be useful. Actually, very few Internet service providers do have information on environmental topics available on their website. One interesting case study to elaborate on, however, is the French “Neufbox Evolution” by SFR.

This specific home gateway was ecodesigned (following a life cycle analysis), and released in autumn 2010. Compared to the previous version, pretty much progress could be achieved, including:

- Cut in energy consumption (by 30% in use phase and 40% in idle mode). Moreover, the new gateway features three buttons to 1°) turn on the gateway into “eco-mode”; 2°) shut down the Wi-Fi functionality; and 3°) shut down the Neufbox (i.e. on/off button at the back of the device); and
- Cut in material use. The product’s size and weight have been reduced, as well as the number of components included in it (there were twice as many components in the previous version). The case itself is now made up of 261 grams of plastic instead of 448 (-42%). A similar ratio could be found for Fritz!Box 7270 manufactured by AVM and marketed by Telecom Italia: “the weight
of the plastic material used for the case has been reduced of 52% in comparison to a Telecom Italia product having similar functionalities.\(^{86}\)

Additional environmental-friendly features were included in the gateway – they are showcased in section 11.1.4. All in all, the carbon footprint of the Neufbox Evolution decreased from 55 kilograms of CO₂-equivalent to 36 kilograms (-35%). Energy consumption in use phase still accounts for most of the impact, i.e. 73%.\(^{87}\)

However anecdotal it may look, this example is believed to depict one trend of the evolution of gateways, to deliver boxes as compact as possible. This is not a general trend, but some Internet service providers do offer gateways of new generations with the same functionalities (or more) and a reduced environmental impact – the products are more compact, use fewer resources and less energy.\(^{85}\)

- The size of the case is minimized. This means a reduction of plastic material used for casing (and a lower product weight during transportation);
- The number and size of electronic cards are reduced. Indeed, the integration of components is improved constantly: the latest generation of Systems on Chip is embedding always more functionalities than the previous generation. This means a reduction of resource use among components;
- The size and thickness of the PCB are optimized, as the number of layers is increased; and
- Packaging material is reduced.

The market share of those manufacturers offering more environmentally-friendly gateways is not known.\(^{88}\) What is certain is that comparison is difficult from one generation to another: for instance, the French provider Free updated its older “Freebox V5” to a newer “Freebox Revolution”, which indeed is bigger and consumes more energy\(^{89}\) but offers many more functionalities.

11.1.2 Presence of critical raw materials

Although in low concentration, critical raw materials are present in gateways as in much ICT equipment. The most common materials to be found in assembled printed circuit boards include: Beryllium (Be), Gallium (Ga), Ruthenium (Ru), etc.\(^{90}\)

11.1.3 Durability

Attending that gateways are mainly leased to the customer, it is the interest of Internet service providers to enhance the durability of the devices.\(^{91}\) This incentive is absent of a classic business-to-consumer market, where gateways are sold by retailers (in shops or online).

\(^{86}\) Telecom Italia (2013), Information to customer for Fritz!Box 7270 manufactured by AVM. Environmental Declaration – Support documentation.
\(^{87}\) E. Delsol (2011), L’Usine Nouvelle n° 3252.
\(^{88}\) The German manufacturer AVM is yet a big player in the European gateway market, especially in Germany (http://en.avm.de/service/distributors/europe). According to Digital Europe, it was estimated that the Fritz!Box series had a market share of 68% of the digital subscriber line (DSL) consumer equipment in Germany in 2010.
\(^{89}\) According to tests that have been made in France – see: http://www.lesnumeriques.com/freebox-revolution-consommation-electrique-veille-lecture-n17476.html.
Based on after sales information, average lifetime of gateways is typically 4 years. Software update is most commonly done on a regular basis by Internet service providers, without any change of hardware required. However, as gateways are constantly evolving, it still pushes end-users to renew their equipment.

### 11.1.4 End-of-life

Gateways’ main components are electronic cards, plastic casing and various type of cables such as AC/DC power, Ethernet, phone line, etc. Depending on the complexity of the device, the weight ratio between the recyclable and non-recyclable material calculated by LCA tools is between 40% and 50%. However, as gateways are getting increasingly compact, the amount of plastics is constantly reduced and – as plastics is easier to recycle than electronics, the ratio of recyclability is decreasing over the years.

Building on the “Neufbox Evolution” case study, we can highlight the need for recyclability of the “gateways” product group. As a matter of fact, all components of this specific device have been made separable by SFR, so that they can be more easily recycled. This is one axis of ecodesign-thinking to think forward about the product’s end-of-life as soon as the conception phase. However, even this new “Neufbox” is not fully recyclable, but only 69% of it. To this extent, it is most likely that some room for improvement is left for gateways’ end-of-life.

This is further confirmed by the environmental declaration from Telecom Italia, for Fritz!Box 7270: “the product’s case is composed by 3 components and all connections between parts are implemented without screws and with adoption of snap fits, so that disassembling time has been reduced of 72.5% in comparison to a Telecom Italia product having similar functionalities”. Table 29 displays a detailed report of the performance test which has been carried out.

#### Table 29: Performance test report for two gateways offering similar functionalities

<table>
<thead>
<tr>
<th>Product</th>
<th>Case weight (g)</th>
<th>Number of screws</th>
<th>Disassembling time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alice Gate VoIP Plus 2 Wi-Fi</td>
<td>463</td>
<td>7</td>
<td>200</td>
</tr>
<tr>
<td>Fritz!Box 7270</td>
<td>224</td>
<td>0</td>
<td>55</td>
</tr>
<tr>
<td><strong>Reduction percentage</strong></td>
<td><strong>51.6%</strong></td>
<td><strong>100%</strong></td>
<td><strong>72.5%</strong></td>
</tr>
</tbody>
</table>

### 11.1.5 Conclusion for Ecodesign

Recyclability could be an issue further regulated under Ecodesign, beyond energy consumption. End-of-life is much probably the most prominent environmental concern among the “gateways” product group, after energy consumption. Requirements could be defined to ease the dismantling of gateways and extraction of key components with high residual value and/or significant environmental impacts (if not properly treated).

---

91 Interestingly, what is rather detrimental to energy efficiency (known as “split incentive” and described in section 11.3.1) is rather beneficial to durability.


93 Telecom Italia (2013), Information to customer for Fritz!Box 7270 manufactured by AVM. Environmental Declaration – Support documentation.
11.2 Policy coverage

11.2.1 Overview of EU policies
Currently, gateways are regulated under the WEEE and RoHS Directives and REACH Regulation. There are no GPP or EU Ecolabel criteria available for this product group.

<table>
<thead>
<tr>
<th>Table 30: Main EU legislation applicable to the “gateways” product group</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Product group</strong></td>
</tr>
<tr>
<td>Gateway</td>
</tr>
</tbody>
</table>

As was mentioned in Task 3, gateways are already subject to the Ecodesign Regulation 801/2013 on networked standby. As of 1st January 2017, their power consumption shall not exceed 8 Watts.

Electromagnetic radiation is regulated in the EMC Directive. Conformity is already demonstrated by the CE marking.

There does not seem to be any other major environmental legislation applying to gateways in Europe.

11.2.2 Selected Member States policies
Not any specific policy covering gateways could be identified in European Member States.

11.2.3 Industry Self-Regulatory Initiative
The European Code of Conduct on Energy Consumption of Broadband Equipment has been already mentioned and described in Task 3. Furthermore, its target values have been taken as a basis for assuming energy consumption from 2020 onwards.

The Code of Conduct (CoC) gathered the commitment from 19 service providers and manufacturers across the EU-27. However, their global market share within the European market remains unknown, and could not be retrieved from DG JRC. Obviously, the higher the market share, the less Ecodesign is needed (assuming the CoC sets out ambitious enough targets, what is generally considered to be the case by stakeholders). With a figure of typically 90% or above, this CoC could be considered as a kind of voluntary agreement.

11.2.4 Existing third country legislation and labels
Quite a few third country regulatory initiatives have been taken in third countries. However, all labels displayed below are to be opted in on a voluntary basis.

---

First of all, the Energy Star label for Small Network Equipment\(^{97}\) has been mentioned in Task 3. It is worth describing it further here, as it results from a two-step approach:

- A “Base Power Allowance” has been set for each product type, including gateways or Integrated Access Devices (IAD). The respective values can be found in Table 31; and

- “Additional Power Allowance” values have been set for selected additional functional adders (also in Table 31).

The sum of one base power allowance and one or more additional power allowance(s) give a final result for each product – and measured products that are below this result are awarded the Energy Star label. The test standard used is further described in section 11.2.5.

**Table 31: Power allowances in Energy Star label for small network equipment (version 1.0)**\(^{98}\)

<table>
<thead>
<tr>
<th>Product type</th>
<th>Power values (W)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Base power allowances</strong></td>
<td></td>
</tr>
<tr>
<td>IAD – Cable</td>
<td>6.1</td>
</tr>
<tr>
<td>IAD – ADSL</td>
<td>5.5</td>
</tr>
<tr>
<td>IAD – VDSL</td>
<td>7.1</td>
</tr>
<tr>
<td>Optical Network Termination Device (ONT)</td>
<td>4.4</td>
</tr>
<tr>
<td><strong>Additional power allowances</strong></td>
<td></td>
</tr>
<tr>
<td>Fast Ethernet</td>
<td>0.1</td>
</tr>
<tr>
<td>Gigabit Ethernet</td>
<td>0.3</td>
</tr>
<tr>
<td>Wi-Fi (802.11)</td>
<td>0.7</td>
</tr>
<tr>
<td>802.11n per Receive Spatial Stream</td>
<td>0.2</td>
</tr>
<tr>
<td>802.11ac per Receive Spatial Stream</td>
<td>1.3</td>
</tr>
<tr>
<td>Plain old telephone service</td>
<td>0.5</td>
</tr>
</tbody>
</table>

Other labels are present in Asia, namely:

- Energy Conservation Certification Rules for Broadband Customer Premises Equipment have been issued by the China Quality Certification Centre. They apply to broadband customer premises equipment, including home gateways. The label Endorsement is voluntary\(^{99}\);

- The Korea Energy Management Corporation (KEMCO) includes home gateways in its e-Standby Program. They are defined as: “Electronic products, with nameplate output power of power supply less than equal to 150W at LAN port when the maximum network traffic occur, that enable receiving external access networks, connecting home network equipment based on wire/wireless networks, converting protocols, controlling, monitoring, managing and providing

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\(^{98}\) Power values for modems, routers, switches and access points are not displayed. Source: [http://www.energystar.gov/sites/default/files/specs/SmallNetworkEquipment_V1_ENERGYSTAR_ProgramRequirements_Nov2013_0.pdf](http://www.energystar.gov/sites/default/files/specs/SmallNetworkEquipment_V1_ENERGYSTAR_ProgramRequirements_Nov2013_0.pdf).

other home network related services“100. Precise requirements are not known, but since standby is already tackled in Europe through Regulation 801/2013, they may not have to be developed here. Interesting in this Korean example is the introduction of some “warning” label: compliant gateways are entitled to the regular energy-efficiency label, whereas non-compliant products should bear a “Standby Power Warning Label” (see Figure 3). The KEMCO claims that “Korea is the first country to introduce such mandatory label in the world”; and

- Finally, Japan once set up requirements for routers and switches, which can be included in gateways. However, this specific label looks quite outdated, since the specifications make reference to shipment volume of year 2006101.

![Figure 3: Korean standby warning label (left side) and energy saving label (right side)](image)

### 11.2.5 Test standards

Energy Star developed a specific test method to test energy consumption of small network equipment, namely the “ENERGY STAR Test Method for Small Network Equipment”, revised in November 2013. Unfortunately, the test method is not publicly available102.

### 11.2.6 Conclusion for Ecodesign

Regulation 801/2013 on standby is certainly a first step to cap energy consumption of gateways. As we said in Task 3, “one key element to keep in mind is that the targets are not cumulative: hence gateways, which include at least modem and router functions, are subject to the same 8 W and 12 W thresholds than standalone devices. As there is a trend to integrate more and more functionalities into a single gateway beyond modem and router (like Ethernet switch, WiFi 802.11xx access point, VoIP, etc.), Regulation 801/2013 may finally give a real cap to energy consumption of in-house networking equipment.”

Moreover, the Code of Conduct is another means to limit energy consumption in use phase. However, the market share of participants remains unknown and may call for (mandatory) Ecodesign requirements. The US Energy Star for small network equipment could serve as one example to help setting such requirements.

### 11.3 Appropriateness of Ecodesign or Energy labelling

#### 11.3.1 Excessive cost

Internet boxes (gateways) are often set to the consumers’ disposal by the Internet service providers, either explicitly rent at a fixed price (3–5 € / month) or implicitly included in the subscription’s price.

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100 [http://www.kemco.or.kr/new_eng/pg02/pg020100300_2.asp](http://www.kemco.or.kr/new_eng/pg02/pg020100300_2.asp)
102 A one-page note of clarifications on this test method has been made public, but this does not bring much light to the method itself. See: [http://www.energystar.gov/sites/default/files/specs//SNE%20Test%20Method%20Clarification%20Memo.pdf](http://www.energystar.gov/sites/default/files/specs//SNE%20Test%20Method%20Clarification%20Memo.pdf)
This is also a reason why, according to the IEA, service providers, as they make bulk purchases and then deliver vast numbers of network-enabled devices, could take a lead role in bringing together the stakeholders that can influence energy consumption. The European CoC is a first step towards.

Gateways are specific in the sense that they are often leased to the customer by the Internet service provider, instead of bought. The Internet service provider remains the owner of the gateway, while the customer pays the electricity bill. This is a case of “split incentive”, which may result in a low consideration for energy consumption from manufacturers and/or service providers. A similar concern occurred for Complex Set Top Boxes (CSTB) and was highlighted by ENER Lot 18 Preparatory Study:

“The decision to buy a particular STB model is currently made by the service providers who purchase complex STB from appliance manufacturers. […] Purchasers of complex STB mainly focus on proposed functionalities and on the product price rather than on environmental characteristics (e.g. energy consumption, use of recycled materials, hazardous substances). It is a tricky situation for subscribers who can hardly take into consideration environmental aspects in their buying decision as the choice is very limited or null.”103

However, if we consider that the purchase price may be approached by the sum of monthly payments in leasing, an average price of 100 € might be assumed104. Table 32 below provides further information on the relation between economic savings as compared to purchase price.

Table 32: Detailed cost calculation for the “gateways” product group

<table>
<thead>
<tr>
<th>(Home) gateway</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Average purchase / leasing price</td>
<td>100 €</td>
</tr>
<tr>
<td>Energy consumption / year (classic / fibre)</td>
<td>53 / 77 kWh</td>
</tr>
<tr>
<td>Lifetime</td>
<td>4 years</td>
</tr>
<tr>
<td>Average EU electricity price (domestic)</td>
<td>0.2 € / kWh</td>
</tr>
<tr>
<td>Energy costs over lifetime</td>
<td>42.4 / 61.6 €</td>
</tr>
<tr>
<td>Energy savings potential in use phase (2020)</td>
<td>10%</td>
</tr>
<tr>
<td>Economic savings potential</td>
<td>4.2 / 6.2 €</td>
</tr>
<tr>
<td>Relation (economic savings / purchase price)</td>
<td>4 / 6%</td>
</tr>
</tbody>
</table>

As long the average sales price does not increase more than 4-6%, the average product life cycle is likely to remain cost-neutral. However, it is complicated to follow the same reasoning for the “gateways” product group as for the others, because gateways are subject to quick technological

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103 BIO Intelligence Service (2008), ENER Lot 18 Preparatory Study – Complex Set Top Boxes (CSTB).

104 On the French market, the Orange Livebox is rented for 3 € per month (what makes 144 € if used four years; however the Livebox is occasionally available for sale at the price of 79 € (http://boutique.orange.fr/doc/contrat3179.pdf). An average price of 100 € looks reasonable and was not challenged by stakeholders.
change anyway: Internet service providers offer frequent updates which do not result into higher prices.

11.3.2 Suitability of Ecodesign measures or Energy labelling

Home gateways have high sales in Europe today, and the stock of EU-27 is promised to increase (see Task 3). Action to cap energy consumption has been already taken: by the European Commission on the one hand (Regulation 801/2013 on standby mode) and by the industry on the other hand (Code of Conduct on Energy Consumption of Broadband Equipment). In this context, would Ecodesign or Energy labelling requirements be suitable for gateways?

Final customers, i.e. users of gateways, have a very limited choice of products – typically two or three per Internet service provider, with a relatively low number of Internet service providers in a single country. This situation may feed the following conclusions:

- Energy labelling may be not effective, at least at the beginning, since the range of products available is narrow. So far, power consumption (and non-energy related aspects even more so) are not perceived as a significant argument by the end user to create a differentiation between in home networking products. However, it can be argued that energy labelling would be an incentive for manufacturers to differentiate their products with competitors and within their own portfolios – a parallel may be drawn with TVs, even if the market structure is different, where the introduction of the energy labelling of TVs had a significant impact on the market.

- Ecodesign looks definitely appropriate (in case the CoC is not signed by the majority of manufacturers and/or does not set ambitious targets in terms of energy efficiency), since the “natural” market pressure for energy-efficient products is almost inexistent (energy savings for gateways, as well as other environmental improvements, will not stem from consumers’ demand). So one prominent rationale behind Ecodesign Regulation stems for the very business model of Internet service providers: since most of them lease their gateways to their customers, they do not have much incentive to make them more energy-efficient.

Additional requirements on recyclability may also be set. As explained in section 11.1.4., this would help to make the end-of-life of gateways better.

11.3.3 Conclusion for Ecodesign

At first sight, it seems that extended Ecodesign requirements (including recyclability) would make sense. The appropriateness of Energy labelling would need to be looked deeper into at the stage of the Preparatory Study.

11.4 Industrial competitiveness

11.4.1 Market structure

A major feature of the gateway market is that all devices are manufactured outside Europe, in Asian countries with low cost manpower. This does not speak for or against Ecodesign requirements, but it should be noted that the implementation of any Implementing Measures would require a strong collaboration between manufacturers and Internet service providers.

105 ECOS and EEB, stakeholder’s comments to Task 4
11.4.2 Innovation and employment

Regarding the product design and development, there are several models:

- Low end Home GateWays (HGW) are designed and developed in East Asia (e.g. Taiwan, India, China) based on specifications coming from European manufacturers;

- Middle range and high end HGW are designed and developed in East Asia (e.g. Taiwan, India, China), but the software development is made in Europe and in Asia, based on specifications coming from European manufacturers; and

- For innovative or/and complex products such as Media GW, the product design and product development are usually made in European manufacturer labs, knowing that EU manufacturer R&D labs in Asia may be also involved in the product development.

11.4.3 International competition

European companies are trying to keep all development tasks with a significant added value and know-how compared to the Asian competition. Development activities are kept in Europe as long as they are innovative and as long as their cost is not significantly higher than in Asia. This explains why some European companies have some of their labs in Asia. It is a way to keep existing know how without significant extra cost compared to Asian competition.

The other activities linked to business, such as marketing, sourcing, sale, distribution, after sale, are mainly located in Europe.

11.4.4 Conclusion for Ecodesign

The value chain of gateways is clearly split between a manufacturing Asia and a R&D Europe. Regulation of gateways under Ecodesign would “simply” mean that specifications handed over by European companies to their Asian counterparts would integrate Ecodesign requirements, i.e. manufacture gateways of lower energy consumption / better recyclability / etc.

11.5 Product group summary and recommendations

Table 33 below presents a simplified scoring of the four main sections above, for the product group “gateways”.

<table>
<thead>
<tr>
<th>Product group</th>
<th>Other environmental impacts</th>
<th>Policy gaps</th>
<th>Appropriateness of Ecodesign</th>
<th>Appropriateness of Energy labelling</th>
<th>Industrial competitiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gateways</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>+</td>
<td>++</td>
</tr>
</tbody>
</table>

The more “+” there are in the assessment, the more favourable it is for Ecodesign or Energy labelling Regulation to be implemented.

The ++ scoring on “Policy gaps” reflects the uncertainty about the Code of Conduct. Indeed, as the market share of participants in Europe is unknown, we cannot fully assess the completeness of policy coverage. The reasoning is that, if typically 90% or more of the market is covered by the CoC, Ecodesign requirements would be redundant (and scoring on “Policy gaps” then lowered to only +).

The following types of Ecodesign measures could in principle be envisaged for gateways:
• Minimum requirements on energy efficiency. A mandatory compliance with the CoC for Broadband Equipment would be an option\textsuperscript{106}; and

• Minimum requirements on recyclability.

Energy labelling does not look as promising as Ecodesign at first sight, but could eventually give an incentive to manufacturers and Internet service providers, so that they differentiate their products and market energy-efficient gateways.

12. Greenhouse covers

12.1 Main other environmental issues

Table 34 below provides an overview of relevant further environmental aspects of the “greenhouse covers” product group, and possible improvement options linked to them. Energy consumption has been discussed in Task 3. Hence the table and the paragraphs below focus on the main other environmental impacts of the product group.

**Table 34: Overview of relevant direct environmental issues and potential for improvement – Greenhouse covers**

<table>
<thead>
<tr>
<th>Environmental issue categories</th>
<th>Scoring</th>
<th>Description of the environmental issue</th>
<th>Description of related improvement potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water consumption in use phase</td>
<td>++</td>
<td>Water used for cleaning of greenhouse cover</td>
<td>None identified</td>
</tr>
<tr>
<td>Consumables (detergents, etc.)</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use of critical raw materials (see the EU list)</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Presence of flame retardants (halogenated, etc.)</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Presence of plasticisers (phthalates)</td>
<td>+</td>
<td>Some evidence that phthalates such as DEHP used in plastic covers may end up in food grown in greenhouse. Also DBP in PVC variants may negatively impact plants.</td>
<td>Less toxic, high-molecular-weight phthalates or other less harmful substances exist. A dedicated preparatory study would have to determine whether they can be used for concerned plastic greenhouse covers or if phthalate-free plastics can be used. Inform about presence of phthalates in different cover materials.</td>
</tr>
<tr>
<td>Presence of other toxic substances</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use of F-gases</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiation levels</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safety (fuel leakage, vibrations, etc.)</td>
<td>+</td>
<td>Glass greenhouses constitute cut risk when they break</td>
<td>Less dangerous glass variants exist, such as</td>
</tr>
</tbody>
</table>

---


108 [http://pubs.acs.org/doi/abs/10.1021/jf203502e](http://pubs.acs.org/doi/abs/10.1021/jf203502e)
### Environmental issue categories

<table>
<thead>
<tr>
<th>Environmental issue categories</th>
<th>Scoring</th>
<th>Description of the environmental issue</th>
<th>Description of related improvement potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health (hygiene, noise level, etc.)</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Durability (reusability, upgradability, reparability, etc.)</td>
<td>+++</td>
<td>Large differences in expected lifetime of different cover materials.</td>
<td>Improvement option lies in selecting the appropriate cover for the purpose.</td>
</tr>
<tr>
<td>End-of-life (recyclability, recycled content)</td>
<td>++</td>
<td>Depending on cover material, different homogenous materials need to be disposed of or used for other purposes: glass, acrylic, polycarbonate or polyethylene.</td>
<td>Selecting appropriate cover material and treatment option.</td>
</tr>
<tr>
<td>Direct emissions to air</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct emissions to water</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct emissions to soil</td>
<td>0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Scoring: “0” if not an issue for the product group. If this is an issue, the indicative importance of the environmental issue is provided from 1 (low) to 3 (high).

### 12.1.1 Water consumption in use phase

Greenhouses are typically cleaned with (warm) water. This is recommended twice a year, before and after winter.

No possible Ecodesign or Energy Labelling requirements have been identified.

### 12.1.2 Presence of plasticisers (phthalates)

Plastic based greenhouse covers may contain phthalates that can end up in grown plants and vegetables. In a study conducted at the Institute of Food and Biological Engineering at Zhejiang Gongshang University DEHP concentration in vegetables positively correlated with DEHP content of polytunnel cover and its thickness and negatively correlated with the height of the greenhouse and its age.109

According to Greenpeace corrugated PVC sheeting used for greenhouses may contain the phthalate DBP. They further explain that according to work undertaken by the Institute of Horticultural research in Wellesbourne, UK, as little as 200 picogram (1 picogram=10⁻¹² g) DBP per litre of air can kill plants.110

Less toxic, high-molecular-weight phthalates or other less harmful substances exist. A dedicated preparatory study would have to determine whether they can be used for concerned plastic greenhouse covers or if phthalate-free plastics can be used.

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Hazardous substances should generally be treated in respective regulations such as REACH.

12.1.3 Safety
Broken greenhouse glass cover constitutes a cut risk. Alternative glass variants, such as tempered glass are available, which break into less harmful smaller pieces.
This issue has not been considered further here.

12.1.4 Durability
Different cover materials have very different durability characteristics (see Task 3).
There may be a case for defining minimum durability requirements for certain greenhouse cover materials (e.g. polytunnels). However, in principle, cover materials have per se different expected lifetimes. The improvement option lies in identifying the most appropriate cover material for the purpose including consideration of its expected lifetime.
A possible Ecodesign or Energy Labelling measure would hence be the provision of such information.

12.1.5 End-of-life
Depending on cover material, different homogenous materials need to be disposed of or used for other purposes, e.g. glass, acrylic, polycarbonate or polyethylene.
Recycled materials may be used in greenhouse covers. The feasibility of prescribing recycled content would have to be assessed. Presumably this is most appropriate for those materials for which a functioning market for recycled materials exists. In that case, additional requirements may not be necessary.
Information on appropriate end-of-life treatment could increase recycling rates. However, no information on achieved recycling rates was available. Information on appropriate end-of-life treatment could be implemented together with other information requirements.

12.1.6 Conclusion for Ecodesign
For greenhouse cover materials their basic performance characteristics are of interest, e.g. insulation, light transmission, light diffusion, condensation, durability. As specific uses and climatic conditions may require particular materials, Ecodesign should not impose specific absolute requirements but rather facilitate decision making by users of such cover products. In addition to performance characteristic supplementary information could be provided such as on appropriate end-of-life treatment.

12.2 Policy coverage
This section is dedicated to the regulatory coverage of the product groups addressed, be it through legislation, within the EU or in third countries, through voluntary agreements and environmental labels or standards. The goal is to identify where Ecodesign or Energy Labelling regulations could have added value beyond the existing legislation, and, in the case of third country legislation, whether there is successful legislation that could serve as a model for Ecodesign or Energy Labelling legislation.

12.2.1 Overview of EU policies
Few “classic” Ecodesign related EU policies apply to greenhouse covers.
Table 35: Main EU legislation applicable to the “greenhouse covers” product group

<table>
<thead>
<tr>
<th>Product group</th>
<th>WEEE</th>
<th>RoHS</th>
<th>REACH</th>
<th>EPBD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greenhouse covers</td>
<td>-</td>
<td>-</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

**REACH Regulation** applies. Hence, hazardous substances such as certain phthalates are best regulated through this regulation. Presence and hazardousness of plasticisers would have to be assessed and checked for their current or planned inclusion in REACH.

The **EPBD Directive** applies to all buildings, where a “building means a roofed construction having walls, for which energy is used to condition the indoor climate”. This definition would apply to greenhouses. However, Member States implementing the Directive “may decide not to set or apply the requirements referred to … non-residential agricultural buildings with low energy demand and non-residential agricultural buildings which are in use by a sector covered by a national sectoral agreement on energy performance”. Hence, specific requirements may be in place in different Member States.

Further, “Member States shall take the necessary measures to ensure that minimum energy performance requirements are set for building elements that form part of the building envelope and that have a significant impact on the energy performance of the building envelope when they are replaced or retrofitted, with a view to achieving cost-optimal levels.”

Therefore, the EPBD Directive provides a framework for setting minimum energy performance requirements for greenhouse building elements. Focus is, however, the reference building in which a building element is used and not the characteristics of the material itself.

Also, implementation in Member States may vary.

The **Construction Products Regulation** (305/2011) defines conditions for the marketing of construction products and defines criteria for assessing the performance of such products. A construction product is defined as “any product or kit which is produced and placed on the market for incorporation in a permanent manner in construction works or parts thereof and the performance of which has an effect on the performance of the construction works with respect to the basic requirements for construction works.” The performance of a construction product describes “the performance related to the relevant essential characteristics, expressed by level or class, or in a description.” The regulation explicitly reference characteristics such as insulation, durability or the sustainable use of natural resources. Currently the Construction Products Regulation does not seem to be applied to greenhouse covers. However, there does not seem to be a reason why it could not.

### 12.2.2 Selected Member States policies

Given the provisions in the EPBD, Member States policies may be established with regard to greenhouses and their “building elements”. These have not yet been assessed here. A quick check of the German implementation reveals that greenhouses (and hence related building elements) have obviously been excluded from energy performance requirements. No indication of such implementation in other Member States was found.

Similarly for the Construction Product Regulation no indication of its application to greenhouse covers in Member States was found, though this could not be fully checked.
The Dutch Government has implemented an ambitious sector agreement with the Horticulture sector to address the energy efficiency of greenhouse in the Netherlands. However this concerns the whole operations and not cover materials in particular.

12.2.3 Industry Self-Regulatory Initiative
No applicable SRIs have been identified.

12.2.4 Existing third country legislation and labels
No third country legislation and labels have been identified.

12.2.5 Test standards
A range of test standards exists to measure basic performance characteristics of building materials, including parameters such as light transmission and insulation. Specific test standards for the concerned cover materials have not been identified.

12.2.6 Conclusion for Ecodesign
For information requirements on the basic performance characteristics of greenhouse cover materials the Construction Products Regulation and to a lesser degree the EPBD seem the most appropriate framework. Energy Labelling may be considered should greenhouse cover materials not be able to be adequately covered there.

12.3 Appropriateness of Ecodesign or Energy labelling
Whereas the “regulatory coverage” section addressed the question of current mandatory and voluntary instruments (are they enough to cover this specific product group?), the section on “Appropriateness of Ecodesign requirements” addresses the question of future regulation (would Ecodesign or Energy labelling adequately cover this specific product group?).

12.3.1 Excessive cost
Specific costs are not assessed as no specific technological improvements are suggested. Information requirements likely impose only minimal additional costs to manufacturers as these would relate to basic parameters that are anyway often communicated and similar across manufacturers, just often not according to the same standards.

Such information may help users of greenhouse cover materials to make the best choice for their purpose and also more easily consider total lifetime costs of each cover material considered.

12.3.2 Suitability of Ecodesign measures or Energy labelling
Setting minimum performance requirements for greenhouse covers may interfere with particular performance needs with regard to plants, certain growing conditions or adaptations to local climatic conditions. There may be some scope for the definition of strict requirements, e.g. on durability of plastic covers for polytunnels. However, this would likely also influence costs, which may be judged differently by different users. However, basic information requirements on energy performance related

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parameters of different cover materials could help consumer make informed choices. For greenhouse cover materials Energy labelling, together with specific information requirements may be the most appropriate approach.

Greenhouse covers fall under the scope of the Ecodesign Directive as their environmental performance can be assessed independently of the greenhouse structure:

In Art. 2(1), the Ecodesign directive defines ‘Energy-related product’, (a ‘product’) to mean “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;”

12.3.3 Conclusion for Ecodesign
Energy labelling is the more suitable approach.

12.4 Industrial competitiveness

12.4.1 Market structure
Greenhouse cover materials are sold by manufacturers of greenhouses. Hence, they may not only be available on the market individually but purchased together with the greenhouse structure. A large number of manufacturers and construction companies, often established locally, are on the market. Also, these would often specialise on specific greenhouse types and materials.

12.4.2 Innovation and employment
Energy labelling would likely not lead to significant technological innovations and implications for jobs but rather raise awareness for energy use of greenhouses and related relevant characteristics.

12.4.3 International competition
Given the diversified market structure and local markets, no effect on international competition is expected.

12.4.4 Conclusion for Ecodesign
Energy labelling could reduce information asymmetries in the market and provide a level playing field for the just comparison of different greenhouse cover materials.

12.5 Product group summary and recommendations
Table 36 presents a simplified scoring of the three main sections above, for the product group “Greenhouse covers”.
Table 36: Overall scoring of the "Greenhouse covers" product group

<table>
<thead>
<tr>
<th>Product group</th>
<th>Other environmental impacts</th>
<th>Policy gaps</th>
<th>Appropriateness of Ecodesign</th>
<th>Appropriateness of Energy labelling</th>
<th>Industrial competitiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greenhouse covers</td>
<td>++</td>
<td>+</td>
<td>+</td>
<td>+++</td>
<td>++</td>
</tr>
</tbody>
</table>

The more “+” there are in the assessment, the more favourable it is for Ecodesign Regulation or Energy labelling to be implemented.

All in all Energy labelling would be a suitable approach for addressing energy related performance characteristics of greenhouse cover materials. However, before Energy labelling is considered it should be attempted to include information requirements on greenhouse cover materials in the more appropriate Construction Products Regulation (and to a lesser degree the EPBD).

Should Construction Product Regulation not be sufficiently applicable or applied in individual Member States, there is a case for introducing basic information requirements as part of Energy labelling on the following characteristics:

- U-values;
- Light transmission;
- Light diffusion;
- Durability; and
- Life cycle costs.
13. Hair dryers

13.1 Main other environmental issues

Table 37 below provides an overview of the relevant environmental aspects of the “hair dryers” product group, and possible improvement options linked to them. Energy consumption and material efficiency have been discussed in Task 3. Hence the table and the paragraphs below focus on the main other environmental impacts of the product group.

**Table 37: Overview of relevant direct environmental issues and potential for improvement – Hair dryers**

<table>
<thead>
<tr>
<th>Environmental issue categories</th>
<th>Scoring</th>
<th>Description of the environmental issue</th>
<th>Description of related improvement potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water consumption in use phase</td>
<td>0</td>
<td>Antimony, beryllium, might be used in small quantities in electronic components. Cobalt and chromium are present in metal alloys of the product parts. Overall quantities are small.</td>
<td>For the heating element, Titanium Beta Alloy and Nickel- Molybdenum Alloy are available as alternative materials that do not include critical raw materials. However, Titanium Beta Alloy is very costly and Nickel Molybdenum Alloy does not withstand temperature as well.</td>
</tr>
<tr>
<td>Consumables (detergents, etc.)</td>
<td>0</td>
<td>Flame retardants are present for safety reasons; the exact nature of these is not known.</td>
<td>Possible to exclude halogenated flame retardants and use alternatives. Some hair dryers comply with Blue Angel requirements. Impact on product costs would need to be looked into.</td>
</tr>
<tr>
<td>Presence of critical raw materials (see the EU list(^{112}))</td>
<td>+</td>
<td>Plasticizers are present in cabling (e.g. power cords)</td>
<td>Less toxic, high-molecular-weight phthalates or other less harmful substances exist. A dedicated</td>
</tr>
</tbody>
</table>


\(^{113}\) CECED, stakeholder’s input to Task 4.


\(^{115}\) Stakeholder’s input to Task 4 (anonymized).
<table>
<thead>
<tr>
<th>Environmental issue categories</th>
<th>Scoring</th>
<th>Description of the environmental issue</th>
<th>Description of related improvement potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Presence of other toxic substances</td>
<td>0</td>
<td></td>
<td>preparatory study would have to determine whether they can be used for hair dryers or if phthalate-free plastics can be used and be environmentally preferable.</td>
</tr>
<tr>
<td>Presence of F-gases</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiation levels</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safety (fuel leakage, vibrations, etc.)</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health (hygiene, noise level, etc.)</td>
<td>++</td>
<td>High noise level could be a drawback or even an issue as the hair dryer is used close to ears.</td>
<td>Some hair dryers on the market already achieve better noise performance.</td>
</tr>
<tr>
<td>Durability (reusability, upgradability, reparability, etc.)</td>
<td>++</td>
<td>Considering the low price of usual hair dryers, when broken down customers may prefer to buy a new model rather than repairing it.</td>
<td>Durability requirements similar to those adopted for vacuum cleaners could be explored.</td>
</tr>
<tr>
<td>End-of-life (recyclability, recycled content)</td>
<td>+</td>
<td></td>
<td>The marking of plastics used in large parts (perhaps those that weigh over 25 g) could be feasible here. This is likely to make recycling easier.</td>
</tr>
<tr>
<td>Direct emissions to air</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct emissions to water</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct emissions to soil</td>
<td>0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Scoring: “0” if not an issue for the product group. If this is an issue, the indicative importance of the environmental issue is provided from + (low) to +++ (high).

### 13.1.1 Noise

A particular health impact which could occur during the use phase of the hair dryer is noise.

The noise volume of a hair dryer can negatively impact the health of the user, since it is used quite close to the ear. Some hair dryers can have a noise level of above 85 or 90 decibels (dB), which classify them in the “very loud” noise category (according to the American Speech-Language-Hearing Association)\(^{116}\). The Oeko-Institut study\(^{117}\) found that noise emissions of hair dryers can be well above


85 decibel, even if 50-60% of the products tested emit less than 85 dB. Noise is a criteria taken into account in the awarding of the German Blue Angel label: the maximum noise emission for a product to be awarded the Blue Angel label is 80 dB, a value below which 35-50% of products fall.

13.1.2 Durability
Within the German Blue Angel for hair dryers (see section 13.2.2), one of the requirements is that the manufacturer offers a warranty of at least two years. This echoes the Directive on certain aspects of the sale of consumer goods and associated guarantees, according to which “in the case of a lack of conformity, the consumer shall be entitled to have the goods brought into conformity free of charge by repair or replacement […], or to have an appropriate reduction made in the price or the contract rescinded with regard to those goods […], within two years as from delivery of the goods”118.

In Task 3 report, the assumed lifetime of hair dryers was 4 years. This is being confirmed by one manufacturer, which states that “from our research, usage is already 3.9 years for consumer hair dryers (n=7,646)”. It is not said and known to which extent this 4-year lifetime could be improved; yet anyway, this average lifetime conceals the issue of early failures. Early failures are difficult to track, but they introduce the concern that, considering the low price of usual hair dryers, when broken down customers might prefer to buy a new model rather than repair it.

And finally, reference may be made to the Regulation on vacuum cleaners, which introduces durability aspects. Indeed, as of 1 September 2017, not only the annual energy consumption of vacuum cleaners is capped, but also the following requirements are set119:

- The hose, if any, shall be durable so that it is still useable after 40,000 oscillations under strain;
- Operational motor lifetime shall be greater than or equal to 500 hours.

A dedicated Preparatory Study could focus on those aspects and see how they could be extended to hair dryers.

13.1.3 Conclusion for Ecodesign
Improvement potential is present for noise, use of flame retardants, and maybe durability. Ecodesign requirements for noise are rather straightforward to implement120. With respect to the other issues, it remains to be decided whether a substitution is feasible or can be reasonably expected from manufacturers, and whether Ecodesign or RoHS / REACH would be the appropriate instrument121.

13.2 Policy coverage
This section is dedicated to the regulatory coverage of the product groups addressed, be it through legislation, within the EU or in third countries, through voluntary agreements and environmental labels or standards. The goal is to identify where Ecodesign or Energy Labelling regulations could have

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120 Here, “rather straightforward” is meant as compared to requirements on material efficiency for instance, or disassembly time, etc. On the contrary, there are test standards for noise as for energy efficiency, and Ecodesign requirements could be based on those.
121 For further information, see generic section on RoHS and REACH in Task 2 supplementary report on resources.
added value beyond the existing legislation, and, in the case of third country legislation, whether there is successful legislation that could serve as a model for Ecodesign or Energy Labelling legislation.

### 13.2.1 Overview of EU policies

Currently, hair dryers are regulated under the EU WEEE, RoHS and REACH.

**Table 38: Main EU legislation applicable to the “hair dryers” product group**

<table>
<thead>
<tr>
<th>Product group</th>
<th>WEEE</th>
<th>RoHS</th>
<th>REACH</th>
<th>EPBD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hair dryers</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>-</td>
</tr>
</tbody>
</table>

### 13.2.2 Selected Member States policies

The following section is dedicated to Member States policies which are in place inside the EU and of which the following table gives an overview.

**Table 39: Environmental labels at Member States level**

<table>
<thead>
<tr>
<th>Product group</th>
<th>RAL-UZ 175</th>
<th>-</th>
<th>-</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hair dryer</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The only label which could be identified to certify hair dryers” is the German Blue Angel label. The criteria for the award of the Blue Angel label for hair dryers date from August 2012\(^\text{122}\).

Table 40 shows an extract of the requirements hair dryers have to comply with in order to obtain the Blue Angel label. However, the requirements listed here below are not exhaustive and there exist still various other demands.

**Table 40: Requirements of Blue Angel label with respect to hair dryers\(^\text{122}\)**

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Hair dryer</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Energy consumption</strong></td>
<td>5.2 Wh/(g/min)</td>
</tr>
<tr>
<td><strong>Noise emissions (max. dB)</strong></td>
<td>80</td>
</tr>
<tr>
<td><strong>Material of touchable surfaces</strong></td>
<td>Compliance with REACH and other regulations. Ban</td>
</tr>
<tr>
<td><strong>Safety</strong></td>
<td>Compliance with requirements for GS(^\text{123})</td>
</tr>
<tr>
<td><strong>Endurance test (hours of operation)</strong></td>
<td>200</td>
</tr>
</tbody>
</table>

---

\(^{122}\) Blue Angel (2012), Vergabegrundlage für Umweltzeichen, Haartrockner RAL-UZ 175.

\(^{123}\) GS (Geprüfte Sicherheit, "Tested Safety") is a voluntary German certification mark for technical equipment.

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Hair dryer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warranty (min. in years)</td>
<td>2</td>
</tr>
</tbody>
</table>

So far, three hair dryers were awarded the Blue Angel label, namely the Silvercrest Haartrockner SHTR 2200 A1 by Lidl, the Relax comfort and Relax comfort Touch hair dryers by Savoir Vivre International\textsuperscript{124}.

13.2.3 Industry Self-Regulatory Initiative
No relevant SRI could be identified.

13.2.4 Existing third country legislation and labels
“Hand-held hair dryers” are one of the product groups for which criteria have been developed by the Environmental Protection Administration of Taiwan. The current version, revised in January 2013, sets out requirements on:

- Energy efficiency;
- Maximum content of some hazardous substances for plastic components over 25g: cadmium, lead, chromium, mercury, PBB, PBDE, i.e. the six substances of the RoHS Directive, with chloroparaffins in addition;
- Disassemblability;
- Noise emissions; and
- Electromagnetic interference\textsuperscript{125}.

The implementation of environmental criteria for hand-held hair dryers took place in 2001 and the latest version of the requirements was defined in January 2013.

13.2.5 Test standards
What is currently measured in order to assess energy efficiency is the drying rate per minute. In standard IEC 61855:2003, “Household electrical hair care appliances”, the drying rate is defined thanks to the formula $DR = M_1 - M_2$, where $M_1$ is the amount of water before drying and $M_2$ the amount of water after one minute of drying and five seconds of waiting\textsuperscript{126}. The Blue Angel also names the DIN EN 61855 norm to assess drying rate.

As such, there is not any exhaustive test standard to assess energy efficiency – there is only a drying rate test that, for instance, does not include any measurement of the styling capabilities of a hair dryer. This is one of the critics addressed to the IEC 61855:2003 test standard. Additionally, the drying rate test uses a large sheet of soaked cotton with the hairdryer held in the same place for one minute and this, some stakeholders say, clearly does not replicate use: a large sheet of cotton acts very differently to a tress of hair. A hairdryer is not held in the same place for a minute, but rather moved around with respect to the hair it is drying and styling\textsuperscript{127}.

\textsuperscript{124} [http://www.blauer-engel.de/produktwelt/haushalt-wohnen/haartrockner](http://www.blauer-engel.de/produktwelt/haushalt-wohnen/haartrockner)
\textsuperscript{127} Stakeholder’s input to Task 4, anonymised.
However, technical discrepancies have been noted by stakeholders, which are presented through the next three points:

- IEC 61855 mandates that the position of the hair dryer is such that the temperature at the cloth is 75 °C. There seems to be no reason why this temperature should have been chosen – there are no references in IEC 61855, nor does this temperature reflect normal usage;
- The use of a fixed drying time of 1 minute is an issue if the hair dryer dries in less time. The drying time will be underestimated as the hair dryer will simply be blowing hot air at an already dry piece of cloth; and
- The ring holding the cloth is much bigger that the output of a hair dryer, so the hair dryer will dry the small area within it that covers its output area. However water in the cloth outside this drying area will wick into the drying area and act as an ill-defined sink of water feeding the drying area.

According to stakeholders, this would call for the development of a brand new standard.

Standards for noise also exist, namely the EN 60704 standard for “Household and similar electrical appliances – Test code for the determination of airborne acoustical noise”. Even if the standard is not publicly available, the Blue Angel states that the three first parts must be used to assess noise, and namely:

- EN 60704 – 1: General requirements;
- EN 60704 – 2-9: Specific requirements for hair dryers; and
- EN 60704 – 3: Control and verification method of obtained values.

**13.2.6 Conclusion for Ecodesign**

Energy efficiency is not regulated so far, to the exception of the Blue Angel voluntary label. Besides, there may be room to regulate noise levels. For both topics (energy efficiency and noise), test standards are available, even if criticized by stakeholders. And finally, there might be some room for improvement beyond RoHS and REACH with respect to halogenated flame retardants (also as they are a criterion in the Blue Angel).

**13.3 Appropriateness of Ecodesign or Energy labelling**

**13.3.1 Excessive cost**

The discussion about “excessive cost” shall follow a simplified Life-Cycle Cost analysis (LCC), to make sure that savings stemming from lower energy consumption exceed any increase in purchase price. In the case of hair dryers, Table 41 below sums up the LCC performed.

For hair dryers, an average price is provided in the Oeko-Institut study. Depending on models and manufacturers, the average sale price for hair dryers ranges between 15 € and 80 €, with most models not exceeding 50 €. The study takes on an average price of 41 €, which is the (simple) average price in Germany in 2010 for 46 products on the market. It seems that this price has been averaged over model numbers, rather than volume of sales and, according to some stakeholders, this 41 € may be underestimated. It is, however, the most reliable data we can rely on.

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Yet it is difficult to get reliable prices for Best Available Technology (BAT) hair dryers: the two hair dryers mentioned on the Blue Angel webpage are the “Silvercrest Haartrockner SHTR 2200 A1” by Lidl, which costs 9.99 €\(^{129}\), and the “Relax comfort Haartrockner” by Savoir Vivre International, which costs 89 €\(^{130}\). It turns out that improvement options for hair dryers, in terms of energy efficiency, do not present excessive cost.

### Table 41: Detailed cost calculation for the “hair dryer” product group

<table>
<thead>
<tr>
<th></th>
<th>Hair dryer</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Average purchase price</strong></td>
<td>41 €</td>
</tr>
<tr>
<td><strong>Energy consumption / year</strong></td>
<td>40 / 55 / 70 kWh(^{131})</td>
</tr>
<tr>
<td><strong>Lifetime</strong></td>
<td>4 years</td>
</tr>
<tr>
<td><strong>Average EU electricity price (domestic)</strong></td>
<td>0.2 € / kWh</td>
</tr>
<tr>
<td><strong>Energy costs over lifetime</strong></td>
<td>32 / 44 / 56 €</td>
</tr>
<tr>
<td><strong>Energy savings potential in use phase</strong></td>
<td>30 %</td>
</tr>
<tr>
<td><strong>Economic savings potential</strong></td>
<td>9.6 / 13.2 / 16.8 €</td>
</tr>
<tr>
<td><strong>Relation (economic savings / purchase price)</strong></td>
<td>23 / 32 / 41 %</td>
</tr>
</tbody>
</table>

The relation between economic savings and purchase price is balanced, depending on the assumption taken for yearly energy consumption. It is always positive, however, meaning that as long the average sales price does not increase more than 23 to 41%, the average product life cycle is likely to remain cost-neutral.

Some stakeholders claim that the improvements needed to reach the 30% savings may be more costly than the economic savings they imply, but none of them could provide robust evidence of this.

### 13.3.2 Suitability of Ecodesign measures or Energy labelling

There seems to be no major hindrance to the implementation of Ecodesign requirements to the “hair dryers” product group. Indeed, the following characteristics of the product group make it pretty suitable for Regulation:

- Mass market products;
- Slow technical evolution (as compared to ICT products for instance);
- There is room for improvement potential regarding both energy and noise efficiency (see Task 3 report and above);
- Standards and labelling criteria have been developed (even if criticized); and
- Products are rather homogenous, also between EU Member States. This means that hair dryers’ size, weight, power, and even design is not that different from one model to another – for

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\(^{129}\) https://shop.relax-comfort.com/relax-comfort-white.html

\(^{130}\) Those three different values refer to the three different assumptions for energy consumption at individual product level, as displayed in Task 3 (Low / Medium / High Range).
instance the Regulation on motors encompasses a far wider range of products, as rated output may be between 0.75 kW and 375 kW, the number of poles from 2 to six, etc.\(^{132}\)

The question whether Ecodesign would be better than Energy labelling, or the opposite, or complementary may be discussed here. Both options look possible at first sight. Energy labelling is feasible since we face a business-to-consumer configuration, with probably a sufficient differentiation in energy efficiency across the whole product group\(^{133}\).

It would remain to be seen if Energy labelling would be enough to drive the market of hair dryers towards a significantly enhanced energy performance. And finally, it is up to the Commission to decide whether minimal requirements should apply to all products or if manufacturers should be able to decide between a A to G scale of energy classes.

13.3.3 Conclusion for Ecodesign
Both Ecodesign and Energy labelling would be appropriate for hair dryers. A Preparatory Study would/should help to decide which kind of Regulation would be more effective and make an accurate estimate of environmental benefits.

13.4 Industrial competitiveness

13.4.1 Market structure
The market for hair dryers is highly competitive, with many manufacturers competing for bigger market shares. In that sense, competition in this product category is fierce and regulation under the Ecodesign Directive may not result in a big increase in prices.

13.4.2 Innovation and employment
Dealing with innovation, it should be noted that product differentiation already exists on the hair dryers market, what would mean that diverse “fields” are available for innovation (high versus low power, design versus basic, high end versus low end, ionic and ceramic dryers). According to one stakeholder, big technical breakthroughs have been made in the hair dryer realm in recent years\(^{115}\).

13.4.3 International competition
It is not known exactly which share of hair dryer manufacturing takes place within the EU, yet eight times more hair dryers got imported than exported by the EU-27 in 2012, while also the amount of exports was negligible. Suppliers from all over the world, when exporting to the EU, would have to comply with the proposed legislation. Hence theoretically, at least in the early stages, following the adoption of Implementing Measures and assuming robust market surveillance, European producers might have a considerable advantage if they are better prepared for product and process innovations than their international competition.


\(^{133}\) Tests conducted by the Blue Angel in the framework of criteria development for hair dryers showed a 55% gap in energy consumption between the best and the worse devices tested (n=10). This figure should be carefully regarded, as the test standard used was IEC 61855, which is being criticized.
13.4.4 Conclusion for Ecodesign

At first sight, industrial competitiveness of European manufacturers of hair dryers would not be damaged by the implementation of Ecodesign or Energy labelling measures.

13.5 Product group summary and recommendations

Table 42 below presents a simplified scoring of the three main sections above, for the product group "hair dryers".

Table 42: Overall scoring of the "hair dryers" product group

<table>
<thead>
<tr>
<th>Product group</th>
<th>Other environmental impacts</th>
<th>Policy gaps</th>
<th>Appropriateness of Ecodesign</th>
<th>Appropriateness of Energy labelling</th>
<th>Industrial competitiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hair dryers</td>
<td>+</td>
<td>++</td>
<td>+++</td>
<td>+++</td>
<td>++</td>
</tr>
</tbody>
</table>

The more "+" there are in the assessment, the more favourable it is for Ecodesign or Energy labelling Regulation to be implemented.

The following types of Ecodesign measures could in principle be envisaged for hair dryers:

- Minimum requirements on energy efficiency; and
- Minimum requirements on noise levels.

In addition, Energy Labelling may be an interesting option to explore for this product group.
14. Hand dryers

14.1 Main other environmental issues

Table 43 below provides an overview of the relevant environmental aspects of the “hand dryers” product group, and possible improvement options linked to them. The table and the paragraphs below focus on the main other environmental impacts of the product group.

NOTE: It is being claimed by stakeholders “that the scope of any Ecodesign requirement should be extended beyond hand dryers to include paper towels – the most common way of hand drying and the method with the biggest environmental impact”\(^{134}\). However, we must clearly state now that the scope of Ecodesign is only Energy-related Products and cannot be extended to any “drying hand method”. The comparison of electric hand dryers and paper towels is definitely not the purpose of this Ecodesign Working Plan study.

Table 43: Overview of relevant direct environmental issues and potential for improvement – Hand dryers

<table>
<thead>
<tr>
<th>Environmental issue categories</th>
<th>Scoring</th>
<th>Description of the environmental issue</th>
<th>Description of related improvement potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water consumption in use phase</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consumables (detergents, etc.)</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Presence of critical raw materials (see the EU list(^{135}))</td>
<td>+</td>
<td>As in all EEE, some CRM might be present.</td>
<td>Non-halogenated flame retardants exist. A dedicated preparatory study would have to determine whether they can be used for hand dryers and would be environmentally preferable.</td>
</tr>
<tr>
<td>Presence of flame retardants (halogenated, etc.)</td>
<td>+</td>
<td>As in all EEE, some flame retardants might be present.</td>
<td>Less toxic, high-molecular-weight phthalates or other less harmful substances exist. A dedicated preparatory study would have to determine whether they can be used for hand dryers or if phthalate-free plastics can be used and be</td>
</tr>
<tr>
<td>Presence of plasticisers (phthalates)</td>
<td>+</td>
<td>As in all EEE, some plasticisers might be present.</td>
<td></td>
</tr>
</tbody>
</table>

\(^{134}\) Dyson, stakeholder’s comment to Task 4.

### Environmental issue categories

<table>
<thead>
<tr>
<th>Scoring</th>
<th>Description of the environmental issue</th>
<th>Description of related improvement potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Presence of other toxic substances</td>
<td>0</td>
<td>environmentally preferable.</td>
</tr>
<tr>
<td>Presence of F-gases</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Radiation levels</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Safety (fuel leakage, vibrations, etc.)</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Health (hygiene, noise level, etc.)</td>
<td>++</td>
<td>Noise and hygiene may be an issue.</td>
</tr>
<tr>
<td>Durability (reusability, upgradability, reparability, etc.)</td>
<td>++</td>
<td>Durability may be an issue.</td>
</tr>
<tr>
<td>End-of-life (recyclability, recycled content)</td>
<td>+</td>
<td>Hand dryers are mainly made of aluminium, steel and/or plastics (see Task 3), i.e. materials that can be recycled.</td>
</tr>
<tr>
<td>Direct emissions to air</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Direct emissions to water</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Direct emissions to soil</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

Scoring: “0” if not an issue for the product group. If this is an issue, the indicative importance of the environmental issue is provided from + (low) to +++ (high).

The main reference studies for environmental impacts of hand dryers are the two following life cycle assessments (LCAs): the Quantis study from 2009\(^{136}\) which was commissioned by Excel Dryer, and the MIT assessment from 2011\(^{137}\) which was commissioned by Dyson.

The main differences in assumptions in the hand dryer studies are summarized in the following table.

### Table 44: Major assumptions used in the two LCAs of hand dryers\(^{136,137}\)

<table>
<thead>
<tr>
<th>Assumption</th>
<th>Quantis study</th>
<th>MIT study</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hand dryer system(s) analysed</td>
<td>Dyson - Airblade, aluminium</td>
<td>Excel Dryer – XLERATOR</td>
</tr>
<tr>
<td></td>
<td>Dyson - Airblade, plastic</td>
<td>Standard warm air dryer</td>
</tr>
<tr>
<td></td>
<td>Standard warm air dryer</td>
<td></td>
</tr>
<tr>
<td>Functional unit (in number of pairs of hands)</td>
<td>1</td>
<td>260,000</td>
</tr>
</tbody>
</table>


Table 45: Noise levels comparison (between manufacturer’s statement and study’s measurement)

<table>
<thead>
<tr>
<th>Hand dryer model</th>
<th>Manufacturer’s statement</th>
<th>Study’s measurement – without hands introduced</th>
<th>Study’s measurement – with hands introduced</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Standard) warm air hand dryer</td>
<td>73-75 dB</td>
<td>82 dB (+11%)</td>
<td>82 dB (+11%)</td>
</tr>
<tr>
<td>Xlerator (Excel Dryer)</td>
<td>78-80 dB</td>
<td>83 dB (+5%)</td>
<td>103 dB (+30%)</td>
</tr>
<tr>
<td>Airblade (Dyson)</td>
<td>84 dB</td>
<td>87 dB (+4%)</td>
<td>90 dB (+7%)</td>
</tr>
</tbody>
</table>

Although interesting as such, the results of the LCAs performed all came down to this conclusion that environmental impacts from hand dryers mostly occurred in use phase and are linked to energy consumption. For instance, (indirect) water consumption is due to electricity generation, for which water is used – and water used during manufacturing process and cooling account only for a smaller share of total water consumption over the lifecycle. It has been calculated that 41,229 litres of water are consumed by a jet air hand dryer throughout its life cycle (corresponding to 77% of the overall water consumption), and 126,883 litres of water are consumed by a warm air hand dryer throughout its life cycle (corresponding to 92% of the overall water consumption)\textsuperscript{136}. Water is just one example that environmental impacts of hand dryers mainly occur through use phase, but the same holds true for emissions to air or emissions to water for instance.

14.1.1 Noise

Even if used for a short time, hand dryers can have a high noise volume. NSF Protocol P335 for Hygienic Commercial Hand Dryers includes requirements related to noise levels: “Any continuous noise, measured at a distance of one meter directly in front of the system, shall not exceed 90 dBA. Any periodic noise associated with unit operations shall not exceed 100 dBA.”\textsuperscript{138} Even if the Dyson Airblade was the first to receive NSF Certification to P335, numerous people have noted that new hand dryers are significantly louder than the older, less energy efficient models\textsuperscript{139}.

This was confirmed by another study entitled “Noise from Energy Efficient Hand Dryers: Is this Progress?\textsuperscript{140}”, which was focussing solely on the noise levels of hand dryers and which was contradicting manufacturers’ statements (Table 45).


\textsuperscript{140} Fullerton, J. L. and Unger, G. (2010). Acoustics of energy efficient hand dryers: Is this progress? Journal of the Acoustical Society of America. 127, 1833, \url{http://dx.doi.org/10.1121/1.3384273}
be noted that within a 2-meter distance, any noise level is higher than 80 dB. Table 46 below summarizes the results of the study.

Table 46: Noise levels of jet air hand dryers in laboratory experiment and public washroom

<table>
<thead>
<tr>
<th>Distance to hand dryer (in m)</th>
<th>Noise level (in dB) – Laboratory experiment</th>
<th>Noise level (in dB) – Public washroom</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>94.1</td>
<td>-</td>
</tr>
<tr>
<td>1.0</td>
<td>87.4</td>
<td>-</td>
</tr>
<tr>
<td>2.0</td>
<td>86.3</td>
<td>83.6 for one hand dryer</td>
</tr>
<tr>
<td></td>
<td></td>
<td>92.0 for two hand dryers</td>
</tr>
<tr>
<td>10.0</td>
<td>-</td>
<td>77.9</td>
</tr>
</tbody>
</table>

There are technical improvement options with respect to the noise level of hand dryers, as Dyson showed with its Dyson Airblade dB hand dryer, which is, according to the manufacturer, 50% quieter than the original Dyson Airblade. In order to achieve this improvement, the sound from two key sources was reduced, namely air rush noise and motor noise. The first kind of noise was reduced through a redesign of the shape of the apertures through which the air is forced, while the second kind of noise was diminished by improvements directly at the motor.

Also lower sound levels are available on the market, even in new models including: the Clean Dry by Toto (58-62 dBA), Jet Towel by Mitsubishi (65 dBA), Airforce and AirMax by World Dryer (83 dBA), and SpeedFlow by Saniflow.

14.1.2 Hygiene

Also the hygiene of hand driers has been challenged, since they blow air with bacteria onto the hand and the face. According to a study from the University of Westminster, “the performance of both the warm air dryer and the jet air dryer was inferior to paper towels in all respects (drying efficiency, bacterial numbers on the hands, bacterial contamination of the air flow and surfaces of the devices, and transmission of bacteria in the washroom) with the one exception that the jet air dryer is equal in drying efficiency. The jet air dryer was shown to be superior to the warm air dryer in all respects except for similar bacterial contamination and greater transmission potential.”

Other studies are globally in line, thus supporting following evidence:

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142 Dyson Airblade Brochure: [http://www.dysonairblade.co.uk/mediabinary/Files/Brochures/Airblade_Brochure_GB.pdf](http://www.dysonairblade.co.uk/mediabinary/Files/Brochures/Airblade_Brochure_GB.pdf).


• **Towels vs. Electric hand dryers**: From a hygiene viewpoint, paper towels are superior to electric air dryers. Paper towels should be recommended in locations where hygiene is paramount, such as hospitals and clinics.\(^{146}\)

• **Warm air hand dryer vs Jet air hand dryer**: The results are rather inconclusive. Opposing assertions are to be found in the literature:
  - “Air bacterial counts in close proximity to hand drying were 4.5-fold higher for the jet air dryer compared with the warm air dryer”\(^{147}\); and
  - “The Airblade™ was superior to the warm air dryers for reducing bacterial transfer. Its short, 10 s drying time should encourage greater compliance with hand drying and thus help reduce the spread of infectious agents via hands.”\(^{148}\)

To this regard, Dyson indicates that long dry times are problematic, as they increase the likelihood that users will give up and leave the bathroom with their hands still damp and more liable to transmit bacteria. By targeting the dry time, hand dryers are able to reduce hygiene and energy impacts.\(^{134}\)

It seems that the hygiene issue identified could be mitigated though better product design. According to stakeholders, inspiration should be sought from the Ecodesign Regulation for vacuum cleaners with its requirement on maximum dust re-emission, which clearly demonstrates that hygiene/health issues can be addressed under Ecodesign policy.\(^{149}\) Indeed, the following requirements are set in the aforementioned Regulation:\(^{150}\):
  - Dust pick up on carpet (dpuc) shall be greater than or equal to 0.75. This limit shall not apply to hard floor vacuum cleaners;
  - Dust pick up on hard floor (dpuhf) shall be greater than or equal to 0.98. This limit shall not apply to carpet vacuum cleaners; and
  - Dust re-emission shall be no more than 1.00 %.

### 14.1.3 Durability

Within the German Blue Angel for hand dryers (see section 14.2.2), one of the requirements is that the manufacturer offers a warranty of five years over the whole device as an option.

Again, reference may be made to the Regulation on vacuum cleaners, which introduces durability aspects. As was also presented in the “Hair dryers” product group, the following requirements are set:\(^{150}\):
  - The hose, if any, shall be durable so that it is still useable after 40,000 oscillations under strain; and
  - Operational motor lifetime shall be greater than or equal to 500 hours.

A Preparatory Study could focus on those aspects and see how they could be extended to hand dryers.

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\(^{147}\) Best EL, Parnell P, Wilcox MH (2014), Microbiological comparison of hand-drying methods: the potential for contamination of the environment, user, and bystander.

\(^{148}\) Snelling AM, Saville T, Stevens D, Beggs CB (2011), Comparative evaluation of the hygienic efficacy of an ultra-rapid hand dryer vs conventional warm air hand dryers.

\(^{149}\) ECOS and EEB, stakeholders’ comments to Task 4.

14.1.4 Conclusion for Ecodesign

Beyond energy consumption, noise could be relatively straightforward to regulate under Ecodesign. Requirements in terms of hygiene may be also formalised in terms of Ecodesign. Additional information on durability (as well as flame retardants, plasticisers, etc.) would be needed in order to complement the overview of hand dryers’ main environmental issues.

14.2 Policy coverage

This section is dedicated to the regulatory coverage of the product groups addressed, be it through legislation, within the EU or in third countries, through voluntary agreements and environmental labels or standards.

14.2.1 Overview of EU policies

Currently, hand dryers are regulated under the WEEE and RoHS Directives and REACH Regulation.

<table>
<thead>
<tr>
<th>Product group</th>
<th>WEEE</th>
<th>RoHS</th>
<th>REACH</th>
<th>EPBD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hand dryers</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>-</td>
</tr>
</tbody>
</table>

Criteria for Green Public Procurement (GPP) of hand dryers have not been developed so far. As hand dryers are commonly installed in public bathroom and almost all buildings occupied by public authorities, it would definitely make sense to develop some. GPP criteria already exist for the following product groups, which are part of the same “environment”:

- Flushing toilets and urinals (published in 2013)\(^\text{151}\); and
- Tissue paper, including paper towels (draft)\(^\text{152}\).

One step in this direction, though not a direct one, has been done by the UK Enhanced Capital Allowance (ECA) Scheme, which provides businesses with enhanced tax relief for investments in equipment that meets published energy-saving criteria. A list of eligible products was set out (the Energy Technology List); it includes energy-efficient hand dryers that businesses can procure. For instance, “The award-winning Vortex EcoSmart hand dryer from SAVORTEX has recently been approved and accepted onto the Energy Technology List (ETL) by the Enhanced Capital Allowance (ECA)”\(^\text{153}\).

14.2.2 Selected Member States policies

The following section is dedicated to Member States policies which are in place inside the EU and of which the following table gives an overview.

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Thus, the only label which could be identified to certify hand dryers is the German Blue Angel label. The criteria for the award of the Blue Angel label for hand dryers were first released in April 2010\textsuperscript{154} and were recently updated in May 2014\textsuperscript{155}.

Table 49 shows an extract of the requirements hand dryers have to comply with in order to obtain the Blue Angel label. The Blue Angel does not distinguish between jet air and warm air hand dryers, so that both kinds of devices are encompassed within the label’s criteria\textsuperscript{156}. Both award criteria from 2010 and 2014 are presented below, so as to show the evolution. For instance, in the 2014 award criteria, a requirement on the design for recyclability was added. However, the requirements listed here below are not exhaustive.

<table>
<thead>
<tr>
<th>Date of release</th>
<th>April 2010</th>
<th>May 2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy consumption</td>
<td>17 Wh for a maximum drying time of 30 seconds</td>
<td>12 Wh for a maximum drying time of 30 seconds and a minimum drying rate of 90%</td>
</tr>
<tr>
<td>On/Off</td>
<td>-</td>
<td>The device must have a on/off button</td>
</tr>
<tr>
<td>Standby</td>
<td>-</td>
<td>The energy performance in standby must lie at 0.5 W (maximum)</td>
</tr>
<tr>
<td>Noise emissions (max. dB)</td>
<td>-</td>
<td>85</td>
</tr>
<tr>
<td>Material of touchable surfaces</td>
<td>Compliance with REACH and other regulations</td>
<td></td>
</tr>
<tr>
<td>Safety</td>
<td>Compliance with requirements for GS\textsuperscript{157}</td>
<td></td>
</tr>
<tr>
<td>Design for recyclability</td>
<td>-</td>
<td>The device must be easy to disassemble</td>
</tr>
<tr>
<td>Warranty (as an option, in years)</td>
<td>-</td>
<td>5</td>
</tr>
</tbody>
</table>

So far, ten hand dryers on the market have been awarded the label, five of which are manufactured by AIR-WOLF and the other five by ELECTROSTAR\textsuperscript{158}.

\textsuperscript{154} Blue Angel (2010), Vergabegrundlage für Umweltzeichen, Elektrische Händetrockner RAL-UZ 87.
\textsuperscript{155} Blue Angel (2014), Vergabegrundlage für Umweltzeichen, Elektrische Händetrockner RAL-UZ 87.
\textsuperscript{156} The German text is: “Diese Vergabegrundlage gilt für elektrische Händetrockner (z.B. Warmlufthändetrockner,Hochgeschwindigkeitshändetrockner”).
\textsuperscript{157} GS (Geprüfte Sicherheit, “Tested Safety”) is a voluntary German certification mark for technical equipment.

14.2.3 Industry Self-Regulatory Initiative

No relevant SRI could be identified.

14.2.4 Existing third country legislation

The Taiwanese Energy Conservation Labelling program sets the following requirements\textsuperscript{159}: the measured Useful Energy Ratio for Energy Label qualified hand dryer products shall be no less than 90%. If the product is touch activated, each drying session shall be less than 40 seconds; if the product is motion activated, the power shall be cut-off within 2 seconds after the sensor sensed the absence of user, and each drying session shall be less than 1 minute.

Hand dryers are also part of the e-Standby Program from the Korea Energy Management Corporation (KEMCO). They are defined as “electrical equipment that utilize fan or electrical heat to dry hands with the nameplate consumption power of 3,000W or below”\textsuperscript{160}. Additional information on this specific product group could not be obtained.

14.2.5 Test standards

The Blue Angel label for hand dryers is based on American test standard NSF Protocol P335, which indicates that certified products must dry the users’ hands within 15 seconds. Studies have shown this is the typical amount of time a person will spend drying their hands\textsuperscript{161}. This test standard relies on various conditions to ensure the objectivity of the results, including:

- Test group of three men and three women;
- The width and length of the hands are capped:
  - For men, maximum 208 mm long and 95 mm wide;
  - For women, maximum 196 mm long and 85 mm wide;
- No jewels must be worn;
- Ambient temperature of 23°C (+/- 5°C) and moisture degree of 55% (+/- 5%);
- Temperature of the water with which people wash their hands before the test = between 25 and 30°C;
- Mass of water to be put on the hands on average:
  - For men, 4.0 grams;
  - For women, 3.5 grams; and
- Technical specifications regarding the paper used to assess how much water is left on the hands after the test (how wet they still are).

According to Dyson, this is currently the only standard that exists to measure the drying (and energy) efficiency of hand dryers. Yet, thus far, the wider hand drying industry has chosen not to adopt the NSF standard and instead make claims on dry time based on their own unverified testing\textsuperscript{134}.

\textsuperscript{158} http://www.blauer-engel.de/produktwelt/elektrogerate/energiesparende-h-ndetrockner-ausgabe-april-2010.
\textsuperscript{160} http://www.kemco.or.kr/new_eng/pg02/pg02100300_2.asp
Standards for noise also exist, namely the EN 60704 standard for “Household and similar electrical appliances – Test code for the determination of airborne acoustical noise”.

14.2.6 Conclusion for Ecodesign

To the exception of the Blue Angel environmental label, policy coverage of the “hand dryers” product group appears to be quite limited in Europe (other labelling initiatives are present in Asia – Taiwan and Korea). Yet test standards are available both for noise and energy efficiency so that to this extent, Ecodesign requirements may look interesting. Also the development of GPP criteria could be an option.

14.3 Appropriateness of Ecodesign or Energy labelling

14.3.1 Excessive cost

The discussion about “excessive cost” shall follow a simplified Life-Cycle Cost analysis (LCC), to make sure that savings stemming from lower energy consumption exceed any increase in purchase price. The case of hand dryers is made complicated by the fact that two main technologies are available, with much difference in purchase price across them. As a matter of fact, a warm air hand dryer will be cheaper to buy but consume more energy in use time, whereas a jet air hand dryer will be more expensive to buy but consume less energy in use time.

The range price for hand dryers is quite broad, from below 100 € to above 800 €. It has been assumed that the average price for (conventional) warm air hand dryers was about 300 €, whereas the new air jet hand dryers are significantly more expensive than average, with an (assumed) buying price of around 600 €. Table 50 below sums up the LCC performed, including two different columns:

- Without technology switch. Energy savings for warm air hand dryers only were assumed to be 15% in Task 3 Report; and
- With technology switch. Energy savings when moving from warm air to jet air hand dryers were assumed to be 68% in Task 3 Report.

**Table 50: Detailed cost calculation for the “hand dryers” product group**

<table>
<thead>
<tr>
<th>Without technology switch</th>
<th>With technology switch</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Average purchase price</strong></td>
<td>300 €</td>
</tr>
<tr>
<td><strong>Energy consumption / year</strong></td>
<td>1,400 kWh</td>
</tr>
<tr>
<td><strong>Lifetime</strong></td>
<td>8 years</td>
</tr>
<tr>
<td><strong>Average EU electricity price (non-domestic)</strong></td>
<td>0.12 € / kWh</td>
</tr>
<tr>
<td><strong>Energy costs over lifetime</strong></td>
<td>1,344 €</td>
</tr>
<tr>
<td><strong>Energy savings potential in use phase</strong></td>
<td>15%</td>
</tr>
<tr>
<td><strong>Economic savings potential</strong></td>
<td>201.6 €</td>
</tr>
</tbody>
</table>

A large sample of models and prices can be found at: [http://www.hygienesuppliesdirect.com/sub/hand_dryers](http://www.hygienesuppliesdirect.com/sub/hand_dryers).
If specific Ecodesign requirements are set and achievable while keeping the warm air technology, the relation between economic savings and purchase price is the following: as long the average sales price does not increase more than 67%, the average product life cycle is likely to remain cost-neutral. If strong / ambitious requirements on energy consumption are set through Ecodesign, they may force manufacturers to switch from warm air to jet air technology. In this case, the relation between economic savings and purchase price is the following: as long the average sales price does not increase more than 304%, the average product life cycle is likely to remain cost-neutral.

Costs anyway are one prime consideration for most organisations responsible for specifying and running public bathrooms. Higher up-front investment costs in the most energy efficient hand drying methods seem to pay back over time, when contrasted with the high running costs of warm air hand dryers or paper towels respectively. Figure 4 below illustrates this, based on calculation made by Dyson.

![Figure 4: Annual running costs of different hand drying solutions (in euros)](image)

### 14.3.2 Suitability of Ecodesign measures or Energy labelling

There seems to be no major hindrance to the implementation of Ecodesign requirements to the “hand dryers” product group. Indeed, the following characteristics of the product group make it pretty suitable for Regulation:

- Mass market products (even if business-to-business);
- No excessive cost would occur (even if a change in technology may be necessary); and
- Standards and labelling criteria have been developed.

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163 Dyson. Methodology for running cost calculations can be found here: [www.dysonairblade.co.uk/calcs](http://www.dysonairblade.co.uk/calcs). Among those assumptions, a 0.10 £ electricity price per kWh is totally consistent with the EU’s 0.12 € (above). Assumptions for paper towels use are 400 units per day, 365 days a year, with an average paper towel cost of 0.01 £.
One could wish to go one step further. Indeed, as jet air hand dryers are 68% more energy efficient than warm air dryers, some stakeholders claim that this is “an obvious case for Ecodesign to ban standard dryers and only leave the jet air technology on the market”\textsuperscript{149}.

Energy labelling, on the other hand, does not sound like a promising option, since the market is business-to-business.

14.3.3 Conclusion for Ecodesign
Ecodesign requirements look reasonable for “hand dryers”. At least the general features of the product group do not present any major counter-argument to the implementation of Ecodesign Regulation. Even a ban of warm air hand dryers could be envisaged.

14.4 Industrial competitiveness

14.4.1 Market structure
The market of hand dryers is rather a business-to-business one, as hand dryers are typically installed in the bathrooms of restaurants, offices, etc. There are a few major players in the market of hand dryers, including Conair, Dyson, Excel Dryer, etc. Nonetheless, products are also sold by a big number of SMEs\textsuperscript{164}. As for the possibility of new entrance, it may deteriorate, since some amount of experience is probably to manufacture most energy-efficient products.

14.4.2 Innovation and employment
Little information could be earned on innovation and employment stemming from the implementation of Ecodesign requirements to hand dryers. One aspect that a dedicated Preparatory Study should examine more closely is on proprietary technology. It is pretty sure that the jet air technology is not patented (as many manufacturers do make use of it), but some design improvement options to lower noise levels could be subject to patents.

14.4.3 International competition
Electric hand dryers are one option to dry one’s hands, the other being paper towels. Hence the industry claims that the major competitor of hand dryers are paper towels – and according to them, paper towels are the most common drying solution. It is estimated that the paper towel industry is worth some 1.5 billion euros per annum, versus a hand drying industry worth only 300 million euros\textsuperscript{134}. As costs represent a major sales argument, and as it is clearly favourable to (energy-efficient) hand dryers, the implementation of Ecodesign requirements could rather help manufacturers to expand.

14.4.4 Conclusion for Ecodesign
The global picture is balanced, since Ecodesign requirements could foster R&D and market positions (on the one hand), but also be detrimental to smaller players that could not be able to adjust (on the other hand).

\textsuperscript{164} CECED, stakeholder’s input to Task 4.
14.5 Product group summary and recommendations

Table 51 below presents a simplified scoring of the four main sections above, for the product group “hand dryers”.

Table 51: Overall scoring of the "Hand dryers" product group

<table>
<thead>
<tr>
<th>Product group</th>
<th>Other environmental impacts</th>
<th>Policy gaps</th>
<th>Appropriateness of Ecodesign</th>
<th>Appropriateness of Energy labelling</th>
<th>Industrial competitiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hand dryers</td>
<td>++</td>
<td>+++</td>
<td>+++</td>
<td>++</td>
<td>++</td>
</tr>
</tbody>
</table>

The more “+” there are in the assessment, the more favourable it is for Ecodesign or Energy labelling Regulation to be implemented.

The following types of Ecodesign measures could in principle be envisaged for hand dryers:

- Minimum requirements on energy efficiency;
- Minimum requirements on noise levels; and
- Design specifications related to hygiene.

Energy labelling is not very appropriate, but GPP criteria could be an interesting policy instrument to explore (complementary to Ecodesign, if any).
15.1 Main other environmental issues

Table 52 below provides an overview of the relevant environmental aspects of the “high pressure cleaners” product group, and possible improvement options linked to them, based on information provided by stakeholders and gathered in the literature. Energy consumption and material efficiency have been discussed in Task 3. Hence the table and the paragraphs below focus on the main other environmental impacts of the product group.

Table 52: Overview of relevant direct environmental issues and potential for improvement – High pressure cleaners

<table>
<thead>
<tr>
<th>Environmental issue categories</th>
<th>Scoring</th>
<th>Description of the environmental issue</th>
<th>Description of related improvement potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water consumption in use phase</td>
<td>+++</td>
<td>Water consumption is inherent to the cleaning process.</td>
<td>Water consumption can be reduced by a better cleaning efficiency and product improvement&lt;sup&gt;165&lt;/sup&gt; (narrowing the diameter of the nozzle).</td>
</tr>
<tr>
<td>Consumables (detergents, etc.)</td>
<td>+</td>
<td>Usually no consumables required for high pressure cleaning. Detergents are sometime used to remove special kind of dirt, e.g. grease or oil.</td>
<td>The consumption of detergents can be reduced by a better cleaning efficiency (of the detergents and the HPC), and a precise dosage system. Environmental impacts can be reduced by using more environmentally friendly detergents.</td>
</tr>
<tr>
<td>Presence of critical raw materials (see the EU list&lt;sup&gt;166&lt;/sup&gt;)</td>
<td>+</td>
<td>Some critical raw materials may be parts of semi-manufactured materials, subsystems or components of a high pressure cleaner.</td>
<td></td>
</tr>
<tr>
<td>Presence of flame retardants (halogenated, etc.)</td>
<td>+</td>
<td>Brominated and chlorinated flame retardants are present in some HPC, especially in CWC and HWC&lt;sup&gt;167&lt;/sup&gt;.</td>
<td>Non-halogenated flame retardants exist. A dedicated preparatory study would have to determine whether they can be used for HPC.</td>
</tr>
<tr>
<td>Presence of plasticisers (phthalates)</td>
<td>+</td>
<td>Phthalates can be found in some HPC, especially in PVC-cables and PVC-hoses.</td>
<td>Less toxic, high-molecular-weight phthalates or other less harmful substances</td>
</tr>
</tbody>
</table>

<sup>165</sup> Source: European Cleaning Journal, High pressure cleaners – can they be sustainable?, November, 28<sup>th</sup>, 2011 (http://www.europeancleaningjournal.com/magazine/articles/special-features/high-pressure-cleaners-can-they-be-sustainable).


<sup>167</sup> CWC (Cold Water Commercial cleaners) and HWC (Hot Water Commercial cleaners).
<table>
<thead>
<tr>
<th>Environmental issue categories</th>
<th>Scoring</th>
<th>Description of the environmental issue</th>
<th>Description of related improvement potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Presence of other toxic substances</td>
<td>+</td>
<td>Toxic substances such as heavy metals are present in some HPC especially in PVC-hoses.</td>
<td>A dedicated preparatory study would have to determine whether or not heavy metals can be substituted in HPC.</td>
</tr>
<tr>
<td>Presence of F-gases</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiation levels</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safety (fuel leakage, vibrations, etc.)</td>
<td>+++</td>
<td>High pressure cleaning operation generates vibrations which can cause Hand Arm Vibration Syndrome (HAVS).</td>
<td>Vibrations can be reduced by product improvement (design of the handle of the spray lance).</td>
</tr>
<tr>
<td>Health (hygiene, noise level, etc.)</td>
<td>+++</td>
<td>Noise emission from the high pressure cleaning unit (engine and pump) and from the water jet during cleaning operations. Some domestic appliances can emit noise up to 95 dB.</td>
<td>Reduction of noise and power to an optimum level, development of innovative nozzle technologies, implementation of appropriate cleaning practices.</td>
</tr>
<tr>
<td>Durability (reusability, upgradability, reparability, etc.)</td>
<td>++</td>
<td>Short durability is a problem of poor quality products. Those products have a shorter life span, are not sufficiently repairable, spare parts are not available, no upgrade possible.</td>
<td>Products can be designed to ease the access to key components facilitate the repair and reuse.</td>
</tr>
<tr>
<td>End-of-life (recyclability, recycled content)</td>
<td>++</td>
<td>HPC are usually made of aluminium and plastics.</td>
<td>Some products on the market are recyclable up to 90% with appropriate design.</td>
</tr>
<tr>
<td>Direct emissions to air</td>
<td>+++</td>
<td>Direct emissions, CO, CO₂ and particulate matter (for hot water commercial products) from the consumption of heating oil.</td>
<td>Emissions and particulate matter can be reduced by improvement of cleaning efficiency for all HPC and usage of low emissions burner for hot water HPC.</td>
</tr>
<tr>
<td>Direct emissions to water</td>
<td>++</td>
<td>Emissions to water are caused by cleaning of objects or surfaces polluted with oil, grease, etc., or by using detergents.</td>
<td>Emissions and pollution with oil, etc., cannot be reduced by modification of the HPC. Some professional HPC are equipped with a sucking system that collects, recycles and allow reusing up to 95% of the direct water consumption of the HPC. Emissions to water of...</td>
</tr>
</tbody>
</table>
### Environmental issue categories

<table>
<thead>
<tr>
<th>Scoring</th>
<th>Description of the environmental issue</th>
<th>Description of related improvement potential</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>detergents can be reduced by a precise dosing system.</td>
</tr>
</tbody>
</table>

Direct emissions to soil

<table>
<thead>
<tr>
<th>Scoring</th>
<th>Description of the environmental issue</th>
<th>Description of related improvement potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>+</td>
<td>Emissions to soil can possibly occur if the cleaning process is done on unpaved ground.</td>
<td>Emissions to soil cannot be reduced by modification of the HPC.</td>
</tr>
</tbody>
</table>

Scoring: “0” if not an issue for the product group. If this is an issue, the indicative importance of the environmental issue is provided from + (low) to +++ (high).

### 15.1.1 Water consumption

High pressure cleaning operations inevitably generates significant water consumption hence water consumption is a major environmental issue for HPC. Water consumption of HPC is estimated at 350 L/hr, 650 L/hr and 700 L/hr respectively for Cold Water Domestic, Cold Water Commercial and Hot Water Commercial HPC, according to the industry.

According to the industry, significant improvements of water consumption can be achieved by improving the cleaning efficiency of HPC. For example, the reduction of the time required to operate a cleaning task is an important parameter of the water consumption efficiency of HPC: a manufacturer carried out some tests on two 160 bar models that showed that using for an identical cleaning task a 700 L/hr machine required 1 hour 12 minutes to clean compared with only 26 minutes for a 1,200 L/hr machine, generating more than 500 L of water savings while saving energy and labour costs.

The design of HPC nozzle can also lead to significant water savings: a manufacturer developed a new nozzle technology for domestic HPC that reduces cleaning operations time up to 50 % and claims that this new technology generates energy and water savings of up to 50 %.

Finally, some professional HPC are equipped with a sucking system that collects used water which can be recycled by the cleaning unit. A manufacturer claims that up to 95% of the water consumed can be recycled and reused with such a system.

### 15.1.2 Durability

Durability of high pressure cleaners is closely linked to the quality of the products. Product’s lifespan improvement can be achieved by increasing:

- The reparability of the products, to be considered at the design phase, can be improved by using a limited number of components and assemblies, as many standard parts as possible and by ensuring a good accessibility to the components to be replaced;
- The availability of spare parts until the end of the projected service life of the products: some manufacturers guarantee a spare parts supply for up to 10 years after a model goes out of production; and

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168 However, manufacturers argue that using a domestic HPC to wash a car consumes between 6 and 10 times less water than the use of a simple hose pipe at low pressure. The additional pressure and water flow provides a level of cleaning performance that cuts cleaning time. Source: European Cleaning Journal, *High pressure cleaners – can they be sustainable?*, November, 28th, 2011 (http://www.europeancleaningjournal.com/magazine/articles/special-features/high-pressure-cleaners-can-they-be-sustainable).

169 Source: Kärcher, [http://www.karcher.com/int/Products/Home__Garden/Pressure_washers/50_percent_faster.htm](http://www.karcher.com/int/Products/Home__Garden/Pressure_washers/50_percent_faster.htm).

• The resistance of key elements of the products such as the hose, some engine parts (pumps).

15.1.3 Safety
High pressure cleaners can be subject to inadvertent movement, with the potential to cause harm to workers or people standing close to the cleaning operations. The following safety issues regarding high pressure cleaners can be stated:

• The powerful spray from a high pressure cleaner can travel at speeds exceeding 3,300 kilometres per hour\textsuperscript{172} and can cause serious damages to the human body;
• Debris propelled by water jets can injure eyes, skin, and body parts upon impact;
• Electric shock can occur if the pressure washer is not used properly;
• For fuel-powered hot water pressure cleaners, engines can cause carbon monoxide poisoning if the product is used in confined spaces or partially enclosed spaces;
• High pressure cleaning is physically demanding work; workers are often required to work in awkward positions or in confined spaces, to lift heavy tools or materials, and to work with high push/pull (reaction) force. Those working conditions can cause musculoskeletal injuries; and
• The very purpose of the activity is to clean or remove chemical substances; hence contact with hazardous chemical substances is a real risk in the high pressure cleaning process.

Some of those safety risks can be addressed by equipping the products with special features such as dead man's trigger, unloaders and thermal relief valves, adjustable nozzle to change the spray pattern from narrow (higher pressure) to wide (lower pressure), but most of those issues depends directly on the user’s practices and can be addressed with safe practices implementation and appropriate legislation and standards (see section 15.2).

15.1.4 Noise
Noise is emitted from the high pressure cleaning unit due to the mechanical operation of the engine and the pump, and from the water jet during cleaning operations. In addition of being a nuisance for the environment, noise is also damaging for the human health, especially for worker frequently exposed to noise emissions from HPC. According to manufacturers’ technical data, cold water domestic HPC can make a noise up to 95dB.

Some manufacturers try to tackle the noise emission issue e.g. by reducing noise and power to an optimum level, or by developing new nozzle technologies. According to the motor used, the noise made by HPCs can be reduced. As an example, Kärcher reduced by 10 dB the noise of some of its cold water domestic HPC models compared to average similar appliances, by using water-cooled motor instead of using external air-cooled motor, reaching a maximum noise level of 76 dB.

15.1.5 Conclusion for Ecodesign
Besides the energy consumption issue, other environmental aspects are of importance regarding high pressure cleaners. Water consumption, durability, recyclability, noise and safety aspects could be improved thanks to a proper design, and some manufacturers are communicating on models allowing such environmental benefits.

\textsuperscript{171} Source: Kärcher, \url{http://www.karcher.com/versions/int/assets/ecoefficiency_GB_0911.pdf}.
15.2 Policy coverage

This section is dedicated to the regulatory coverage of the product groups addressed, be it through legislation, within the EU or in third countries, through voluntary agreements and environmental labels or standards. The goal is to identify where Ecodesign or Energy Labelling regulations could have added value beyond the existing legislation, and, in the case of third country legislation, whether there is successful legislation that could serve as a model for Ecodesign or Energy Labelling legislation.

15.2.1 Overview of EU policies

Currently, high pressure cleaners are regulated under the EU WEEE and RoHS Directives, and REACH Regulation.

**Table 53: Main EU legislation applicable to the “High Pressure Cleaners” product group**

<table>
<thead>
<tr>
<th>Product group</th>
<th>WEEE</th>
<th>RoHS</th>
<th>REACH</th>
<th>EPBD</th>
</tr>
</thead>
<tbody>
<tr>
<td>High pressure</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>-</td>
</tr>
<tr>
<td>cleaners</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

**Outdoor Noise Directive (2000/14/EC)**

The Noise Emission in the Environment by Equipment for Use Outdoors Directive, or Outdoor Noise Directive, aims at controlling and monitoring noise of equipment for use outdoors so as to reduce noise nuisance and to remove technical barriers to trade arising out of European Member States’ different noise requirements. Manufacturers are required to measure, or have measured, the sound power level of the 57 categories of equipment listed in the Directive, 22 of which have to meet limits. HPC fall under the Directive and are subject to noise marking only.

**Other relevant Directives**

- Noise Directive (2003/10/EC) on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (noise). The regulations introduced exposure limits in relation to noise in the workplace and defines the average level of noise that an employee could be exposed to during an average day or week;
- Physical Agents (Vibration) Directive (2002/44/EC) on minimum requirements for the health and safety of workers exposed to vibration. It introduces exposure action and limit values for both hand-arm vibration and whole-body vibration, setting minimum standards for the control of vibration risks;
- 97/68/EC Directive on emission of gaseous and particulate pollutants from internal combustion engines. The Directive stipulates the maximum permitted exhaust emissions as a function of the power of the relevant engine. Moreover the Directive includes a series of emission limit stages of increasing stringency with corresponding compliance dates. Manufacturers must ensure that new engines comply with these limits in order that they can be placed on the market; and
- PED (Pressure equipment Directive - 97/23/EC) sets out the standards for the design and fabrication of pressure equipment and also sets the administrative procedures requirements for the "conformity assessment" of pressure equipment.
15.2.2 Selected Member States policies
No Member State policy applying to domestic and commercial HPC has been identified.

15.2.3 Industry Self-Regulatory Initiative
EUnited Cleaning\textsuperscript{173} produces Technical Recommendations (TR), i.e. “semi-standards” for issues that the cleaning machines industry considers as not adequately covered by European or international standards. Thus, the industry defines requirements and recommends measures in addition to the existing European and international standards.

Examples of specific TR are given below:

- TR 34001 “Electromagnetic compatibility (EMC)”: this document recommends those European standards for electromagnetic compatibility that must be taken into consideration to fulfil the essential requirements of European Directive 2004/108/EC on the electromagnetic compatibility of cleaning machines; and

- TR 34002 “Machinery Directive Guideline”: this TR is a guideline for manufacturers applying the Machinery Directive, besides the specification of requirements within relevant safety standards.

Moreover EUnited Cleaning set up the “EUnited Cleaning Burner Efficiency” labelling scheme that applies to burners of oil-heated stationary or quasi-stationary HPC, which have to meet requirements on thermal exhaust loss, CO emissions, and dust emissions. An example of such label is presented in Figure 5.

![Figure 5: Example of label according to the EUnited Cleaning scheme for oil-heated HPC](image)

15.2.4 Existing third country legislation and labels
In the US, high pressure cleaners are targeted by the Clean Water Act (CWA) though this legislation refers to the user practices and not the design of the device. This Act is the principle law governing pollution control and water quality of the USA's waterways. The objective of this Act is to restore and maintain the chemical, physical and biological integrity of the USA's waters. Section 301 of the CWA prohibits a point source discharge of pollutants into waters of the USA without a National Pollutant Discharge Elimination System (NPDES) permit. The NPDES permits require treatment of the

\textsuperscript{173} The association of European cleaning machines manufacturers - EUnited Cleaning - represents the leading producers of floor cleaning machines and high pressure cleaners for commercial and industrial use.
pollutants to a degree that will comply with established water quality standards. Discharges from Power (Pressure) Washers that clean such things as equipment, a restaurant's solid waste storage areas, or a parking lot and discharges the process water into a storm drain are prohibited without an NPDES permit.

15.2.5 Test standards

No specific standard on energy (and water) consumption has been identified for HPC, but one European standard related to safety has been identified: EN 60335 “Safety of household and similar electrical appliances standard”.

Standard EN 60335 deals with the safety of high pressure cleaners without traction drive, intended for household and commercial indoor or outdoor use with a rated pressure up to 2.5 MPa and not exceeding 35 MPa. It also applies to steam cleaners and those parts of hot water high pressure cleaners incorporating a steam stage which have a capacity not exceeding 100 L, a rated pressure not exceeding 2.5 MPa.

This standard does not apply to high pressure water jet machines which are covered by EN 1829.

15.2.6 Conclusion for Ecodesign

Policy coverage of the HPC product group mainly encompasses health and safety issues, as well as chemical and hazardous substances. No specific policy or initiative covering energy and water consumption were identified.

15.3 Appropriateness of Ecodesign or Energy labelling

15.3.1 Excessive cost

The unit price of HPCs varies greatly according to the product group. The following sale price ranges and averages are based on Internet research.

- Cold Wat. Dom. HPC cost between 70 € and 400 €, resulting in average cost price of 200 €.
- Cold Wat. Com. HPC cost between 120 € and 2,000 €, resulting in average cost price of 500 €.
- Hot Wat. Com. HPC cost between 3,000 € and 5,000 €, resulting in average cost price of 4,500 €.

The discussion about “excessive cost” follows a simplified Life-Cycle Cost analysis (LCC), to make sure that savings stemming from lower energy consumption exceed any increase in purchase price. In the case of HPC, Table 54 below sums up the LCC performed.

<table>
<thead>
<tr>
<th></th>
<th>Cold Wat HPC Dom</th>
<th>Cold Wat HPC Com</th>
<th>Hot Wat HPC Com</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average purchase price</td>
<td>200 €</td>
<td>500 €</td>
<td>4,500 €</td>
</tr>
<tr>
<td>Electricity consumption / year</td>
<td>19.2 kWh</td>
<td>400 kWh</td>
<td>750 kWh</td>
</tr>
<tr>
<td>Oil consumption / year</td>
<td>-</td>
<td>-</td>
<td>7,500 kWh</td>
</tr>
<tr>
<td>Lifetime</td>
<td>10 yrs</td>
<td>12 yrs</td>
<td>10 yrs</td>
</tr>
</tbody>
</table>
The average Cold Water Domestic, Cold Water Commercial and Hot Water Commercial HPC life cycles are likely to remain cost-neutral as long the average sales price does not increase more than 2%, 12% and 28% respectively.

### 15.3.2 Suitability of Ecodesign measures or Energy labelling

Considering that the improvement potential is about 10%, this means that there is not enough difference between the “worst” and the “best” models, in terms on energy consumption, to set an energy label.

Applying Ecodesign to high pressure cleaners could be a good example to address various important issues with a single tool. Indeed, improvement potential exists on energy, water, noise, durability and recyclability aspects according to some manufacturers’ claims.

### 15.3.3 Conclusion for Ecodesign

Ecodesign could be a useful policy instrument to address issues not already covered, even if the compliance of requirements for Cold Water Domestic HPC at affordable cost for customers is questionable.

### 15.4 Industrial competitiveness

#### 15.4.1 Market structure

EUUnited Cleaning represents several European HPC manufacturers among which are the two market leaders, i.e. Kärcher and Nilfisk Advance. A large share of the market is dominated by few manufacturers, but there is also a large number of small companies which produce HPC.

#### 15.4.2 Innovation and employment

No data on employment related to HPC was available. According to EUUnited Cleaning, water and energy efficiency have been a driver for innovation for the two main European producers of HPC. On its website, one of the main producers in Europe shows several HPC products with very high water and energy efficiency.
15.4.3 International competition

The cleaning machines sector is highly specialised and strongly export-oriented with an export share around 60%. State of the art technology, excellent processing and the development of new areas of application, secure the European manufacturers a good position within the scope of international competition.

15.4.4 Conclusion for Ecodesign

Considering that the market is strongly export-oriented it would be important to take into account within a preparatory study the potential consequences of Ecodesign measures on export.

15.5 Product group summary and recommendations

Table 55 below presents a simplified scoring of the four main sections above, for the product group “high pressure cleaners”.

<table>
<thead>
<tr>
<th>Product group</th>
<th>Other environmental impacts</th>
<th>Policy gaps</th>
<th>Appropriateness of Ecodesign</th>
<th>Appropriateness of Energy labelling</th>
<th>Industrial competitiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cold Wat HPC Dom</td>
<td>+++</td>
<td>++</td>
<td>+++</td>
<td>+</td>
<td>++</td>
</tr>
<tr>
<td>Cold Wat HPC Com</td>
<td>+++</td>
<td>++</td>
<td>+++</td>
<td>+</td>
<td>++</td>
</tr>
<tr>
<td>Hot Wat HPC Com</td>
<td>+++</td>
<td>++</td>
<td>+++</td>
<td>+</td>
<td>++</td>
</tr>
</tbody>
</table>

The more “+” there are in the assessment, the more favourable it is for Ecodesign Regulation or Energy Labelling to be implemented.

The “+++” in the column related to “other environmental impacts” reflects the information provided in Table 52, for “water consumption”, “safety”, “health” and “direct emissions to air”. It is important to note that most of these issues are already covered by several regulations related to their environmental impacts.

The following types of Ecodesign measures could in principle be envisaged for HPC:

- Minimum requirements on energy efficiency;
- Minimum requirements on water efficiency in the use phase; and
- Minimum requirements on the operational motor life time and on the durability of specific parts (e.g. spray lance, pumps, burners)\(^\text{174}\).

To reach these objectives, more specific recommendations should be developed during the course of a Preparatory Study, if any, taking into account that:

- Measures related to the nozzle would enable to reduce both the water and the energy consumption: and

\(^{174}\) Suggestion from a stakeholder taking Vacuum cleaners Ecodesign Regulation for example.
- Measures related to the motor efficiency may lead to significant costs if they lead to increase the size and the weight of the product.

Energy labelling does not seem to be a relevant option due to limited differences between the “worst” and the “best” models, in terms on energy consumption.
16. Lifts

16.1 Main other environmental issues

Table 56 below provides an overview of the relevant environmental aspects of the “lifts” product group, and possible improvement options linked to them. Energy consumption and material efficiency have been discussed in Task 3. Hence the table and the paragraphs below focus on the main other environmental impacts of the product group.

Table 56: Overview of relevant direct environmental issues and potential for improvement – Lifts

<table>
<thead>
<tr>
<th>Environmental issue categories</th>
<th>Scoring</th>
<th>Description of the environmental issue</th>
<th>Description of related improvement potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water consumption in use phase</td>
<td>0</td>
<td>For a representative installation (in Paris) ca. 0.2 litre of cleaning and degreasing agents are used for annual corrective and preventive maintenance(^\text{175}). This would be hardly linked to the design of the lift, and therefore cannot be blamed on the lift itself.</td>
<td></td>
</tr>
<tr>
<td>Consumables (detergents, etc.)</td>
<td>0</td>
<td>Presence of critical raw materials at low concentration levels in the lift’s electronic components.</td>
<td></td>
</tr>
<tr>
<td>Presence of critical raw materials (see the EU list(^\text{176}))</td>
<td>+</td>
<td>Presence of critical raw materials at low concentration levels in the lift’s electronic components.</td>
<td>Non-halogenated flame retardants exist. A dedicated preparatory study would have to determine whether they can be used for lifts and would be environmentally preferable.</td>
</tr>
<tr>
<td>Presence of flame retardants (halogenated, etc.)</td>
<td>+</td>
<td>Flame retardants might be present in some components of a lift.</td>
<td>Less toxic, high-molecular-weight phthalates or other less harmful substances exist. A dedicated preparatory study would have to determine whether they can be used for lifts or if phthalate-free plastics can be</td>
</tr>
<tr>
<td>Presence of plasticisers (phthalates)</td>
<td>+</td>
<td>Plasticisers might be present in some components of a lift.</td>
<td></td>
</tr>
</tbody>
</table>

\(^{175}\) European Lift Association (ELA), stakeholder input to Task 4.

<table>
<thead>
<tr>
<th>Environmental issue categories</th>
<th>Scoring</th>
<th>Description of the environmental issue</th>
<th>Description of related improvement potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Presence of other toxic substances</td>
<td>0</td>
<td>Traces of F-gases can be used in some gas buffers. The use of F-gases is the regulated in the corresponding regulation EC 842/2006 on certain fluorinated greenhouse gases.</td>
<td>The industry must be (and is) EC 842/2006 compliant. Therefore the improvement potential is very low.</td>
</tr>
<tr>
<td>Presence of F-gases</td>
<td>+</td>
<td>It is known that lift equipment is prone to cause electromagnetic emissions. The level of such emissions is regulated by specific standards which give presumption of conformity to the relevant EU Directives.</td>
<td>A continuous update of the legal requirements for electromagnetic emissions and of the relevant standards will help keeping the impact of such emissions under control, by adapting the requirements to the evolution of the lift products.</td>
</tr>
<tr>
<td>Radiation levels</td>
<td>+</td>
<td>Oil leakage in both hydraulic and (to a lesser extent) traction lifts may occur.</td>
<td>Various improvement options do exist (see section 16.1.2).</td>
</tr>
<tr>
<td>Safety (fuel leakage, vibrations, etc.)</td>
<td>++</td>
<td>Vibrations and noise are of concern.</td>
<td>Although pretty much related to the integration of the lift into the building, noise and vibrations can be lowered within one single lift. For instance, sound insulation can be achieved by means of a heavy single-layered, or a double-layered, well.</td>
</tr>
<tr>
<td>Health (hygiene, noise level, etc.)</td>
<td>++</td>
<td>Durability is not a prevailing issue, since lifts have a long lifetime (typically 40 years). Moreover, all parts of a lift can be replaced, some of them within preventive maintenance. Some components of a lift might be reused, if still efficient (in rare occasions).</td>
<td></td>
</tr>
<tr>
<td>Durability (reusability, upgradability, reparability, etc.)</td>
<td>+</td>
<td>Materials used for lifts are mainly recyclable, but not always recycled.</td>
<td>Permanent magnets could be marked.</td>
</tr>
<tr>
<td>End-of-life (recyclability, recycled content)</td>
<td>++</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct emissions to air</td>
<td>0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

177 European Federation for Small and Medium-size Elevators Enterprises (EFESME), stakeholder input to Task 4.
<table>
<thead>
<tr>
<th>Environmental issue categories</th>
<th>Scoring</th>
<th>Description of the environmental issue</th>
<th>Description of related improvement potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct emissions to water</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct emissions to soil</td>
<td>0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Scoring: “0” if not an issue for the product group. If this is an issue, the indicative importance of the environmental issue is provided from + (low) to +++ (high).

Lift manufacturers usually claim that the two major environmental impacts of lifts are: 1) material use in manufacturing phase and 2) energy consumption in use phase, which have been both studied in Task 3. All other contributors to environmental impacts over the whole life cycle, they say, account for less than 5% of the total\(^{178}\).

### 16.1.1 Presence of critical raw materials

Some (critical) raw materials may be parts of semi-manufactured materials, subsystems or components of a lift. Indeed, as electronic components are estimated to be about 1.5% or 2% of a lift’s total weight, there is a certain amount of critical raw materials present in such lift components.

From researches made in conjunction with the evaluation of the Carbon Footprint of a certain new lift products, it emerged that the amount of Neodimium was about 0.001% of the total weight of the concerned lift\(^{177}\). However, specific information from suppliers would be needed to identify precisely all critical raw materials used. Today, suppliers do not have any legal duty to provide such information.

More specifically, rare-earth materials are mainly concentrated in the permanent magnets used for traction motors in the most recent types of traction lifts. As mentioned in Task 3, permanent magnet motors are a means to improve energy efficiency of lifts. Mechanically, the impact of such rare earth materials is increasing as the market share of these new products is growing. The permanent magnet motors technology was first introduced a time when the concern about the negative impact of such materials was not a primary issue\(^{177}\). Nowadays, it is up to the manufacturers to develop new solutions which could minimize the use of rare earth materials in traction motors.

### 16.1.2 Safety – Risk of oil leakage

Leakage of oil is an issue which slightly affects, more or less, most of the existing lifts. There are small leakages of lubricating oil and/or grease, normally present in most lifts fitted with slide guide shoes: this happens involuntarily due to the collection of the excess at the bottom of the guide rails in the pit. More recently, some containers have been fitted to collect such small quantity of lubricant, but it is still inevitable to seen large stains and oil on the pit floor\(^{177}\).

In traction lifts, the total amount of oil present is several millilitres only\(^{179}\). The total amount of oil present in hydraulic lifts of course is greater, and there might be some leakage of oil – yet the amount of leakage is extremely limited during the normal operation of the lift, due to the special provisions which shall be implemented to cope with the higher pressure involved. There is still some risk of accidental dispersion of fluid during the replacement of any exhausted lift. In any case, the damage caused by this type of fluid, especially by those being used in the most recent (hydraulic) units, is much lower than that caused by the lubricating oil.

\(^{178}\) Feedback from various stakeholders (received per email).

\(^{179}\) VDMA, stakeholder’s comment to Task 4.
Possible improvement options include:

- Reduction of the need for grease or oil lubrication of the guide rails;
- Changes in the design of the related equipment in hydraulic lifts, and development of appropriate means to cut the risk of accidentally spilling oil during replacement procedures; and
- Accurate selection of the type of oil in use. If possible, further research and development may be carried out to eliminate the oil’s residual adverse impact to the environment.

According to stakeholders, most of the improvement options mentioned are already being implemented\(^{177}\).

### 16.1.3 Safety and health – Vibrations and noise

Vibrations and noise are not a negligible issue regarding the “performance quality level” of the lifts, even if they are often due to some improper preparation of the building: they depend on how the lift is incorporated to the building\(^{179}\). Although there are not yet specific vibration level requirements in the lift standards, there are some legal requirements which limit the level of vibrations and noise in specific areas of some type of buildings. This is already a constraint which establishes a certain maximum level of vibrations and noise emitted by the lifts\(^{177}\).

For example, lift vibrations get measured by KONE using a specific Protocol that get in ISO 18738\(^{175}\). And generally speaking, the natural improvement of the “quality of life” expectations would likely drive the market towards a continuous reduction of noise and vibrations (slowly but inexorably).

Dealing with noise, VDI 2566 guideline (see section 16.2.5 for more information) suggests technical improvement options for sound insulation. According to VDI, “The acoustical requirements to be met by a building depend on the arrangement of the machine room and the well with respect to the nearest room requiring protection. Sound insulation can be achieved by means of a heavy single-layered, or a double-layered, well. Single-layered wells are preferred for reasons of structural stability.”\(^{180}\)

### 16.1.4 End-of-life

According to the Environmental Product Declaration published by KONE for its MonoSpace (mid-rise elevator solution), the metals represent about 97% of the elevator material weight and are recyclable\(^{181}\). It is not said, however, how much of this is actually recycled, since lifts are not owned by manufacturers, and waste disposal is regulated differently in every Member State. Yet even if no scientific evidence is available on lifts' recycling, there is economic incentive for dismantlers to recycle discarded lifts – so that there is no hint that they do not recycle actually.

From the Carbon Footprint mentioned above, it turns out that the result of the recyclability (for a certain residential type of lift) was actually fairly good. In details, the impact of recyclability, considered in conjunction with the disposal of the equipment, was only 0.7 % of the total Carbon Footprint value\(^{177}\).

Last but not least, as long as traction lifts with permanent magnet motors are concerned, the marking of permanent magnets could be introduced (as also suggested as a horizontal measure). According to stakeholders, if marking, it should be placed on the housing of the motor\(^{175}\).

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1580 VDI (2008), VDI 2566 Blatt 1 – Arbeitsexemplar.
16.1.5 Conclusion for Ecodesign

Material efficiency may be introduced as a requirement, but energy consumption remains the major environmental impact of lifts. Requirements for safety and health, regarding oil leakage, vibrations and noise, fall within the scope of Ecodesign regulation but may be more adequately covered by (a revision of) the Lifts Directive – see section 16.2.1.

16.2 Policy coverage

This section is dedicated to the regulatory coverage of the product groups addressed, be it through legislation, within the EU or in third countries, through voluntary agreements and environmental labels or standards. The goal is to identify where Ecodesign or Energy Labelling regulations could have added value beyond the existing legislation, and, in the case of third country legislation, whether there is successful legislation that could serve as a model for Ecodesign or Energy Labelling legislation.

16.2.1 Overview of EU policies

Currently, lifts are regulated under the REACH Regulation. Also the Lifts Directive and the Directive on the Energy Performance of Buildings (EPBD) are relevant to consider.

Table 57: Main EU legislation applicable to the “lifts” product group

<table>
<thead>
<tr>
<th>Product group</th>
<th>WEEE</th>
<th>RoHS</th>
<th>REACH</th>
<th>EPBD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lifts</td>
<td>-</td>
<td>-</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

Lifts have to comply with REACH as toxic substances can be included in them in very low amounts. Also halogenated substances and plasticizers are used in plastics (e.g. PVC), and the use of such substances is regulated by REACH.

It is interesting to note that lifts are not subject to the WEEE and RoHS Directives. The rationale behind it is that they are “large stationary installations”, so they do not present much risk of “leakage” into the environment. The WEEE and RoHS Directives apply to products that can be moved and carried; they do not apply to fixed installations.

**Lifts Directive (Directive 95/16/EC and 2014/33/EU)**

The so-called “Lifts Directive” was adopted in 1995. Article 2 of the Directive sets out requirements regarding health and safety. This Directive has been updated and a new Lift Directive 2014/33/EU published. It will be enforced in April 2016.

The Lifts Directive does not make any reference at all to energy consumption. Essential health and safety requirements mentioned in Annex I are rather general requirements and do not include anything on oil leakage, vibrations and noise (as addressed in section 16.1). However, the essential health and safety requirements listed in Annex 1 of both Directives are not the only ones applicable to lifts, since they are supplemented by those listed in the Machinery Directive, and also considered as

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applicable\textsuperscript{184}. Moreover, it is left to the responsibility of the designer to carry out a risk assessment in order to identify if there are other risks which are not covered by those essential safety requirements\textsuperscript{177}.


On 19 May 2010, a recast of the Energy Performance of Buildings Directive was adopted by the European Parliament and the Council of the European Union in order to strengthen the energy performance requirements and to clarify and streamline some of the provisions from the 2002 Directive it replaces. As of 31 December 2020, new buildings in the EU will have to consume “nearly zero” energy and the energy will be “to a very large extent” from renewable sources. However, there is no specific target set for the renovation of existing building\textsuperscript{185}.

Lifts and escalators represent only between 3% and 8% of the energy consumption of buildings, whether main public buildings or residential dwellings\textsuperscript{186}. However, lifts (and escalators) are neither explicitly mentioned nor explicitly covered by the Energy Performance of Buildings Directive: it is still unclear what a “building” really includes, and there is room left for Member States interpretation.

One option would be the inclusion of lifts into EPBD. This seems to be the favoured option of the E4 study coordinator (Professor Aníbal de Almeira)\textsuperscript{187}, who oriented the Portuguese transposition of EPBD in this direction (see next section). This is also the preference of some stakeholders, including the European Lifts Association (ELA) and the German Verband Deutscher Maschinen- und Anlagenbau (VDMA). It is not certain, however, that specific requirements for lifts will ever be as precise within EPBD as they could be within Ecodesign Regulation (see section 16.3.2 for development).

**16.2.2 Selected Member States policies**

For the reason that lifts are a part of buildings, ELA recommends to define energy efficiency requirements, if needed, in the corresponding Directive for buildings (EPBD). The fact that Denmark (see regulation BR10) and Portugal (see Portaria n° 349-D/2013) included such requirements for lifts in their national transpositions supports ELA recommendation\textsuperscript{188}.

Indeed, the transposition of EPBD in Portugal is one example of Member State action to reduce energy consumption of lifts. “Taking advantage of the reputation of the team of Professor de Almeida (University of Coimbra), the Portuguese authorities accepted to integrate lifts & escalators in the national law covering the energy performance of buildings and imposed some energy efficiency improvement to all public buildings lifts in Portugal. The German guideline VDI 4707 was used as a basis to measure energy consumption (see section below). The process is on track and it is expected that the Decree will be published during the first quarter of 2013”\textsuperscript{189}. Indeed, the Decree of August 2013 (118/2013), was the transposition of EPBD into Portuguese law, and was followed by the Ordinance of December 2013 (349-D/2013). This Ordinance calls for an oncoming methodology or, by


\textsuperscript{185} ECEEE, EPBD Recast (Directive 2010/31/EU): \url{http://www.eceee.org/policy-areas/buildings/EPBD_Recast}.

\textsuperscript{186} \url{http://www.lift-report.de/index.php/news/417/355/ELA-2010-Seminar-in-Berlin}.


\textsuperscript{188} ELA, stakeholder comment to Task 3 (received per email).

default, the following rule will apply: as of 31st December 2015, all new lifts placed on the market will have to respect VDI 4707 class B or above.

A similar transposition of EPBD took place in Denmark, i.e. the Building Regulation 2010 (BR 2010)\(^{190}\). It sets out information requirements, and namely: “The power consumption of lifts based on expected transport per day must be stated. Standby consumption must also be stated. Provision must be made for measuring consumption”. The expected standby consumption and the energy consumption from operation of lifts will be included in the energy performance framework after 2015.

### 16.2.3 Industry Self-Regulatory Initiative

Beyond the German Guideline VDI 4707, which has been developed by the Association of German Engineers (Verein Deutscher Ingenieure) and which will be presented later on, the only industry initiative that could be identified is Product Category Rules (PCR) for lifts.

These specific PCR have been under development since May 2013, and final publication is expected to take place in June 2015\(^{191}\). A “draft PCR for second open consultation – Lifts (elevators)” was released and made public in May 2014. It provides draft Product Category Rules (PCR) for the assessment of the environmental performance of lifts, and the declaration of this performance by an Environmental Product Declaration (EPD).

The function of the lift can be defined as the vertical (or inclined) transportation of persons, freight or both. The functional unit which has been defined to carry out Life Cycle Analysis (LCA) is the transportation of 1 ton of load over a distance of 1 kilometre. The system boundaries covered by this PCR can be broken down to:

- Upstream module (cradle-to-gate), core module (gate-to-gate), and downstream module (gate-to-grave);
- Product stage, (building) construction process stage, use stage, and end-of-life stage according to EN 15804\(^{192}\); and
- “Cradle-to-Gate”, “Cradle-to-Job”, and “Cradle-to-Grave” according to typical clustering of life cycle stages in LCA studies.

As is also illustrated in figure below, the scope of Product Category Rules goes far beyond energy consumption (and energy efficiency). The letters in the figure are referring to the annexes (A to C) of the draft PCR.

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\(^{190}\) Available in English at: [http://www.buildup.eu/sites/default/files/content/BR10_ENGLISH.pdf](http://www.buildup.eu/sites/default/files/content/BR10_ENGLISH.pdf).


\(^{192}\) EN 15804 (2012), Sustainability of construction works — Environmental product declarations — Core rules for the product category of construction products.
The European Federation for Small and Medium-size Elevators Enterprises (EFESME) considers that “a voluntary type of instrument such as PCR for Lifts, duly agreed upon by the higher possible representatives of the lift industry, might lead to the expected results while limiting the burden for all the companies involved”\(^{177}\). They also emphasize the need of PCRs to also consider the environmental impact of partial modernizations. “This would encourage the improvement of the energy efficiency of lifts in existing buildings, because it would guarantee a more efficient and less expensive way of greatly improving the energy performance of the existing stock of lifts, without the need to fully produce completely new lifts”\(^{177}\).

However, it should be noted that Product Category Rules are only a methodological convention, which defines how an LCA should be carried out and sets the (minimal) content of the Environmental Product Declaration. They do not include any requirements on the product itself.

16.2.4 Existing third country legislation and labels

One Mexican endorsement label (Sello FIDE No. 4165) establishes specifications for electric traction elevators for passenger transport and movement of objects with vertical guides, with or without machine room.

The 2011-revision of this Mexican label sets out requirements on\(^{193}\):

- Energy consumption in both standby and travel modes, based on VDI standard 4707; and
- Noise levels (60 dB inside the lift’s cabin).

16.2.5 Test standards

Three different test standards have to be mentioned:

- ISO standard 25745 on energy consumption;
- VDI 4707 guideline on energy consumption; and
- VDI 2566 guideline on noise levels.

Also at European level, standard EN 81-20/50 exists and deals with safety aspects of lifts (but not with any energy efficiency aspects). There is an ongoing roadmap to migrate standard EN 81-20/50, as well as other regional standards, to a single ISO 22559-6, thus getting one global standards for lifts (used as identical national standard worldwide). This roadmap encompasses three different phases and should be completed by 2026:

- Phase I: Identical adoption of EN 81-20/50 as ISO 22559-6/7 and creation of a regional Technical Specifications (TS);
- Phase II: First amendment to ISO 22559-6/7; and
- Phase III: Regular (every 3 years) revisions Final result and incorporation of regional TS.

ISO standard 25745 series

The ISO 25745 standard is named “Energy performance of lifts, escalators and moving walks” and made out of two parts:

- Part 1: Energy measurement and verification; and
- Part 2: Energy calculation and classification for lifts (elevators).

With ISO 25745, an international standard is available which provides some ways to evaluate the energy consumption of lifts during their use phase. At the moment, there are no standards giving specific indications for lifts concerning their ecological impact extended to the whole life cycle. Stakeholders, ranging from ELA to EFESME, vote in for this ISO standard, which is considered to be the most reliable and representative available.

VDI 4707 guideline

VDI 4707 is a lift energy efficiency classification guideline which has been established by the Association of German Engineers (Verein Deutscher Ingenieure). It classifies lifts from A to G according to their energy performance, in a way that is much similar to Energy labelling. However, it should be noted that ‘the VDI 4707-1 recommendation of the German engineers’ association is not a norm. It is only a guideline giving indications about the energy efficiency of lifts and a way to classify them.”

The VDI 4707 guideline breaks down energy demand into two parts:

- Standby demand: “the standby demand is determined 5 minutes after the last trip has ended and includes all relevant components for readiness for operation and maintaining it in standby” and
- Travel demand: “travel demand is typically determined with a reference trip with an empty cabin and covers a complete trip cycle. The measurement starts at open door at first level. The lift

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195 Bucher Hydraulics (2010), VDI 4707 "Energy efficiency of lifts".
doors close and the lift travels to the top level when the doors open and close once. The cabin travels down and the measurement cycle ends when the doors open\textsuperscript{195}.

Elevators are assigned to different energy efficiency classes depending on their calculated standby and travel demand values, what is further illustrated by Figure 7. Specific demand classes for standby and travel modes are detailed in Table 58.

![Image of elevator energy efficiency classification](http://www.schindler.com/content/nz/internet/en/mobility-solutions/products/elevators/_jcr_content/rightPar/downloadlist/downloadList/56_1371006083020.download.asset.56_1371006083020/VDI%20Brochure.pdf)

**Figure 7:** VDI 4707 elevator energy efficiency classification, established by the Association\textsuperscript{196}

**Table 58: Energy demand classes for standby and travel modes\textsuperscript{197}

<table>
<thead>
<tr>
<th>Class</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standby (power in W)</td>
<td>≤ 50</td>
<td>≤ 100</td>
<td>≤ 200</td>
<td>≤ 400</td>
<td>≤ 800</td>
<td>≤ 1,600</td>
<td>&gt; 1,600</td>
</tr>
<tr>
<td>Travel (energy consumption in mWh/(kgm))</td>
<td>≤ 0.56</td>
<td>≤ 0.84</td>
<td>≤ 1.26</td>
<td>≤ 1.89</td>
<td>≤ 2.80</td>
<td>≤ 4.20</td>
<td>&gt; 4.20</td>
</tr>
</tbody>
</table>

Today, the “big four” manufacturers are using the VDI standard, and even if the precise figure is not known, the vast majority of new lifts fall into class A or class B. All KONE’s latest products, for instance, are class A\textsuperscript{198}. VDI 4707, however, gets criticized by some stakeholders as discriminating some type of products still very popular in the market. They claim that the calculation performed in VDI 4707 is not correct, and the results in most cases are quite far from those obtained by the implementation of the ISO 25745-2 standard\textsuperscript{197}.

The VDI 4707 standard still serves as a basis for various purposes, including the transposition of EPBD in Portuguese law, or the voluntary label developed in Mexico.

**VDI 2566 guideline**

VDI 2566 has been dealing with noise emissions of lifts since 1988, and is currently under revision to cover and to refer to latest state of the art technology. This guideline includes\textsuperscript{199}:  


\textsuperscript{197} Toni Tukia (2014), Determining and modelling the energy consumption of elevators. Master thesis of Aalto University – School of Electrical Engineering.

\textsuperscript{198} Phone interview with a representative from Schindler.
• Reference values for the noise emission in the machine room (airborne and structure-borne-sound levels), in front of landing doors, in the well, and in the car;

• Recommendations for sound insulation in the building (airborne and structure-borne-sound insulations) aiming at complying with the permissible noise-exposure values in rooms requiring protection (occupied areas);

• Planning aids for the structure-borne-sound-insulated mounting of equipment; and

• Guidance for the measurement of noise emission and noise exposure in occupied areas, and of sound insulation in completed systems and buildings.

Dealing with noise, it should be noted that noise levels are much dependent on a proper integration of the lift into the building.

16.2.6 Conclusion for Ecodesign

Policy coverage of the lifts product group is already pretty dense. Most notably, the Energy Performance of Buildings Directive (EPBD) forms an existing framework into which specific requirements on energy consumption could fit. Moreover, two promising European initiatives could be elaborated on: Product Category Rules (PCR) on the one hand, and the VDI 4707 test standard on the other hand – both of them being complementary to each other.

16.3 Appropriateness of Ecodesign or Energy labelling

16.3.1 Excessive cost

Relevant information is related both to purchase price (CAPEX) and the cost in use phase (OPEX), including energy and other maintenance costs.

Purchase price

Not any price is available on the manufacturer’s websites. 80,000–90,000€ could serve as a broad range for residential buildings199, which is yet the whole installation cost, including labour. Generally speaking, the cost calculation is made difficult since manufacturers tend to place only BAT lifts on the market. Manufacturers commonly equip residential and tertiary lifts with the same technology, to the exception of regenerative drive (mostly for high-range lifts today); this means that the gap in energy consumption between residential and tertiary lifts, above all, is due to the number of starts.

Information is scarce and difficult to get, since prices and costs can vary very much across different lift configurations. As far as excessive cost is concerned, it can only be said that excessive cost could occur if the requirements set are too ambitious: for instance if target values are extremely tight and force manufacturers to switch to regenerative drive and/or permanent magnet motors even for mid-rise or small rise elevators.

Maintenance costs

The E4 study underlines that “manufacturers strongly compete for maintenance contracts, thus offering not only lifts as a product, but as a part of a general service package. The transformation of the market from a manufacturing to a service-oriented sector is often seen as completed”. Manufacturers are much interested in maintenance contracts, since they bring cash flows on a more regular basis. One could conclude that this business-model is closed to a leasing business-model, but

199 http://www.pap.fr/conseils/copropriete/installer-un-ascenseur/a3287
no manufacturer made the switch to a real service-oriented business-model so far (where the lift is only leased and remains the property of the manufacturer). This shift to “functional economy” has been thought about since the 1990s, but the extended lifetime of lifts make it difficult to implement. As a matter of fact, the building owners prefer to be proprietary of the lift (including all related software solutions), so that they can hedge the risk of a bankruptcy of the lift manufacturer. And, stakeholders say, the larger the building is, the more the owner wants to keep property of the vertical transport service within his building\textsuperscript{175}.

A general trend is that maintenance costs grow with complexity, which means that (old) hydraulic lifts of simple design are much cheaper to maintain than newer traction lifts (with more electronics included). However, regarding maintenance costs, it is being said that they are not necessarily higher with a new range of technological options\textsuperscript{198}. Parallel to this is the trend to have more proprietary solutions in state-of-the-art lifts than in older models\textsuperscript{200}.

16.3.2 Suitability of Ecodesign measures or Energy labelling

**Suitability within the Ecodesign Directive**

When it comes to setting Ecodesign requirements for lifts, several points are brought forward by stakeholders:

- **Energy efficiency is mainly driven by market forces.** Some manufacturers claim that much progress has already been done\textsuperscript{201}. This means that products placed on the market today are more energy-efficient than they used to be. It is also believed that the development of VDI 4707 already gave a “push” to the market. To this extent, lifts placed on the market today could be considered as energy-efficient enough, stakeholders say, and Regulation as unnecessary “administrative burden that [needs to be kept to] an absolute minimum”\textsuperscript{202}. The discussion on the installed base of lifts will take place in the next section;

- **Sales are limited.** As stated in Task 3 report, yearly sales of lifts in the EU-27 are estimated to be of approximately 110,000 units. Some stakeholders have insisted that this sales volume is below the 200,000 of the Ecodesign Directive (2009/125/EC). However, it shall be remembered that this mark is only indicative in the Directive\textsuperscript{203}.

- **Lifts are tailor-made products.** VDMA points out that “lifts can be designed very individually and customer-specific so that they are sometimes difficult to compare. Hence, these do not represent an easily comparable mass product and they are not suitable for a regulation under the Ecodesign Directive”\textsuperscript{179}. Indeed, lifts are integrated into buildings, and this can affect their respective energy consumption. However, Ecodesign Regulation may be appropriate even for tailor-made products, and the presence of test standards for lifts softens the argument of products being tailor-made products;

- **Other kinds of requirements could be envisaged, including:**
  - Requirements on the efficiency and lifetime of the motor (taking inspiration from the vacuum cleaner Regulation\textsuperscript{204});

\textsuperscript{200} Phone interview with the European Federation for Small and Medium-size Elevators Enterprises (EFESME).

\textsuperscript{201} According to Mitsubishi, 70% savings have been already achieved since the 1960s for elevators and 38% for escalators.

\textsuperscript{202} KONE, stakeholder’s comment to Task 4.

\textsuperscript{203} The text is this: “The product shall represent a significant volume of sales and trade, indicatively more than 200 000 units a year within the Community according to the most recently available figures”.

\textsuperscript{204} ECOS and EEB, stakeholders’ comments to Task 4.
− Information requirements, for instance: next to the lift calling button, there could be a mandatory sign indicating in which configuration / load the energy consumption is minimal. This way, people could decide to take the stairs if they are alone; or, if there are too many passengers and several adjacent elevators, they could split into two or three groups instead of cramming into a single one.

− In addition, it would be interesting to study the possibility of changing only the control system of lifts, i.e. without refurbishing the shaft, cabin and machinery. Theoretically, separate action on software should be cheaper to implement than any physical change, while causing (possible) significant energy savings. The feasibility of such Ecodesign / Energy labelling requirements would need to be further explored.

Energy labelling does not sound as promising as Ecodesign (or EPBD), since lifts installed today are not very much different in terms of energy consumption: as stated above in section 16.2.5, at least lifts placed on the market by manufacturers of the “big four” fall into VSI classes A or B. This means that the range for energy-efficiency would probably not be as big enough to design seven different energy classes (within Energy labelling).

Ecodesign and EPBD

As explained in section 16.2.1, the inclusion of lifts into EPBD would be an option to regulate energy consumption. This route might indeed not provide as precise regulation for new lifts as Ecodesign could, but bears the potential to address also existing lifts and obligate owners of buildings to (partly and cost efficiently) modernise existing installations179. In other words, Ecodesign will not have any impact on the installed base, but could EPBD have one? Does EPBD introduce any requirement for renovation works? A dedicated Preparatory Study would have to elaborate on this.

Whereas the argument of the installed base would speak for EPBD, time could rather speak for Ecodesign (even if Ecodesign policy process is also appreciably long). As a matter of fact, Member States could introduce obligations for lifts through the current EPBD but are not obliged to, and EPBD at European level will need quite long to recast. With EPBD it would take years before a new revision is launched with no certainty about the lift case, and there would be a major risk of Member States not transposing the requirements in an ambitious or precise way. According to consumers' representatives at European level, this makes the EPBD option much less appealing204.

16.3.3 Conclusion for Ecodesign

An in-depth study, which could be either a Preparatory Study explicitly, or a general update of the E4 study with a clear focus on policy action, should clarify to which extent Ecodesign or EPBD Regulation are appropriate for lifts.

16.4 Industrial competitiveness

16.4.1 Market structure

There are big four lifts manufacturers in Europe (Schindler, KONE, ThyssenKrupp, Otis) and several hundreds of smaller players (present at national levels)205. In one single country like Germany, there are over 800 companies working in the lift industry (including component-makers). It is also being said that the number of manufacturers in Italy alone is higher than the overall number in the rest of

205 Mitsubishi could be mentioned along with the big players, but its share on the European market is not as significant as it is on the American or Asian markets.
There is a connection between the sales of new lifts and the after-sales service, which is the reason why there are so many thousands of SMEs operating in Europe.

According to VDMA, “especially SME’s are challenged by the tough competition on the one hand and the dense regulation on lifts on the other hand”.

16.4.2 Innovation and employment

In year 2008, it was estimated that some 150,000 workers were involved in the lift sector in the EU, 60% of them in the field of installation, renovation and maintenance. Although the number of lifts in service in Europe has grown steadily, the number of employees has certainly not grown in parallel by a proportional amount. It has not been possible to get any figure at broader European level.

16.4.3 International competition

Obviously, any Regulation on the environmental performance of lifts should carefully consider the implications of products which are manufactured in countries outside Europe, where such rules and concerns about the environmental impact are almost completely ignored. However, as Ecodesign requirements uniformly apply to all manufacturers regardless of where they are originally located, this concern is really relative.

16.4.4 Conclusion for Ecodesign

The split of the lift industry between a few big players and many smaller manufacturers probably means that Ecodesign requirements would not be equally received (and implemented) by all obligated parties.

16.5 Product group summary and recommendations

Table 59 below presents a simplified scoring of the four main sections above, for the product group “lifts”.

Table 59: Overall scoring of the "lifts" product group

<table>
<thead>
<tr>
<th>Product group</th>
<th>Other environmental impacts</th>
<th>Policy gaps</th>
<th>Appropriateness of Ecodesign</th>
<th>Appropriateness of Energy labelling</th>
<th>Industrial competitiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lifts</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>+</td>
<td>++</td>
</tr>
</tbody>
</table>

The more “+” there are in the assessment, the more favourable it is for Ecodesign or Energy labelling Regulation to be implemented.

The following types of Ecodesign measures could in principle be envisaged for lifts:

- Minimum requirements on energy efficiency. These requirements could be set either through Ecodesign or the Energy Performance of Building Directive (EPBD); and
- Minimum requirements on noise and vibrations.

Energy labelling, due to the relative closeness of new lifts’ energy performance, does not look applicable to the “Lifts” product group.

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206 ETUI (2010), A Trade Union look at the Lift Sector.
17. Mobile phones

### 17.1 Main other environmental issues

Table 60 below provides an overview of relevant further environmental aspects of the “mobile phones, smartphones” product group, and possible improvement options linked to them. Energy and basic resource consumption have been discussed in Task 3. Hence the table and the paragraphs below focus on the main other environmental impacts of the product group.

Table 60: Overview of relevant direct environmental issues and potential for improvement – Mobile phones

<table>
<thead>
<tr>
<th>Environmental issue categories</th>
<th>Scoring</th>
<th>Description of the environmental issue</th>
<th>Description of related improvement potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water consumption in use phase</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consumables (detergents, etc.)</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use of critical raw materials (see the EU list[^207])</td>
<td>++</td>
<td>A number of different critical raw materials is used in mobile phones.</td>
<td>Easy retractability of battery at EoL can facilitate increase of cobalt recycling rates. Some manufactures attempt and achieve phase out of beryllium and to a limited extend antimony based on grounds of hazardousness.[^208] According to stakeholder comment, limited substitution possible due to unique material properties. Recycling is presently happening through metallurgical processes. Industrial scale recycling and smelter technologies do not exist for some materials. Increase use-time of mobile phones and facilitate increased recycling.</td>
</tr>
<tr>
<td>Presence of flame retardants</td>
<td>+</td>
<td>Possibly flame retardants in plastic and electronic</td>
<td>Non-halogenated flame retardants exist. A dedicated</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Environmental issue categories</th>
<th>Scoring</th>
<th>Description of the environmental issue</th>
<th>Description of related improvement potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>(halogenated, etc.)</td>
<td></td>
<td>components (Printed Circuit Boards, connectors)(^{209}). Individual companies have completely phased out all bromine and chlorine, including brominated flame retardants (BFRs).(^{210}) Others have phased out BFRs for select models only.</td>
<td>preparatory study would have to determine whether they can be used for mobile phones and if they provide life cycle environmental benefits.</td>
</tr>
<tr>
<td>Presence of plasticisers (phthalates)</td>
<td>+</td>
<td>Phthalates are used in mobile phone cables</td>
<td>Alternatives with less harmful phthalates or other substances possible. Some manufacturers achieve phthalate-free cables.(^{210})</td>
</tr>
<tr>
<td>Presence of other toxic substances</td>
<td>+</td>
<td>Possibly arsenic in display glass. PVC used in cables.</td>
<td>Some manufacturers achieve arsenic-free glass and PVC free cables.(^{210})</td>
</tr>
<tr>
<td>Use of F-gases</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiation levels</td>
<td>++</td>
<td>Electromagnetic radiation is technology immanent.</td>
<td>Improvement potential not clear as technological options to limit electromagnetic exposure are widely already implemented.</td>
</tr>
<tr>
<td>Safety (fuel leakage, vibrations, etc.)</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health (hygiene, noise level, etc.)</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Durability (reusability, upgradability, reparability, etc.)</td>
<td>+++</td>
<td>Discussed in Task 3.</td>
<td></td>
</tr>
<tr>
<td>End-of-life (recyclability, recycled content)</td>
<td>+++</td>
<td>Discussed in Task 3.</td>
<td></td>
</tr>
<tr>
<td>Direct emissions to air</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct emissions to water</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct emissions to soil</td>
<td>0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Scoring: "0" if not an issue for the product group. If this is an issue, the indicative importance of the environmental issue is provided from + (low) to +++ (high).


17.1.1 Use of critical raw materials

The following critical raw materials may be used in mobile phones based on typical components, i.e. plastic casings, ICs, PCBs:211

- Possibly **antimony** in (plastic) flame retardants as substitute for banned flame retardants;
- **Beryllium** in electronic components;
- **Borates** commonly used in LCDs (and possibly in display glass?);
- **Cobalt** in rechargeable Li-Ion batteries (its major use);
- **Gallium** in Integrated Circuits (ICs) and in LEDs (presumably experiencing rapid growth);
- **Germanium** used for high-brightness LEDs;
- **Indium** used i.a. in LCDs (strong growth expected), lead-free solders, batteries, LEDs;
- **Magnesium** alloys used in some mobile phones;
- **Natural graphite** in Li-Ion batteries;
- Small amounts of **niobium** used;
- **PGMs**: platinum and palladium in some printed circuit boards, iridium for manufacture of LEDs and used in OLEDs; in manufacture of LCDs; and
- Light Rare Earth Elements used in NiMH batteries.

It is not clear to what extent phone variants are on the market that do not make use of these. Some manufactures attempt and achieve phase out of beryllium and to a limited extend antimony based on grounds of hazardousness.212

Li-Ion batteries are the main use for cobalt, amounts used in mobile phones hence more significant than for other critical raw materials. Recycling of cobalt is possible if batteries are treated separately at end-of-life. Improvement potential hence lies in facilitating easy retrieval of battery (within seconds for economic operation).213 Increased life-time reduces overall needed resource quantities (see Task 3 report). Increased recycling rates lead to increased quantities of available recycled material.

No indication on available substitutes for the other mentioned critical raw materials.

_Ecodesign may play a role in addressing critical raw materials through promoting longer lifetime and increased recycling rates and easy retractability of the battery (see Task 3)._211

17.1.2 Presence of flame retardants

Flame retardants are used to comply with fire safety requirements. Possibly flame retardants in plastic and electronic components (Printed Circuit Boards, connectors).

Use of flame retardants is informed by REACH Regulation (1907/2006) and restricted in RoHS. Less harmful substitutes are available, e.g. through use of antimony (see previous Section).

213 See Task 2 supplementary report and Task 3 report on mobile phones.

Individual companies have completely phased out all bromine and chlorine, including brominated flame retardants (BFRs).\textsuperscript{214} Others have phased out BFRs for select models only. Non-halogenated flame retardants exist. A dedicated preparatory study would have to determine whether they can be used for mobile phones and if they provide life cycle environmental benefits.

*Hazardous substances in mobile phones should be addressed in the dedicated RoHS and REACH regulations.*

17.1.3 Presence of plasticisers (phthalates)
Mobile phones usually use cables for their own power supply, which often contain phthalates; Phthalates are also used in synthetic rubber and flexible PVC.

Some manufacturers achieve phthalate-free cables.\textsuperscript{214}

Less toxic, high-molecular-weight phthalates or other less harmful substances exist. A dedicated preparatory study would have to determine whether they can be used for mobile phones or if phthalate-free plastics can be used and provide life cycle environmental benefits.

Phthalates as a particular group of hazardous substances in mobile phones should be addressed in the dedicated RoHS and REACH regulations.

17.1.4 Presence of other toxic substances
Based on claim by at least one manufacturer about arsenic-free displays\textsuperscript{214}, presence of arsenic in displays may be an issue. Also PVC is used for cables, with alternatives being available.

17.1.5 Radiation levels
Electromagnetic radiation (EMC, EMF) is technology immanent and consumers clearly exposed to it. There is, however, no clear indication that it impacts consumers and that existing legal requirements cannot or are not met. Technological options exist to limit electromagnetic exposure. Long-term studies still need to be completed on the effects of electromagnetic radiation.

*Should radiation levels be identified to exceed safe limits these should be addressed in the respective regulations.*

17.1.6 Durability (reusability, upgradability, reparability, etc.)
See Task 3.

17.1.7 End-of-life (recyclability, recycled content)
See Task 3.

17.1.8 Conclusion for Ecodesign
Durability (economic and technical lifetime) and end-of-life treatment/treatability are the major issues. These have been thoroughly discussed in Task 3.

\textsuperscript{214} https://www.apple.com/environment/toxins/
17.2 Policy coverage

This section is dedicated to the regulatory coverage of the product groups addressed, be it through legislation, within the EU or in third countries, through voluntary agreements and environmental labels or standards. The goal is to identify where Ecodesign or Energy Labelling regulations could have added value beyond the existing legislation, and, in the case of third country legislation, whether there is successful legislation that could serve as a model for Ecodesign or Energy Labelling legislation.

17.2.1 Overview of EU policies

Currently, EU WEEE, RoHS and REACH are relevant for wireless chargers for consumer electronics. No applicable Ecolabel or GPP criteria were identified.

Table 61: Main EU legislation applicable to the “wireless chargers” product group

<table>
<thead>
<tr>
<th>Product group</th>
<th>WEEE</th>
<th>RoHS</th>
<th>REACH</th>
<th>EPBD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mobile phones, smartphones</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>-</td>
</tr>
</tbody>
</table>

Mobile phones fall under scope of WEEE Directive (2012/19/EU) under category 3. IT and telecommunications equipment or category 4.

With regard to Annex III they would fall in the category 6. Small IT and telecommunication equipment (no external dimension more than 50 cm).

Ecodesign could facilitate the prevalence of adequate design of products to allow for easy retractability of batteries for the recovery of contained cobalt and safer operations. Also ensuring easy accessibility of key components could be achieved through Ecodesign. Setting such Ecodesign requirements is an implicit suggestion in Article 4 of the WEEE Directive.

The RoHS Directive (2011/65/EU) similarly applies to mobile phones and falls in Category “IT and telecommunications equipment” in Annex 1. Hence, its provisions apply, i.a. Article 4 on Prevention, hence the restricted substances and the tolerated maximum concentrations apply.

Provisions of REACH Regulation (1907/2006) apply with regard to use of substances in the product. No consideration of specific substances has been taken here. Should the product group contain substances that are subject to specific provisions in REACH, it is conceivable that Ecodesign establishes additional criteria to limit exposure to these substances in the final product. This would be in line with the consideration of the European Parliament and of the Council in establishing the REACH Regulation ((14) in the preamble). In general preference should however be given to regulating hazardous substances in RoHS and REACH.

Directive 2013/56/EU on batteries and accumulators and waste batteries and accumulators applies to mobile phones. Current provision included in the directive and explained in an accompanying Q&A document are understood to not require fast retractability of battery at end-of-life and easy replacement of batteries by consumers without tools.

In this “Battery Directive” the easy retractability of batteries at end of life and the easy replicability of batteries by consumers (without tools) could be implemented. Should this not be possible, Ecodesign requirements could be developed and defined for mobile phones.
Commission Regulation (EC) for External Power Supplies (No 278/2009) applies to external power supplies of mobile phones and has effectively contributed to reducing overall energy consumption of mobile phones.

Directive on certain aspects of the sale of consumer goods and associated guarantees (1999/44/EC) provides basic requirements on product warranty.

Other policies of direct relevance for mobile phones:
- EMF Directive 2013/35/EU; and

17.2.2 Selected Member States policies

The following section is dedicated to Member States policies which are in place inside the EU and of which Table 62 gives an overview.

<table>
<thead>
<tr>
<th>Product group</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mobile phones</td>
<td>RAL-UZ 106</td>
</tr>
</tbody>
</table>

Thus, the only label which could be identified to certify “mobile phones” is the German Blue Angel label. The criteria for the award of the Blue Angel label for mobile phones date from February 2013 and are valid until 2015.\(^{215}\)

Table 63 shows an extract of the requirements mobile phones have to comply with in order to obtain the Blue Angel label. However, the requirements listed here below are not exhaustive and there exist still various other demands.

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charging bar and notification</td>
<td>Display recharging status and notify when phone should be disconnected from power source after charging is complete</td>
</tr>
<tr>
<td>External power supply</td>
<td>Standardised power supply according to EN 62684 - &quot;Interoperability specifications of common external power supply (EPS)&quot; and respective USB interface</td>
</tr>
<tr>
<td>Warranty</td>
<td>Free-of-charge 2 year warranty except for battery</td>
</tr>
<tr>
<td>Software</td>
<td>Free-of-charge software updates to address especially security issues</td>
</tr>
</tbody>
</table>

\(^{215}\) Blue Angel (2013), Vergabegrundlage für Umweltzeichen, Mobiltelone RAL-UZ 106.
### Requirement

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personal data</td>
<td>To facilitate re-use by others, personal data shall be erasable by user him-/herself and without additional cost</td>
</tr>
<tr>
<td>Batteries</td>
<td>Must be easily retrievable for recycling purposes, with standard tools and within 5 seconds, without punctuating battery. User must be able to replace battery without tools. Requirements for tested battery durability.</td>
</tr>
<tr>
<td>Hazardous substances</td>
<td>Restriction of certain hazardous substances in different components;</td>
</tr>
<tr>
<td>SAR</td>
<td>&lt; 0.6 Watt/ kg</td>
</tr>
</tbody>
</table>

Currently no phones are registered under the Blue Angel scheme.

### 17.2.3 Industry Self-Regulatory Initiative

Last year the International Telecommunication Union (ITU) has announced the creation of an **eco-rating scheme for mobile devices** intended to inform consumers on mobile phones’ environmental impact. 216 Organisations involved supposedly include “Alcatel-Lucent, Apple, BlackBerry, Fujitsu, Huawei, Motorola, Nokia and Samsung, operators AT&T, Orange, KPN, Telefónica and Vodafone, and industry partners including the GSMA”. According to ITU “carbon footprint; battery life; the use of certain chemicals and rare metals; packaging; and recyclability, among others” are considered as criteria considered.

It is still unclear when this scheme will be mature, what it will entail and how effective it will be in improving resource efficiency of mobile phones.

Another industry initiative is the **Code of Conduct on Energy Efficiency of External Power Supplies**. However this does not seem to be pursued actively as effective regulation is in place.

No other self-regulatory initiatives were identified.

### 17.2.4 Existing third country legislation and labels

EPA Taiwan has a regulation/ label for mobile phones in place.

TCO Certification criteria for smartphones have been developed. 217

### 17.2.5 Test standards

No test standard for core interventions on use-time extension and recyclability have been identified.

A related test standard is: EN 62684 - "Interoperability specifications of common external power supply (EPS)"

216 http://www.itu.int/net/pressoffice/press_releases/2013/40.aspx#.VIEiTmNAQ8U
17.2.6 Conclusion for Ecodesign

The most important issues with regard to environmental impacts of mobile phones, i.e. design for durability/longer technical and economic lifetimes as well as easy recoverability of resources at end-of-life are not yet adequately addressed or implemented in existing policies. Ecodesign could complement provisions in WEEE, e.g., imposing requirements on easy retrievability of cobalt (through fast retractability of battery), easy replacability of battery by consumer, and measures to increase economic lifetime of mobile phones, e.g., with regard to data retrieval, security and storage. These considerations are congruent with the conclusions in the Task 3 report.

Easy retractability of battery at end-of-life and easy replicability by end-users could be specified in the existing Battery Directive.

17.3 Appropriateness of Ecodesign or Energy labelling

Whereas the “regulatory coverage” section addressed the question of current mandatory and voluntary instruments (are they enough to cover this specific product group?), the section on “Appropriateness of Ecodesign requirements” addresses the question of future regulation (would Ecodesign or Energy labelling adequately cover this specific product group?).

17.3.1 Excessive cost

As no energy efficiency requirements are suggested, additional costs imposed by technical improvements do not normally lower electricity bills of end-consumers. However, measures to increase technical and economic lifetime could reduce inclination of consumers to purchase new phones, significantly lowering monetary expenses.

No detailed cost assessment was done due to the diverse nature of improvement options and phone technologies. It can be assumed that some of the possibly most effective improvement options can be implemented with little or no cost or even economic benefits (e.g., through economic resource recovery):

- Allow for easy replacement (without tools) of battery by end-user to extend active use-time (already implemented by some manufacturers);
- Allow for easy manual retrieval, archiving and erasure of personal data; this may also require the availability of replacements memory to facilitate disposal of phones into appropriate treatment infrastructure or passing phones on to a new owner (secure erasure is already implemented by some manufacturers);
- Design for easy retractability of battery (within seconds) for improved recycling (already implemented by some manufacturers);

Many of these options are implemented in existing mobile phones. However, there is a natural conflict of interest between longer phone lifetimes and the economic interests of phone manufacturers. Some lifetime extension costs (e.g., buying a new battery) may be perceived as high by consumers, hence considering purchase of newer phones earlier than necessary.

17.3.2 Suitability of Ecodesign measures or Energy labelling

Ecodesign seems suitable for regulation of mobile phones, as:

- Mobile phones are mass market products;
- Technical variants for easy retrievability of battery at end-of-life are on the market;
• Technical variants for easy replicability of batteries by end-users are on the market; and
• Functionality to retrieve and securely erase data is mostly available and would likely only require moderate software adjustments;

Also mobile phones are not strongly integrated into a system.

An open question is the availability of applicable test standards, which would need to be assessed further.

Generally, Ecodesign seems the more appropriate instrument as compared to energy labelling, as no performance continuum has been identified. A caveat is the fast innovation cycle of mobile phones, which may limit suitability of specific Ecodesign measures. Hence, generic and technology neutral requirements should be favoured.

17.3.3 Conclusion for Ecodesign

Ecodesign could adequately cover some resource aspects of mobile phones that are not addressed by other policies or by energy labelling, in particular measures to extend use-time of mobile phones and recyclability.

17.4 Industrial competitiveness

17.4.1 Market structure

The market of mobile phones is highly competitive, with short innovation cycles. It is closely linked to other services (e.g. software eco-systems, apps, telecom providers, search, location based services, mobile payment, etc.) that influence market dynamics. Many manufacturers also sell other electronic devices, components or software. Many mobile phone variants exist on the market (estimate: several hundreds). However, few models make up major share of overall market. Roughly speaking, there are three market segments:

1. Simple mobile phones at lower end of price-spectrum;
2. Feature phones, employing additional features but also in heavy price competition; and
3. High-end phones that compete mostly on features, design and services and only partly on price.

The market structure is perceived as being favourable for Ecodesign requirement, especially as it is dominated by a few large and capable manufacturers. Implementing considered measures is likely

17.4.2 Innovation and employment

Smartphones today could be considered icons of technological innovation. Hence, the industry is developing new smartphone features and related devices at a rapid rate and presumably acts as a catalyst for innovation in related sectors.

At the same time basic technologies are established and standardised.

Introducing Ecodesign requirements could boost further innovation (if implemented technology neutral) and strengthen those companies that already implement such requirements internally. In particular, this innovative industry could stimulate innovation on resource issues also in adjacent sectors.

The mobile phone market is a global market with most devices manufactured and even designed outside Europe. Introducing requirements in Europe would likely stimulate a global uptake. Hence, no specific implications for employment in Europe are expected.
However, design and end-of-life requirements could strengthen the European recycling industry, leading to possible creation of additional jobs.

17.4.3 International competition
See Section before.

17.4.4 Conclusion for Ecodesign
Establishing Ecodesign requirements for mobile phones could stimulate innovation on resource efficiency, especially in related sectors such as recycling infrastructures in Europe. No particular effect on competitiveness in the mobile phone industry is expected if implemented in a technology neutral fashion. The market structure is rather favourable for the uptake of considered Ecodesign measures.

17.5 Product group summary and recommendations
Table 64 below presents a simplified scoring of the four main sections above, for the product group “mobile phones, smartphones”.

Table 64: Overall scoring of the ”mobile phones, smartphones” product group

<table>
<thead>
<tr>
<th>Product group</th>
<th>Other environmental impacts</th>
<th>Policy gaps</th>
<th>Appropriateness of Ecodesign</th>
<th>Appropriateness of Energy labelling</th>
<th>Industrial competitiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mobile phones, smartphones</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
<td>+</td>
<td>+++</td>
</tr>
</tbody>
</table>

The more “+” there are in the assessment, the more favourable it is for Ecodesign Regulation or Energy labelling to be implemented.

Other environmental impacts and related improvement options exist with regard to use-time of mobile phones and increased recyclability.

These issues are not fully addressed by existing policy or effective self-regulation.

In particular, the following Ecodesign measures could be considered: (see also Task 3)

- Requirements for easy and secure retrieval and erasure of personal data;
- Easy accessibility of key components; and
- Provisions on reparability (clear repair instructions).

Furthermore, the Battery Directive would be the most appropriate regulation to implement/ refine

- Requirements for easy retractability of battery at end-of-life (possibly through a horizontal measure for consumer devices or similar); and
- Requirements on easy replicability of battery by end-user without tools

If this is not possible, such provision could be considered in a possible preparatory study on mobile phones.

Generally, better data on the real fate of mobile phones, especially modern higher value smartphones, could significantly improve conclusions on most effective measures for increased resource efficiency.
If REACH and RoHS are continually developed to take into account new evidence those regulations are the best place to deal with many of the substance related issues.

There is no apparent case for Energy labelling.

Possible Ecodesign requirements, developed in close cooperation with the industry in a technology neutral manner, would likely stimulate overall innovation in resource-efficiency, in the industry and beyond. For example, effective tracking and targeting of achieved cobalt recycling rates may be an alternative to imposing specific technological requirements. However, this demands a very proactive and committed stance by industry.
### 18.1 Main other environmental issues

Table 65 below provides an overview of relevant further environmental aspects of the “mobile phones, smartphones” product group, and possible improvement options linked to them. Energy and basic resource consumption have been discussed in Task 3. Hence the table and the paragraphs below focus on the main other environmental impacts of the product group.

**Table 65: Overview of relevant direct environmental issues and potential for improvement – PV inverters**

<table>
<thead>
<tr>
<th>Environmental issue categories</th>
<th>Scoring</th>
<th>Description of the environmental issue</th>
<th>Description of related improvement potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water consumption in use phase</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consumables (detergents, etc.)</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Use of critical raw materials (see the EU list(^{218}))</strong></td>
<td>+</td>
<td>Possible CRMs in inverter related electronic components: Antimony in (plastic) flame retardants as substitute for banned flame retardants. Beryllium in electronic components. Cobalt in rechargeable Li-Ion battery containing variants. Gallium in Integrated Circuits (ICs) and in LEDs. Indium used i.a. in LCDs (strong growth expected), lead-free solders, batteries, LEDs. Natural graphite in Li-Ion batteries. PGMs: platinum and palladium in some printed circuit boards, Light Rare Earth Elements used in NiMH batteries</td>
<td>Design for recyclability for better recoverability.</td>
</tr>
<tr>
<td>Presence of flame retardants</td>
<td>++</td>
<td>Possibly flame retardants in plastic and electronic</td>
<td>Non-halogenated flame retardants exist. A dedicated</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Environmental issue categories</th>
<th>Scoring</th>
<th>Description of the environmental issue</th>
<th>Description of related improvement potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>(halogenated, etc.)</td>
<td></td>
<td>components (Printed Circuit Boards, connectors). PBB and PBDE have been identified in inverters.</td>
<td>preparatory study would have to determine whether they can be used for PV inverters and if they provide life cycle environmental benefits.</td>
</tr>
<tr>
<td>Presence of plasticisers (phthalates)</td>
<td>+</td>
<td>Possibly in attached cables</td>
<td>Less toxic, high-molecular-weight phthalates or other less harmful substances exist. A dedicated preparatory study would have to determine whether they can be used for PV inverters, if phthalate-free plastics can be used and if they provide life cycle environmental benefits.</td>
</tr>
<tr>
<td>Presence of other toxic substances</td>
<td>++</td>
<td>Lead and hexavalent chromium have also been identified.</td>
<td></td>
</tr>
<tr>
<td>Use of F-gases</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiation levels</td>
<td>+</td>
<td>Electromagnetic radiation (high-voltage product)</td>
<td></td>
</tr>
<tr>
<td>Safety (fuel leakage, vibrations, etc.)</td>
<td>+</td>
<td>Electric safety (high-voltage product)</td>
<td></td>
</tr>
<tr>
<td>Health (hygiene, noise level, etc.)</td>
<td>+</td>
<td>Noise has been identified as an issue, especially in residential installations. With large differences between different inverters on the market. This typically relates to ventilation.</td>
<td>Inverters with lower noise emission levels are available on the market.</td>
</tr>
<tr>
<td>Durability (reusability, upgradability, reparability, etc.)</td>
<td>++</td>
<td>Achievable life-time yet unclear. 20 years envisioned. As inverters are increasingly expected to provide “grid services” upgradability is an important issue.</td>
<td>Easy software and possibly hardware updates.</td>
</tr>
<tr>
<td>End-of-life (recyclability, recycled content)</td>
<td>++</td>
<td>Typical issues of electronic products. Not much experience gained. Some manufacturers presumably offer designs for easy recyclability and use recycled material. Take-back schemes offered by some manufacturers.</td>
<td>Design for easy disassembly and recyclability.</td>
</tr>
</tbody>
</table>

---

18.1.1 Use of critical raw materials

Use of critical raw materials is likely related to those typically found in related electronic components:

- Antimony in (plastic) flame retardants as substitute for banned flame retardants.
- Beryllium in electronic components.
- Cobalt in rechargeable Li-Ion batteries. (for inverters containing Li-ion batteries; other battery types on the market)
- Gallium in Integrated Circuits (ICs) and in LEDs.
- Indium used i.a. in LCDs (strong growth expected), lead-free solders, batteries, LEDs.
- Natural graphite in Li-Ion batteries.
- PGMs: platinum and palladium in some printed circuit boards,
- Light Rare Earth Elements used in NiMH batteries

A possible Ecodesign measure could require easy disassembly/ recyclability of PV inverters. However, no information on current recycling procedures were available.

18.1.2 Presence of flame retardants

Use of flame retardants is addressed by REACH Regulation (1907/2006) and restricted in RoHS. As RoHS does not yet apply to PV inverters (see below), hazardous flame retardants may be present in PV inverters. In particular PBB and PBDE have been identified in inverters220, which are banned in RoHS for other products.

Non-halogenated flame retardants exist. A dedicated preparatory study would have to determine whether they can be used for PV inverters and if they provide life cycle environmental benefits.

Hazardous substances are best treated in the dedicated RoHS and REACH regulations. (see below)

18.1.3 Presence of plasticisers (phthalates)

PV inverters contain electric cables, which often contain phthalates.

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Less toxic, high-molecular-weight phthalates or other less harmful substances exist. A dedicated preparatory study would have to determine whether they can be used for PV inverters, if phthalate-free plastics can be used and if they provide life cycle environmental benefits.

Possible occurrence of hazardous phthalates is ideally dealt with through RoHS and REACH.

### 18.1.4 Presence of other toxic substances

Lead and hexavalent chromium have been identified in PV inverters.

These should also best be dealt with in RoHS and REACH.

### 18.1.5 Radiation levels

Electromagnetic radiation (EMC, EMF) is technology immanent. There is, however, no indication that existing legal requirements cannot or are not met. Technological options exist to limit electromagnetic exposure.

Should information on harmful levels or radiation levels become available these are best dealt with in the respective regulations.

### 18.1.6 Safety

Safety is a concern as it is a high-voltage product.

Electric safety is covered by existing regulation.

### 18.1.7 Noise

Has been identified as an issue with large differences in inverters available on the market. Hence technological options exist. It is unclear, to what extend noise is an issue. Limiting noise levels would make most sense for residential installations in close vicinity of people and particularly at night.

Noise could potentially be addressed through Ecodesign, if no prevailing regulation is identified.

### 18.1.8 Durability

Typical lifetime of PV inverters is assumed to be at 15 years, 20 years are envisioned. 5-year warranty times are offered by some manufacturers. Given the increasing demand for the provision of “grid-services” upgradability becomes a major issue. If installed inverters cannot fulfil grid demands but have to in the near future, they may have to be replaced prematurely.

Ecodesign could set requirements on upgradability (software and possibly hardware).

### 18.1.9 End-of-life

Not much experience has been gained. Some manufacturers presumably offer designs for easy recyclability and use recycled material. Take-back schemes are offered by some manufacturers.

Ecodesign could establish requirements for easy disassembly and recyclability.

---

18.1.10 Conclusion for Ecodesign

Conversion efficiency is major issue (as discussed in Task 3). Of additional interest is upgradability, especially in light of increasing demands for various “grid-services”, which may require the replacement or modification of existing PV inverter installations. Also, typical end-of-life issues with regard to electronic components are present, which could be addressed by requirements on easy disassembly and recyclability.

Issues on hazardous substances should best be addressed in future RoHS and REACH regulation.

18.2 Policy coverage

This section is dedicated to the regulatory coverage of the product groups addressed, be it through legislation, within the EU or in third countries, through voluntary agreements and environmental labels or standards. The goal is to identify where Ecodesign or Energy Labelling regulations could have added value beyond the existing legislation, and, in the case of third country legislation, whether there is successful legislation that could serve as a model for Ecodesign or Energy Labelling legislation.

18.2.1 Overview of EU policies

Currently, WEEE Directive and REACH Regulation applies to PV inverters. PV inverters are currently exempted from RoHS. No applicable Ecolabel or GPP criteria were identified.

Table 66: Main EU legislation applicable to the “PV inverters” product group

<table>
<thead>
<tr>
<th>Product group</th>
<th>WEEE</th>
<th>RoHS</th>
<th>REACH</th>
<th>EPBD</th>
</tr>
</thead>
<tbody>
<tr>
<td>PV inverters</td>
<td>X</td>
<td>-</td>
<td>X</td>
<td>-</td>
</tr>
</tbody>
</table>

PV inverters fall under scope of WEEE Directive (2012/19/EU) under category 4. Consumer equipment and photovoltaic panels. With regard to Annex III they would fall in either category 4. Large equipment (any external dimension more than 50 cm) or 5. Small equipment (no external dimension more than 50 cm).

Ecodesign could facilitate the implementation of the WEEE Directive by setting requirements on easy disassembly.

The RoHS Directive does not currently apply to PV inverters as photovoltaic panels are excluded and PV inverters form an integral part of PV installations.

However, according to a stakeholder comment by the European Photovoltaic Industry Association (EPIA), RoHS will apply to residential inverters in the future:

“While large inverters may be exempted under the provision of Article 2 paragraph 4e) of the Directive as they may be included into a “large-scale fixed installation”, the RoHS Directive will apply to smaller inverters, in particular in the residential segment. Indeed, according to the Article 3 paragraph 1 of the Directive, it applies to all ‘electrical and electronic equipment’, where ‘EEE’ means “equipment which is dependent on electric currents or electromagnetic fields in order to work properly and equipment for the generation, transfer and measurement of such currents and fields and designed for use with a voltage rating not exceeding 1 000 volts for alternating current and 1 500 volts for direct current”. Hence, inverters in the residential segment are covered by this definition. Since they were however not included in the scope of the previous RoHS Directive (2002/95/EC), the transitional period
identified in the Article 2 paragraph 2 of the recast RoHS Directive will apply. Residential inverters will therefore have to comply with the provisions of the Directive by 22 July 2019."

Provisions of REACH Regulation (1907/2006) apply with regard to use of substances in the product. No consideration of specific substances has been taken here.

18.2.2 Selected Member States policies

The following section is dedicated to Member States policies which are in place inside the EU and of which the following table gives an overview.

Table 67: Environmental labels at Member States level

<table>
<thead>
<tr>
<th>Product group</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>PV inverters</td>
<td>RAL-UZ 163</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Thus, the only label which could be identified to certify “PV inverters” is the German Blue Angel label. The criteria for the award of the Blue Angel label for PV inverters date from January 2012 and are valid until 2018.222

Table 68 shows an extract of the requirements PV inverters have to comply with in order to obtain the Blue Angel label. However, the requirements listed here below are not exhaustive and there exist still various other demands.

Table 68: Requirements of Blue Angel label with respect to PV inverters

<table>
<thead>
<tr>
<th>Requirement</th>
<th>PV inverter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy efficiency</td>
<td>Total conversion efficiency according to DIN 50530 of min 95 %</td>
</tr>
<tr>
<td>Standby Power consumption</td>
<td>&lt; 0.5 W</td>
</tr>
<tr>
<td></td>
<td>In case of integrated remote data interface: &lt; 5 W</td>
</tr>
<tr>
<td>Provision of reactive power</td>
<td>PV inverter must provide reactive power for grid stability according to VDE-AR-N 4105</td>
</tr>
<tr>
<td>Warranty</td>
<td>Free-of-charge for min 5 years, extendable to 20 years</td>
</tr>
<tr>
<td>Hazardous substances</td>
<td>Various provisions, especially requiring application of RoHS provisions, which do not yet apply to PV inverters.</td>
</tr>
<tr>
<td>End-of-life</td>
<td>Requirements on easy and efficient dismantleability</td>
</tr>
<tr>
<td>Noise</td>
<td>Devices must not exceed 55 dB(A)</td>
</tr>
</tbody>
</table>

Currently no PV inverters are registered under the Blue Angel scheme.

However, according to a comment by EPIA much more important are the network codes developed by the European Network of Transmission System Operators for Electricity (ENTSO-E). These network codes "will lead to binding requirements at national level on grid services that PV inverters need to fulfil". These establish criteria for different sizes of electricity generation units, with the smallest starting at 800W, which would have to fulfil frequency stabilisation criteria.

18.2.3 Industry Self-Regulatory Initiative
No relevant SRIs have yet been identified.

18.2.4 Existing third country legislation and labels
None identified so far.

18.2.5 Test standards
Important test standards for PV inverters are:
- EN 50524: 2009 : "Data sheet and name plate information for photovoltaic inverters"; and

Further applicable test standards exist and would need to be identified.

18.2.6 Conclusion for Ecodesign
The most important impact of PV inverters, conversion efficiency, is currently not addressed by existing regulations. Here, Ecodesign could set minimum conversion efficiencies. However, the increasing provision of grid services should be taken into account and carefully evaluated.

Also requirements on upgradability in light of increasing demand for grid services and possible implications for the replacement of installed inverters could be established by Ecodesign. It would have to be judged if the developed network codes define related requirements on upgradability.

No information was found on applicability of existing noise regulation to inverters. Hence, if deemed relevant, noise may also be considered for treatment in Ecodesign.

RoHS and REACH can likely best address hazardous substances present in PV inverters.

Basic energy related test standards are available. These may have to be refined in light of the additional provision of grid-services which “use” energy, while simultaneously providing an overall benefit.

18.3 Appropriateness of Ecodesign or Energy labelling
Whereas the “regulatory coverage” section addressed the question of current mandatory and voluntary instruments (are they enough to cover this specific product group?), the section on
“Appropriateness of Ecodesign requirements” addresses the question of future regulation (would Ecodesign or Energy labelling adequately cover this specific product group?).

18.3.1 Excessive cost

As PV inverters convert PV generated electricity, their conversion efficiencies directly impact revenue streams of consumers. At 15 year lifetime and purchase costs of 300 €/ kWp, yearly allocated purchase costs would amount to about 20 €/ kWp. This compares to lost annual revenue per 0.5% lower conversion efficiency (estimated at 5 kWh/kWp per year) of

- 0.5 € (2.5 %) at feed-in tariff of 0.10 €; and
- 1 € (5 %) at feed-in tariff of 0.20 €.

(at total conversion losses of ~ 29 kWh/kWp per year at 97 % conversion efficiency)

At feed-in tariff of 0.10 € an increased purchase cost of 7.5 €/kWp would be equalled out by increased revenue due to 0.5% increased conversion efficiency.

At a higher feed-in tariff of 0.20 € an increased purchase cost of 15 €/kWp would be equalled out by increased revenue due to 0.5% increased conversion efficiency.

No information was available with regard to real costs incurred for increased conversion efficiencies.

18.3.2 Suitability of Ecodesign measures or Energy labelling

Ecodesign seems suitable for establishing requirements for PV inverters:

- Conversion efficiency most important environmental impact and not addresses by other regulations;
- Improved technology is available on the market; and
- Test standards available.

Instead of Ecodesign, Energy labelling may be an appropriate alternative with regard to conversion efficiencies as inverter efficiencies can be described on a “performance continuum” and users of such information will usually make detailed calculations on investments and expected revenues. This could thus be facilitated.

With regard to other environmental impacts, in durability/ upgradability, Ecodesign criteria could be established. However, appropriate test standards would have to be identified.

The main caveat is the increased demand on PV inverters for the provision of various grid services. As these service result in lower conversion efficiencies, “allowances” would have to factored in.

18.3.3 Conclusion for Ecodesign

Principally, Ecodesign would be a suitable instrument to address durability/upgradability and also recyclability. However, implications of requirements for additional grid services by PV inverters have to be carefully understood. To better allow for flexible development Energy labelling may better address conversion efficiencies than Ecodesign.

Also, inverters with lower efficiencies may be available at lower costs, contributing to overall advantageous energy production prices under specific circumstances.
18.4 Industrial competitiveness

18.4.1 Market structure
Market is highly concentrated, with European manufacturers having a major share. Market is closely linked to PV market in general.

18.4.2 Innovation and employment
PV inverters are still undergoing major innovation, particularly to adapt to new demands for grid stability and management.
Establishing strong Ecodesign requirements could strengthen European manufacturers against cheaper Asian competitors, as European manufactures will likely more easily meet requirements. This could safeguard jobs in Europe. This would be less so with Energy labelling alone.
Also high conversion efficiencies for renewable energy may contribute to other policy objectives with regard to energy systems transformation.

18.4.3 International competition
Europe is still a technology leader, though there is strong and growing competition especially from Asian manufacturers. See previous Section.

18.4.4 Conclusion for Ecodesign
Establishing Ecodesign criteria could strengthen European manufacturers and competitiveness.

18.5 Product group summary and recommendations
Table 69 below presents a simplified scoring of the four main sections above, for the product group “PV inverters”.

Table 69: Overall scoring of the "PV inverters” product group

<table>
<thead>
<tr>
<th>Product group</th>
<th>Other environmental impacts</th>
<th>Policy gaps</th>
<th>Appropriateness of Ecodesign</th>
<th>Appropriateness Energy labelling</th>
<th>Industrial competitiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>PV inverters</td>
<td>++</td>
<td>+++</td>
<td>++</td>
<td>++</td>
<td>+++</td>
</tr>
</tbody>
</table>

The more “+” there are in the assessment, the more favourable it is for Ecodesign Regulation or Energy labelling to be implemented.

Other environmental impacts related to PV inverters are the durability in light of extensive demands on upgradability, end-of-life recyclability and to a lesser extend noise. Also hazardous substances are relevant for the product group PV inverters.

Except for hazardous substances, these issues are not covered by existing policy.

However, given the extensive increased demands on PV inverters for providing various grid services, possible related detailed provisions in network codes that influence achievable conversion efficiencies, defining Ecodesign criteria may not be straightforward and require detailed definition of “allowances”, e.g. for night-time grid-services and communication capabilities and specific grid-services such as reactive power or frequency stabilisation in specific circumstances.
Altogether, it seems sensible, should the product group be deemed relevant for Ecodesign/ Energy labelling, to develop resource related criteria through Ecodesign and carefully consider the relation of conversion efficiencies, grid services and costs for the definition of minimum Ecodesign or Energy labelling criteria.
19. Refrigerated containers

19.1 Main other environmental issues

Table 70 below provides an overview of relevant further environmental aspects of the “refrigerated containers” product group, and possible improvement options linked to them. Energy consumption has been discussed in Task 3. Hence the table and the paragraphs below focus on the main other environmental impacts of the product group.

Table 70: Overview of relevant direct environmental issues and potential for improvement – Refrigerated containers

<table>
<thead>
<tr>
<th>Environmental issue categories</th>
<th>Scoring</th>
<th>Description of the environmental issue</th>
<th>Description of related improvement potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water consumption in use phase</td>
<td>+</td>
<td>Some refrigerated containers contain water-cooled condensers and need water supply from storage tank.</td>
<td>None identified.</td>
</tr>
<tr>
<td>Consumables (detergents, etc.)</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use of critical raw materials (see the EU list&lt;sup&gt;224&lt;/sup&gt;)</td>
<td>+</td>
<td>Refrigerated containers employ electronic (monitoring and control) components.</td>
<td>Design for recyclability of electronic components</td>
</tr>
<tr>
<td>Presence of flame retardants (halogenated, etc.)</td>
<td>+</td>
<td>As flammability is an important issue, flame retardants likely used in different components. No indication on extent.</td>
<td>Non-halogenated flame retardants exist. A dedicated preparatory study would have to determine whether they can be used for refrigerated containers and if they provide life cycle environmental benefits.</td>
</tr>
<tr>
<td>Presence of plasticisers (phthalates)</td>
<td>+</td>
<td>Possibly in attached cables.</td>
<td>Less toxic, high-molecular-weight phthalates or other less harmful substances exist. A dedicated preparatory study would have to determine whether they can be used for PG X or if phthalate-free plastics can be used</td>
</tr>
<tr>
<td>Presence of other toxic substances</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use of F-gases</td>
<td>+++</td>
<td>Used as refrigerant (e.g. R134a). Have to be refilled regularly.</td>
<td>Use of cyclopentane (and perhaps other substances) for manufacture of polyurethane insulating foam</td>
</tr>
</tbody>
</table>

---

<table>
<thead>
<tr>
<th>Environmental issue categories</th>
<th>Scoring</th>
<th>Description of the environmental issue</th>
<th>Description of related improvement potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Refrigerant leakage</td>
<td></td>
<td>Refrigerant leakage is a common problem. HCFC-141b is still used in insulation foams.</td>
<td>can reduce GWP by supposedly more than 99%225.</td>
</tr>
<tr>
<td>Radiation levels</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safety (fuel leakage, vibrations, etc.)</td>
<td>++</td>
<td>A number of safety issues arise in the handling of refrigerated containers, especially with regard to gases</td>
<td></td>
</tr>
<tr>
<td>Health (hygiene, noise level, etc.)</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Durability (reusability, upgradability, reparability, etc.)</td>
<td>++</td>
<td>Durability of insulation influences energy performance of system.</td>
<td>Regular maintenance.</td>
</tr>
<tr>
<td>End-of-life (recyclability, recycled content)</td>
<td>+</td>
<td>Containers are made of different components, which differ in their recyclability and likely effective recycling rates. Due to the integrated and sealed structure of refrigerated containers, recyclability limited.</td>
<td>Design for recyclability.</td>
</tr>
<tr>
<td>Direct emissions to air</td>
<td>+++</td>
<td>Diesel exhaust in genset variants.</td>
<td></td>
</tr>
<tr>
<td>Direct emissions to water</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct emissions to soil</td>
<td>0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Scoring: “0” if not an issue for the product group. If this is an issue, the indicative importance of the environmental issue is provided from 1 (low) to 3 (high).

19.1.1 Water consumption in use phase
Some refrigerated containers contain water-cooled condensers and need water supply from storage tank.
No related improvement options have been identified.

19.1.2 Use of critical raw materials
To some degree critical raw materials are expected to be used in electronic components used for monitoring and control of the refrigerated container.
Improvement option lies in the proper recycling of these electronic components.

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19.1.3 Presence of flame retardants (halogenated, etc.)
As flammability is an important issue, flame retardants likely used in different components. No indication on magnitude was found.
Non-halogenated flame retardants exist. A dedicated preparatory study would have to determine whether they can be used for refrigerated containers and if they provide life cycle environmental benefits.

19.1.4 Presence of plasticisers (phthalates)
Cables may contain phthalates.
Less toxic, high-molecular-weight phthalates or other less harmful substances exist. A dedicated preparatory study would have to determine whether they can be used for refrigerated containers or if phthalate-free plastics can be used.

19.1.5 Use of F-gases
F-gases are used as refrigerant (e.g. R134a, R-404A, R507A) and in insulation foams (e.g. HCFC-141b in older containers). As leakage is a common problem, refrigerants need to be refilled regularly. Refrigerated containers have to sustain more movement, vibrations, collisions, etc. than stationary systems and hence the “likelihood of leaks or ruptures is also greater”.
Certain F-Gases are banned through the Montreal Protocol; hence substitutes are developed, with the aim to have no ozone depletion potential, a low global warming potential and high energy efficiency. As the specifics are not regulated, a range of F-gases are in use.
An improvement option may be related to the identification of the most environmentally friendly refrigerant (and blowing foam) option and defining performance requirements accordingly. Also, use of hermetic scroll compressors has been suggested for reduced refrigerant losses.

19.1.6 Safety (fuel leakage, vibrations, etc.)
Different safety concerns relate to refrigerated containers. The structure or coating can absorb chemicals which may then be released as toxic gas. Rusting may create an explosive atmosphere. Flammable gases may be emitted, etc.
No improvement options have been identified.

19.1.7 Durability (reusability, upgradability, reparability, etc.)
A performance critical element is the insulation which may deteriorate over time and lose some of its insulation properties.
Regular maintenance and possibly exchange of the insulation foam can maintain energy/cooling performance.

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227 https://www.osha.gov/Publications/OSHA3732.pdf
19.1.8 End-of-life (recyclability, recycled content)
Containers are made of different components, which differ in their recyclability and likely effective recycling rates. Due to the integrated and sealed structure of refrigerated containers, recyclability may be limited.
Design for easy dismantlability/ recyclability may increase recycling rates of different resources (bulk as well as special resources contained e.g. in electronics).

19.1.9 Direct emissions to air
Most refrigerated containers are equipped with gensets, which run on diesel. When not connected to ship or port electricity these produce direct exhaust emissions.

19.1.10 Conclusion for Ecodesign
With regard to possible and applicable Ecodesign measures, focus should indicatively be on energy efficiency, including insulation properties and durability. Refrigerants and blowing agents for insulation foams may also be of interest for Ecodesign consideration beyond their treatment in existing frameworks such as the Montreal Protocol and F-Gases regulation.

19.2 Policy coverage
This section is dedicated to the regulatory coverage of the product groups addressed, be it through legislation, within the EU or in third countries, through voluntary agreements and environmental labels or standards. The goal is to identify where Ecodesign or Energy Labelling regulations could have added value beyond the existing legislation, and, in the case of third country legislation, whether there is successful legislation that could serve as a model for Ecodesign or Energy Labelling legislation.

19.2.1 Overview of EU policies
Few “classic” EU policies apply to refrigerated containers.

<table>
<thead>
<tr>
<th>Table 71: Main EU legislation applicable to the “refrigerated containers” product group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product group</td>
</tr>
<tr>
<td>Refrigerated containers</td>
</tr>
</tbody>
</table>

WEEE and RoHS do not cover refrigerated containers.
REACH is applicable to refrigerated containers. However, it is unclear how this is handled in practice as most refrigerated containers are manufactured in China and may only temporarily enter the European market. Yet, those that are registered in Europe are in principle covered by REACH. Also the Regulation (EC) No 1005/2009 on substances that deplete the ozone layer bans the use of HCFCs for containers placed on the European market. However, the temporary admission of such containers
cannot be prevented, in line with international Conventions.\textsuperscript{228} For the future the Montreal Protocol is expected to effectively regulate use of HCFCs in refrigerated containers (from 2020 or in case of developing countries, from 2030).

\textbf{F-gas regulation} presumably does not effectively regulate HFC emissions from refrigerated containers.\textsuperscript{229} However, certain manufacturers develop compliant refrigerants and insulation foams for refrigerated containers.

Further specific regulations, e.g. relating to transport or food, may be of relevance for refrigerated containers. These have not been identified.

The \textbf{European ship recycling regulation} and \textbf{Marine Equipment Directive} may have implications for containers. However, this could not be confirmed.

No regulation could yet be identified that specifically applies to energy or environmental performance of refrigerated containers beyond Regulation (EC) No 1005/2009.

Conventions by the International Maritime Organization would likely be the best place for global regulations on refrigerated containers, which are then implemented by members.

\section*{19.2.2 Selected Member States policies}

No applicable Member States policies could be identified.

\section*{19.2.3 Industry Self-Regulatory Initiative}

No relevant SRIs have been identified.

\section*{19.2.4 Existing third country legislation and labels}

No third country legislation or labels have been identified.

\section*{19.2.5 Test standards}

No applicable test standards have been identified.

\section*{19.2.6 Conclusion for Ecodesign}

At first sight, few regulations if any at all seem to address energy efficiency and other environmental impacts of refrigerated containers. There could hence by a case for introducing Ecodesign requirements if refrigerated containers can be treated under the scope of Ecodesign.

A limiting factor is probably the small amount of refrigerated containers actually placed on the European market instead of being temporarily admitted. Ecodesign as well as other European regulation may not able to effectively regulate such temporarily admitted containers.

Also test standards may be a limiting factor for a straightforward definition of Ecodesign requirements.


19.3 Appropriateness of Ecodesign or Energy labelling

Whereas the “regulatory coverage” section addressed the question of current mandatory and voluntary instruments (are they enough to cover this specific product group?), the section on “Appropriateness of Ecodesign requirements” addresses the question of future regulation (would Ecodesign or Energy labelling adequately cover this specific product group?).

19.3.1 Excessive cost

No specific costs of refrigerated containers were available. Assuming a purchase price of 15,000 € for a 20-foot refrigerated container and a baseline energy consumption of 65 kWh per day (a bit higher than the conservative estimate in Task 3) and an improved energy consumption of 45 kWh per day as well as an electricity price of 0.12 €/kWh, which we have used for professional users throughout this study, the following economic savings potential can be calculated.

<table>
<thead>
<tr>
<th>Refrigerated containers</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Average purchase price</td>
<td>15,000 €</td>
</tr>
<tr>
<td>Energy consumption/ year (65 kWh/day for 1/3 of a year)</td>
<td>7,908 kWh</td>
</tr>
<tr>
<td>Lifetime</td>
<td>10 years</td>
</tr>
<tr>
<td>Average EU electricity price (domestic)</td>
<td>0.12 €/kWh</td>
</tr>
<tr>
<td>Energy costs over lifetime</td>
<td>9,490 €</td>
</tr>
<tr>
<td>Improved energy consumption/ year (45 kWh/day for 1/3 of a year)</td>
<td>5,475 kWh</td>
</tr>
<tr>
<td>Economic savings potential</td>
<td>2,920 €</td>
</tr>
<tr>
<td>Relation (economic savings / purchase price)</td>
<td>19.5 %</td>
</tr>
</tbody>
</table>

Based on this approximation almost 20 % of original purchase costs could be saved by 30 % improvement in energy consumption/efficiency. Taking a longer lifetime as the basis the saving potential would be much higher.

It is important to note, that manufacturers of refrigerated containers do not have a direct incentive to produce very efficient refrigerated containers as the costs are borne by the user (“split incentive”). Hence better understanding the total cost of ownership could lead to increased demand for efficient refrigerated containers.

19.3.2 Suitability of Ecodesign measures or Energy labelling

Refrigerated containers can be used on ships but also stationary in ports and are then connected to port electricity supply. It could be argued that they do not fall under the strict category of “means of transport” and hence are in the scope of Ecodesign.

Though sizes of containers are highly standardised, the specific equipment and materials used are not. Hence, refrigerated containers differ with regard to achieved cooling efficiencies and insulation...
parameters. Ecodesign could address these through the definition of basic performance requirements. Alternatively also Energy labelling could be established for refrigerated container energy efficiency, provided that clear performance standards are available. Or can be developed.

A limiting factor is the wide range of circumstances that refrigerated containers operate under, e.g. with regard to type and temperature of cargo, climatic conditions, availability of electricity supply, special cargo needs such as back-up power supply (i.e. carrying two gensets).

19.3.3 Conclusion for Ecodesign
The split incentive with regard to use-phase energy costs and the general importance of energy efficiencies favour an Ecodesign approach for refrigerated containers. However, the very diverse range of usage scenarios may make it very difficult to define specific performance requirements. Energy labelling may be easier to implement with regard to energy efficiency as it provides for more flexibility in the range of applications and circumstances. However resource related requirements would be better addressed through Ecodesign.

19.4 Industrial competitiveness

19.4.1 Market structure
Refrigerated container demand and supply is largely determined by global container shipping companies and global trade volumes. Manufacturing takes place mostly in China and more recently in Chile.

Market structure should not be an obstacle for the definition of Ecodesign requirements as manufacturers are used to manufacture containers according to the demands of customers.

19.4.2 Innovation and employment
Innovation in refrigerated container transport is mostly related to the direct customer demands for safe and cost-efficient transport of valuable goods. Sustainability is an issue which is recognised by some manufacturers and actively marketed. If effective Ecodesign requirements were established, these would likely spur further research and development as the market has so far been driven by other considerations. It is conceivable that this would also enhance demand for European expertise and hence job creation here. However, effects of Ecodesign or Energy labelling on jobs could not be well assessed.

19.4.3 International competition
Competition is taking place mostly among non-European manufacturers and traders. Ecodesign requirements could give those companies an advantage that are already actively developing and promoting more sustainable refrigerated containers.

19.4.4 Conclusion for Ecodesign
If Ecodesign requirements could be established for refrigerated containers it is expected that these are favourable for industrial competitiveness and especially innovation on energy and resource efficiency.
19.5 Product group summary and recommendations

Table 73 presents a simplified scoring of the four main sections above, for the product group “refrigerated containers”.

Table 73: Overall scoring of the “Refrigerated containers” product group

<table>
<thead>
<tr>
<th>Product group</th>
<th>Other environmental impacts</th>
<th>Regulatory coverage</th>
<th>Appropriateness of Ecodesign</th>
<th>Appropriateness of Energy labelling</th>
<th>Industrial competitiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Refrigerated containers</td>
<td>++</td>
<td>+++</td>
<td>++</td>
<td>++</td>
<td>+++</td>
</tr>
</tbody>
</table>

The more “+” there are in the assessment, the more favourable it is for Ecodesign Regulation or Energy Labelling to be implemented.

If the general applicability of the Ecodesign Directive to refrigerated containers can be established and appropriate test standards identified/developed, Ecodesign could establish:

- Minimum energy efficiency requirements for different cooling applications;
- Minimum requirements on insulation performance (heat transfer and durability);
- Minimum requirements on dismantleability for recycling; and
- Possibly minimum requirements on refrigerants used, though existing regulation may prevail.

Alternatively energy labelling requirements could be established that would inform users of refrigerated containers on achieved efficiency and thus stimulate market demand for more efficient containers.

If certain types of energy using equipment used in means of transport are deemed of interest for possible inclusion in Ecodesign, a more detailed study should be commissioned, exploring the range of possible technologies and the feasibility of including them in the Ecodesign Working Plan.
20. Signage displays

20.1 Main other environmental issues

Table 74 below provides an overview of the relevant environmental aspects of the “Signage displays” product group, and possible improvement options linked to them. Energy consumption and material efficiency have been discussed in Task 3. Hence the table and the paragraphs below focus on the main other environmental impacts of the product group. It is to note that the issues are basically the same as they are for related products (namely consumer electronics and computers).

Table 74: Overview of relevant direct environmental issues and potential for improvement – Signage displays

<table>
<thead>
<tr>
<th>Environmental issue categories</th>
<th>Scoring</th>
<th>Description of the environmental issue</th>
<th>Description of related improvement potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water consumption in use phase</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consumables (detergents, etc.)</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Presence of critical raw materials (see the EU list&lt;sup&gt;230&lt;/sup&gt;)</td>
<td>+</td>
<td>As in all electronics.</td>
<td>None identified.</td>
</tr>
</tbody>
</table>

Presence of flame retardants (halogenated, etc.)

Used in cabinet structure etc.

Non-halogenated flame retardants are available and can substitute halogenated flame retardants in TVs. The German Blue Angel for TVs requires to avoid halogenated flame retardants and flame retardants with the Risk Statement R 59/53 / Hazard Statement H410 according to REACH, and complying products are on the market. A dedicated preparatory study would have to explore whether this is also suitable for signage displays.

Presence of plasticisers (phthalates)

Used in cabinet structures and light processing films in displays.

Less toxic, high-molecular-weight phthalates or other less harmful substances exist. A dedicated preparatory study would have to determine whether they can be used for signage displays or if phthalate-free plastics can be used.

Presence of other toxic substances

Mercury in CCFL backlights for older LCD signage display designs.

Phased out by efficient LED backlight even for high brightness displays.

<table>
<thead>
<tr>
<th>Environmental issue categories</th>
<th>Scoring</th>
<th>Description of the environmental issue</th>
<th>Description of related improvement potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Presence of F-gases</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiation levels</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safety (fuel leakage, vibrations, etc.)</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health (hygiene, noise level, etc.)</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Durability (reusability, upgradability, reparability, etc.)</td>
<td>++</td>
<td>Sometimes replaced before end of technical lifetime due to upgrades or rearranging of public space.</td>
<td>Integrated computing model that can be replaced or upgraded.</td>
</tr>
<tr>
<td>End-of-life (recyclability, recycled content)</td>
<td>++</td>
<td>Same issues as all electronics. As far as battery powered, retrieval of cobalt in batteries. Mercury in CCFL backlights (as far as they still exist).</td>
<td>Easy removal of PCBs, and if applicable, of batteries. Hg free marking.</td>
</tr>
<tr>
<td>Direct emissions to air</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct emissions to water</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct emissions to soil</td>
<td>0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Scoring: “0” if not an issue for the product group. If this is an issue, the indicative importance of the environmental issue is provided from + (low) to +++ (high).

### 20.1.1 Durability

The technical lifetime of a signage display is estimated at about seven years. Often, though, the economical lifetime is shorter – about four to five years according to stakeholder input. This is due to various reasons. On the one hand, the brightness of the display may deteriorate over time so that the owner is no more satisfied with its performance. Also, if an advertising space or other public space is being refurbished, signage displays that are removed in the process are generally not being reinstalled but replaced. Finally, outdated software can lower performance and be a cause for replacement. While there is no design-related solution for the refurbishment issue, an integrated computing module that can be replaced or upgraded, as developed by Intel, can alleviate the software problem. No specific technical possibilities to avoid the deterioration of brightness have been identified in this study although they probably exist.

### 20.1.2 End-of-life

Signage displays have in principle, the same end-of-life issues as all electronics. They contain resource-relevant components such as printed circuit boards and of course the display itself that would profit from easy dismanteleability. They may also contain batteries, from which cobalt could be recovered if the batteries could be removed quickly. Older versions may still contain mercury backlight, and easy separation of displays containing mercury from those not containing mercury would be beneficial.
20.1.3 Conclusion for Ecodesign

Other environmental issues relate to flame retardants, phthalates, mercury, and durability/end of life issues. This strengthens the case for potential Ecodesign requirements with respect to LED backlighting, because they would tackle efficiency and mercury issues at the same time. Hazardous substances are potentially targeted by other EU policies. This will be discussed in chapter 20.2.1.

20.2 Policy coverage

This section is dedicated to the regulatory coverage of the product groups addressed, be it through legislation, within the EU or in third countries, through voluntary agreements and environmental labels or standards. The goal is to identify where Ecodesign or Energy Labelling regulations could have added value beyond the existing legislation, and, in the case of third country legislation, whether there is successful legislation that could serve as a model for Ecodesign or Energy Labelling legislation.

20.2.1 Overview of EU policies

Signage displays have been deliberately exempted from the scope of the current review of the Ecodesign Regulation for TVs, which has been developed into a Display Regulation. The reason was the technical difference from consumer products that is due to different usage patterns (heavy use, outdoor use, big viewing angle).

Currently, signage displays are regulated under the EU WEEE, RoHS and REACH.

<table>
<thead>
<tr>
<th>Table 75: Main EU legislation applicable to the “Signage displays” product group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product group</td>
</tr>
<tr>
<td>Signage display</td>
</tr>
</tbody>
</table>

Phthalates, plasticizers and other toxic substances are regulated under RoHS or REACH, but maybe not fully. RoHS does not include phthalates, and not all halogenated flame retardants. However, there is currently a process in place where the extension of RoHS to one brominated flame retardant and several phthalates is under discussion. A dedicated Preparatory Study would have to determine which substances exactly are present and whether they are covered by other instruments. If not, the study should analyse whether there is a need for regulation and if so, which legislative instrument should be used (see supplementary report on resources).

In addition to the policies listed above, the Ecodesign Regulations for computers and TVs (the latter currently being under review) are also relevant. As the technological options for improving energy efficiency are basically identical, these regulations can be drawn on in order to formulate criteria adapted to signage displays. The same is true for the Ecolabel: While it has no specific criteria for signage displays, criteria for televisions and computers can be used as a basis.
20.2.2 Selected Member States policies

Signage displays can earn the TCO certified label. Criteria are quite extensive, covering ergonomics, electric and magnetic fields, noise, electrical safety, energy consumption, hazardous substances, lifetime, recyclability, and packaging, along with Corporate Social Responsibility. For energy consumption, it refers to the Energy Star.

Table 76 presents selected requirements.

<table>
<thead>
<tr>
<th>Environmental aspect</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy consumption</td>
<td>Must comply with latest Energy Star requirements for displays.</td>
</tr>
<tr>
<td>Energy consumption of external power supply</td>
<td>Must meet at least the International Efficiency Protocol requirement for level V.</td>
</tr>
<tr>
<td>Cadmium (Cd), mercury (Hg), lead (Pb) and hexavalent chromium (CrVI)</td>
<td>The Flat Panel Display shall not contain cadmium, mercury, lead and hexavalent chromium.</td>
</tr>
<tr>
<td></td>
<td>The maximum level of mercury in background lighting systems allowed is 3.5 mg Hg/lamp.</td>
</tr>
<tr>
<td>Hazardous substances in plastics</td>
<td>Plastic parts weighing more than 25 grams shall not contain flame retardants or plasticizers that contain organically bound bromine or chlorine. (Exempted are printed wiring board laminates, electronic components and all kinds of cable insulation.) The Flat Panel Display shall not contain PBB, PBDE and HBCDD.</td>
</tr>
<tr>
<td></td>
<td>The following non halogenated flame retardants shall not be used in plastic parts that weigh more than 25 grams since they are harmonized and covered by one or more of the hazardous statements restricted for TCO Certified products:</td>
</tr>
<tr>
<td></td>
<td>- Antimony(III) oxide (Sb2O3), CAS: 1309-64-4</td>
</tr>
<tr>
<td></td>
<td>Plastic parts in the Flat Panel Display weighing more than 25 grams shall not contain chlorine or bromine as a part of the polymer.</td>
</tr>
<tr>
<td>Preparation for recycling</td>
<td>Plastic parts weighing more than 25 grams shall be material coded in accordance with ISO 11469 and ISO 1043-1, -2, -3, -4. Such parts shall be listed in the table at Section A.6.4.5. (Exempted are printed wiring board laminates.)</td>
</tr>
<tr>
<td></td>
<td>Each product unit shall have no more than two different types of plastic materials for parts weighing more than 100 grams. (The light guide in FPD panels and Printed Wiring Board laminates are exempted.)</td>
</tr>
</tbody>
</table>

---

20.2.3 Industry Self-Regulatory Initiative

No relevant SRI could be identified.

20.2.4 Existing third country legislation and labels

Signage displays are regulated under the version 6.0 of the US Energy Star for displays. Version 7.0 is currently under development, the process having been launched on February 24, 2014.

Version 6.0 has a requirement on maximum on-mode power, depending on screen size and pixel density (see Table 77). Also, there are requirements on the External Power Supply, and a power management feature is required. Maximum sleep mode and off-mode power is 0.5 W, with certain allowances for network capabilities.

**Table 77: Energy Star 6.0 On-mode power requirements for displays**

<table>
<thead>
<tr>
<th>Product Type and Diagonal Screen Size, d (in inches)</th>
<th>$P_{ON, MAX}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$d &lt; 12.0$</td>
<td>$(6.0 \times r) + (0.05 \times A) + 3.0$</td>
</tr>
<tr>
<td>$12.0 \leq d &lt; 17.0$</td>
<td>$(6.0 \times r) + (0.01 \times A) + 5.5$</td>
</tr>
<tr>
<td>$17.0 \leq d &lt; 23.0$</td>
<td>$(6.0 \times r) + (0.025 \times A) + 3.7$</td>
</tr>
<tr>
<td>$23.0 \leq d &lt; 25.0$</td>
<td>$(6.0 \times r) + (0.06 \times A) - 4.0$</td>
</tr>
<tr>
<td>$25.0 \leq d \leq 61.0$</td>
<td>$(6.0 \times r) + (0.1 \times A) - 14.5$</td>
</tr>
<tr>
<td>$30.0 \leq d \leq 61.0$ (for products meeting the definition of a Signage Display only)</td>
<td>$(0.27 \times A) + 8.0$</td>
</tr>
</tbody>
</table>

20.2.5 Test standards

A test method for displays has been developed under the Energy Star programme. It is also being used by the “TCO certified” label. Furthermore, IEC 62087 Edition 3 on-mode testing methodology for TVs could be applied.
20.2.6 Conclusion for Ecodesign

Existing policies do not yet cover all relevant environmental aspects. Specifically, energy efficiency has not yet been regulated. RoHS and REACH do not yet cover fully all hazardous substances (especially phthalates and halogenated flame retardants) that can be present in signage displays. However, as a RoHS extension is currently under discussion, it is recommended to await the outcome of this process before further discussing the appropriateness of potential Ecodesign requirements.

Finally, existing labels such as TCO development and the US Energy Star with their test methods would provide good starting points for potential Ecodesign requirements.

20.3 Appropriateness of Ecodesign or Energy labelling

Whereas the “regulatory coverage” section addressed the question of current mandatory and voluntary instruments (are they enough to cover this specific product group?), the section on “relevance of Ecodesign requirements” will address the question of future regulation (would Ecodesign or Energy labelling adequately cover this specific product group?).

20.3.1 Excessive cost

The following table gives an overview of the purchase price of typical products and the energy cost savings that would be possible with a 20% lower power rating and, for the advertising pillars which run 24 hours, a day 2 hours less running time. (For the products assumed to be running only 8 hours a day, the figure was kept constant because it is assumed that they are only running when needed anyway). A commercial EU electricity price of 0.12 EUR / kWh (excluding VAT) was assumed.

<table>
<thead>
<tr>
<th>Screen technology</th>
<th>Advertising pillar, 46”</th>
<th>Advertising pillar, 70”</th>
<th>Conference screen, 40”</th>
<th>Conference screen, 82”</th>
<th>Conference screen, 50”</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Average purchase price (EUR)</strong></td>
<td>1,990</td>
<td>11,990</td>
<td>699</td>
<td>49,999</td>
<td>1,099</td>
</tr>
<tr>
<td><strong>Energy consumption kWh / year</strong></td>
<td>2890.8</td>
<td>8322</td>
<td>221.92</td>
<td>2686.4</td>
<td>963.6</td>
</tr>
<tr>
<td><strong>Lifetime / years</strong></td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td><strong>Average EU electricity price (industrial) EUR / kWh</strong></td>
<td>0.12</td>
<td>0.12</td>
<td>0.12</td>
<td>0.12</td>
<td>0.12</td>
</tr>
<tr>
<td><strong>Energy costs over lifetime EUR</strong></td>
<td>1,388 €</td>
<td>3,995 €</td>
<td>107 €</td>
<td>1,289 €</td>
<td>463 €</td>
</tr>
<tr>
<td><strong>Energy savings potential in use phase (%)</strong></td>
<td>26.67</td>
<td>26.67</td>
<td>26.67</td>
<td>20.00</td>
<td>20.00</td>
</tr>
<tr>
<td>Economic savings potential (EUR)</td>
<td>Advertising pillar, 46”</td>
<td>Advertising pillar, 70”</td>
<td>Conference screen, 40”</td>
<td>Conference screen, 82”</td>
<td>Conference screen, 50”</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>------------------------</td>
<td>------------------------</td>
<td>------------------------</td>
<td>------------------------</td>
<td>------------------------</td>
</tr>
<tr>
<td></td>
<td>370.02</td>
<td>1065.22</td>
<td>28.41</td>
<td>257.89</td>
<td>92.51</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Relation (economic savings / purchase price)</th>
<th>19%</th>
<th>9%</th>
<th>4%</th>
<th>1%</th>
<th>8%</th>
</tr>
</thead>
</table>

| Sensitivity: 7 years lifetime | 33% | 16% | 7% | 1% | 15% |

No stakeholder input could be retrieved on the question whether it is likely that purchase cost would increase by more than the cost savings to be expected by way of energy efficiency increase. However, it already becomes clear from the table that the cost case is highly variable, depending on the individual product. Energy savings are less important for high-price products whose life cycle costs are dominated by the purchase price. On the other hand, improvement costs may also be a lower percentage of purchase costs in these products. Once again seems important to create appropriate subgroups.

### 20.3.2 Suitability of Ecodesign measures or Energy labelling

Various conditions are favourable to the implementation of Ecodesign requirements to the “signage displays” product group.

- Relevant and growing market;
- Best Available Technologies (BAT) exist; experience from the much bigger TV and computers markets can be used;
- The migration of experience from the TV market might also help to keep costs down; and
- Existing labels can be used as a basis for Ecodesign requirements.

Possible barriers could be the rapid technological evolution and the variability of products with different configurations. Experience from the computer regulation could be used to deal with this situation. Also the fact that the product generally involves a specialized installer responsible for physical installation and network integration could complicate things.

- Given the broad range in energy efficiency, also energy labelling or a similar mechanism suited to B2B products could be envisaged.

### 20.3.3 Conclusion for Ecodesign

- In general, the product group provides considerable potential and is promising. Requirements seem to be feasible. However, the rapid technological development and high variability need to be addressed.

### 20.4 Industrial competitiveness

According to analyst invidis, focusing on the markets in Germany, Switzerland, and Austria, the market is dominated by multinational corporations. Small and medium enterprises do not play a role. The market is highly concentrated: The three biggest players, Samsung, NEC and LG cover 77.5% of the market. The biggest ten cover 94% of the market. As this is an internationalized market, it is likely that the picture is not much different in other EU Member states. This means that manufacturers could
probably easily adapt to Ecodesign requirements. Furthermore, given that the display technologies are
developed and marketed by manufacturers whose main display R&D is based on the worldwide TV
market which is already subject to Energy Labelling and Ecodesign Regulation, further product
specific regulation would probably have little impact on industrial competitiveness. However, as not
much other information could be retrieved, we cannot be sure of the impact on innovation and
competitiveness.

Table 79: Top ten sellers of professional displays in Germany, Switzerland, and Austria.
Source: Invidis Digital Signage Jahrbuch 2014/15

<table>
<thead>
<tr>
<th>Rank</th>
<th>Enterprise</th>
<th>Market share (by turnover)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Samsung</td>
<td>42,0%</td>
</tr>
<tr>
<td>2</td>
<td>NEC Displays</td>
<td>18,0%</td>
</tr>
<tr>
<td>3</td>
<td>LG</td>
<td>17,5%</td>
</tr>
<tr>
<td>4</td>
<td>Conrac</td>
<td>4,5%</td>
</tr>
<tr>
<td>5</td>
<td>Sharp</td>
<td>4,0%</td>
</tr>
<tr>
<td>6</td>
<td>MMD (Philips)</td>
<td>3,5%</td>
</tr>
<tr>
<td>7</td>
<td>Panasonic</td>
<td>1,5%</td>
</tr>
<tr>
<td>8</td>
<td>Iiyama</td>
<td>1,0%</td>
</tr>
<tr>
<td>9</td>
<td>AG Neovo</td>
<td>1,0%</td>
</tr>
<tr>
<td>10</td>
<td>Sony</td>
<td>1,0%</td>
</tr>
<tr>
<td></td>
<td>Others</td>
<td>6,0%</td>
</tr>
</tbody>
</table>

20.4.1 Conclusion for Ecodesign
It is unlikely that Ecodesign Regulation would negatively impact industrial competitiveness. However,
there is also no indication on whether it would be beneficial.

20.5 Product group summary and recommendations
Table 80 below presents a simplified scoring of the three main sections above, for the product group
“Signage displays”.

Table 80: Overall scoring of the “Signage displays” product group

<table>
<thead>
<tr>
<th>Product group</th>
<th>Other environmental impacts</th>
<th>Policy gaps</th>
<th>Appropriateness of Ecodesign</th>
<th>Appropriateness of Energy Labelling</th>
<th>Appropriateness of Energy</th>
<th>Industrial competitiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signage displays</td>
<td>++</td>
<td>+++</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>++</td>
</tr>
</tbody>
</table>

The more “+” there are in the assessment, the more favourable it is for Ecodesign or Energy Labelling Regulation
to be implemented.

The following requirements could, in principle, be envisaged for Signage displays:
• Minimum energy efficiency requirements;
• Energy Labelling;
• Requirements on quick extractability of batteries, displays, and printed circuit boards;
• Marking of Hg-free displays; and
• Marking of plastics containing brominated flame retardants.
# Wireless chargers for consumer electronics

## 21.1 Main other environmental issues

Table 81 below provides an overview of the relevant environmental aspects of the “wireless chargers for consumer electronics” product group, and possible improvement options linked to them. Energy and basic resource consumption have been discussed in Task 3. Hence the table and the paragraphs below focus on the main other environmental impacts of the product group.

Table 81: Overview of relevant direct environmental issues and potential for improvement – Wireless chargers for consumer electronics

<table>
<thead>
<tr>
<th>Environmental issue categories</th>
<th>Scoring</th>
<th>Description of the environmental issue</th>
<th>Description of related improvement potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water consumption in use phase</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consumables (detergents, etc.)</td>
<td>0</td>
<td>Use of CRMs related to electronic components: Possibly <strong>antimony</strong> in (plastic) flame retardants as substitute for banned flame retardants. <strong>Beryllium</strong> in electronic components. <strong>Cobalt</strong> in wireless charger variants that use rechargeable Li-Ion batteries. <strong>Gallium</strong> in Integrated Circuits (ICs) and in LEDs. <strong>Indium</strong> in lead-free solders. <strong>Natural graphite</strong> in Li-Ion battery containing variants. Possibly <strong>PGMs</strong> in printed circuit boards (PCBs).</td>
<td>For battery containing variants, easy retractability of battery at EoL can facilitate increase of cobalt recycling rates. Lifetime extension could decrease overall demand of CRMs.</td>
</tr>
<tr>
<td>Use of critical raw materials (see the EU list(^{232}))</td>
<td>+</td>
<td>Use of CRMs related to electronic components: Possibly <strong>antimony</strong> in (plastic) flame retardants as substitute for banned flame retardants. <strong>Beryllium</strong> in electronic components. <strong>Cobalt</strong> in wireless charger variants that use rechargeable Li-Ion batteries. <strong>Gallium</strong> in Integrated Circuits (ICs) and in LEDs. <strong>Indium</strong> in lead-free solders. <strong>Natural graphite</strong> in Li-Ion battery containing variants. Possibly <strong>PGMs</strong> in printed circuit boards (PCBs).</td>
<td>For battery containing variants, easy retractability of battery at EoL can facilitate increase of cobalt recycling rates. Lifetime extension could decrease overall demand of CRMs.</td>
</tr>
<tr>
<td>Presence of flame retardants (halogenated, etc.)</td>
<td>+</td>
<td>Possibly flame retardants in plastic and electronic components. According to stakeholder comments only flame retardants used that are needed to comply with fire safety requirements of the</td>
<td>Non-halogenated flame retardants exist. A dedicated preparatory study would have to determine whether they can be used for wireless chargers and if they provide life cycle environmental</td>
</tr>
</tbody>
</table>

---

<table>
<thead>
<tr>
<th>Environmental issue categories</th>
<th>Scoring</th>
<th>Description of the environmental issue</th>
<th>Description of related improvement potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Presence of plasticisers (phthalates)</td>
<td>+</td>
<td>Possibly in attached cables and flexible PVC/ synthetic rubber components.</td>
<td>Less toxic, high-molecular-weight phthalates or other less harmful substances exist. A dedicated preparatory study would have to determine whether they can be used for wireless chargers or if phthalate-free plastics can be used and provide life cycle environmental benefits.</td>
</tr>
<tr>
<td>Presence of other toxic substances</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use of F-gases</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiation levels</td>
<td>++</td>
<td>Electromagnetic radiation is technology immanent. It may be more prominent than in other electronic products given the power transfer between two separate devices in close proximity of consumers.</td>
<td>No indication that wireless chargers are not and could not be made to comply with existing legal standards.</td>
</tr>
<tr>
<td>Safety (fuel leakage, vibrations, etc.)</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health (hygiene, noise level, etc.)</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Durability (reusability, upgradability, reparability, etc.)</td>
<td>++</td>
<td>Presumably more durable than conventional chargers, due to less strain, less moving parts etc. through lack of connection to the phone. Hence, possibly longer lifetime than conventional charger. Some charger types may contain non-removable rechargeable batteries, which may limit lifetime. Some indication that some devices on the market are at risk of premature failure, perhaps more than conventional chargers and other device Short charging / discharging</td>
<td>In case of non-removable batteries, improvement may be reached by allowing for easy change of battery by end-user without tools. No other product group internal improvement potential identified. Possible improvement potential against other external power supply technologies, where these are particularly strained, e.g. certain phone power cords and could be substituted by wireless chargers. (However, these may be best addressed in the respective Ecodesign.</td>
</tr>
</tbody>
</table>

---

<table>
<thead>
<tr>
<th>Environmental issue categories</th>
<th>Scoring</th>
<th>Description of the environmental issue</th>
<th>Description of related improvement potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>End-of-life (recyclability, recycled content)</td>
<td>++</td>
<td>Cycles could stress the batteries as could induced temperature stress.</td>
<td>Regulation</td>
</tr>
<tr>
<td>Di rect emissions to air</td>
<td>0</td>
<td>Similar to other small electronic devices. Some charger types may contain non-removable rechargeable batteries.</td>
<td>In case of non-removable batteries, improvement may be reached by allowing for easy retractability of batteries in end-of-life treatment for economic recoverability of contained cobalt.</td>
</tr>
<tr>
<td>Direct emissions to water</td>
<td>0</td>
<td>Copper as valuable material.</td>
<td></td>
</tr>
<tr>
<td>Direct emissions to soil</td>
<td>0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Scoring: “0” if not an issue for the product group. If this is an issue, the indicative importance of the environmental issue is provided from + (low) to +++ (high).

### 21.1.1 Use of critical raw materials

The following critical raw materials may be used in wireless chargers based on typical components, i.e. plastic casings, ICs, PCBs. It is not clear if these apply to all wireless chargers on the market. Amounts have not been assessed and are likely small compared to other applications for these materials.

- Possibly antimony in (plastic) flame retardants as substitute for banned flame retardants;
- Beryllium in electronic components;
- Gallium in Integrated Circuits (ICs) and in LEDs;
- Indium in lead-free solders; and
- Possibly Platinum Group Metals (PGMs) in printed circuit boards (PCBs).

Wireless charger variants that provide portable power “on-the-go” contain rechargeable batteries and hence normally the following critical raw materials:

- Cobalt in Li-Ion batteries; and
- Natural graphite in Li-Ion battery.

Li-Ion batteries are the most important application of cobalt worldwide. Recycling is possible if batteries are treated separately at end-of-life.

Improvement potential hence lies in facilitating easy retrieval of battery (within seconds for economic operation).234


Measures to increase lifetime of wireless chargers, such as requirements on durability or easy replicability of battery (in battery containing variants) could reduce overall consumption of CRMs.

*Retractability and replicability of battery may best be addressed through the Battery Directive, which would have to adjusted accordingly.*

### 21.1.2 Presence of flame retardants

Flame retardants are used to comply with fire safety requirements. With regard to wireless chargers common plastic casings and electronic components are likely subject to use of flame retardants.

Non-halogenated flame retardants exist. A dedicated preparatory study would have to determine whether they can be used for wireless chargers and if they provide life cycle environmental benefits.

*Use of flame retardants is informed by REACH Regulation (1907/2006) and restricted in RoHS. These should be the primary frameworks for regulating hazardous substances.*

### 21.1.3 Presence of plasticisers

Wireless chargers usually use cables for their own power supply. Cables often contain phthalates, which presumably have health impacts through air intake or contact with skin and especially mucous membranes. Phthalates exposure is presumably cumulative.

Phthalates are also used in synthetic rubber and flexible PVC. Some wireless charger variants use mats as transmitters, on which electronic devices are placed, which hence depending on the materials used may be prone to use of phthalates.

Four phthalates are banned for manufacture and use in the EU (REACH Annex XIV) but not banned in imported products (though reporting is required).

Less toxic, high-molecular-weight phthalates or other less harmful substances exist. A dedicated preparatory study would have to determine whether they can be used for wireless chargers or if phthalate-free plastics can be used and provide life cycle environmental benefits.

*REACH and RoHS should be the primary frameworks for regulating the presence of plasticisers.*

### 21.1.4 Radiation levels

Electromagnetic radiation (EMC, EMF) is technology immanent. It may hence be more prominent than in other electronic products given the power transfer between two separate devices in close proximity of consumers and other devices. There is, however, no indication that existing legal requirements cannot or are not met. This should be closely monitored within appropriate frameworks as wireless chargers provide for a different kind of exposure to electromagnetic radiation.

### 21.1.5 Durability

Wireless chargers are presumably more durable than conventional chargers, due to lack of connection to the phone and, hence, less strain, less moving parts, etc. Therefore, possibly longer lifetime than conventional chargers may be achievable.

Some charger types may contain non-removable rechargeable batteries, which may limit lifetime.
There is some indication that some devices/receivers on the market are at risk of premature failure, perhaps more so than conventional chargers.\textsuperscript{236}

In case of battery containing variants improvement may be reached by allowing for easy change of battery by end-user without tools.

\textit{Durability could potentially be addressed through Ecodesign requirements, though it is not clear if a suitable measurement standard exists. Battery treatment would best be addressed through a revision of the Battery Directive.}

21.1.6 End-of-life

End-of-life issues are similar to other small electronic devices. Some charger types may contain non-removable rechargeable batteries. Of particular interest for end-of-life treatment are copper as valuable material in the coil and cobalt in possible rechargeable batteries.

\textit{In case of non-removable batteries, improvement may be reached by allowing for easy retractability of batteries (within seconds) in end-of-life treatment for economic recoverability of contained cobalt. Other materials can be retrieved if wireless chargers reach proper recycling facilities.}

21.1.7 Conclusion for Ecodesign

Most issues relate to electronic components. More complex electrical and electronic components indicate higher resource consumption than conventional chargers.

With regard to Ecodesign and beyond energy consumption discussed in Task 3 a suitable Ecodesign measure is, for battery containing variants, the easy retractability of battery at end-of-life. This would facilitate increase of critical raw material cobalt recycling rates and also limit exposure of rest of the waste stream to batteries, altogether leading to safer and more effective treatment. This would, however, best be addressed through a revision of the Battery Directive. Should this not be possible product group specific Ecodesign requirements could be established.

Durability of wireless chargers may be an issue, though more evidence is needed.

21.2 Policy coverage

This section is dedicated to the regulatory coverage of the product groups addressed, be it through legislation, within the EU or in third countries, through voluntary agreements and environmental labels or standards. The goal is to identify where Ecodesign or Energy Labelling regulations could have added value beyond the existing legislation, and, in the case of third country legislation, whether there is successful legislation that could serve as a model for Ecodesign or Energy Labelling legislation.

21.2.1 Overview of EU policies

Currently, EU WEEE, RoHS and REACH are relevant for wireless chargers for consumer electronics. No applicable Ecolabel or GPP criteria were identified.

\textsuperscript{236} See e.g. https://de.ifixit.com/Answers/View/153119/nexus+5+wireless+charging+broken+after...
Table 82: Main EU legislation applicable to the “wireless chargers” product group

<table>
<thead>
<tr>
<th>Product group</th>
<th>WEEE</th>
<th>RoHS</th>
<th>REACH</th>
<th>EPBD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wireless chargers for consumer electronics</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>-</td>
</tr>
</tbody>
</table>


With regard to Annex III they would fall in the category 6. Small IT and telecommunication equipment (no external dimension more than 50 cm)


Provisions of **REACH Regulation (1907/2006)** apply with regard to use of substances in the product. No consideration of specific substances has been taken here.

Further specific regulations that (potentially) relate to wireless chargers and that have not yet been assessed further here include.

**Directive 2013/56/EU on batteries and accumulators and waste batteries and accumulators** applies to battery containing wireless charger variants.

As discussed in Task 3 the existing **Commission Regulation (EC) for External Power Supplies (No 278/2009)** is in principle applicable to wireless chargers for consumer electronics. It should be considered, in light of the findings in this report, if wireless chargers for consumer electronics could be included in its next revision. However, as a dedicated preparatory study may be needed, the process could be started earlier.

Other applicable policies:

- EMF Directive 2013/35/EU; and

### 21.2.2 Selected Member States policies

No relevant Member States policies could be identified apart from those covering conventional external power supplies.

### 21.2.3 Industry Self-Regulatory Initiative

No relevant SRI could be identified apart from the different consortia that develop wireless charger technologies (see Task 3).

### 21.2.4 Existing third country legislation and labels

No relevant third country legislation and labels could be identified.
21.2.5 Test standards

Test standards for measuring energy efficiency of external power supplies may be applicable to wireless chargers/ power supplies for consumer electronics, e.g.

EN 50563:2011: External a.c. - d.c. and a.c. - a.c. power supplies – Determination of no-load power and average efficiency of active modes

This would have to be verified in a possible preparatory study.

Stakeholder input indicated consideration of measurement standards in IEC (IEC61980) and SAE (J2954).

21.2.6 Conclusion for Ecodesign

Most important environmental impact of wireless charging is arguably from energy losses in power transmission. Energy efficiency could be addressed in Ecodesign or Energy labelling and is not currently addressed in other policies or voluntary instruments. Specific test standards are not yet available/ known. However, it should be assessed, if existing measurements standards for efficiency of external power supplies are applicable to wireless chargers. Also, standardization mandates could be issued.

With regard to other environmental issues Ecodesign could be utilised to ensure easy retrieval of battery (in battery containing variants, which will only be a small share of wireless chargers on the market) for recovery of contained cobalt and easy replacability of battery by end-user without tools for increased durability. However, it should first be explored if a revision of the existing Battery Directive would be more suitable.

21.3 Appropriateness of Ecodesign or Energy labelling

Whereas the “regulatory coverage” section addressed the question of current mandatory and voluntary instruments (are they enough to cover this specific product group?), the section on “Appropriateness of Ecodesign requirements” addresses the question of future regulation (would Ecodesign or Energy labelling adequately cover this specific product group?).

21.3.1 Excessive cost

Inductive chargers for consumer electronics are generally more costly than conventional chargers/ power supplies. A typical range seems to be 50-100 Euro. Manufacturing costs are mentioned as a potential obstacle for fast adoption of wireless chargers. This may partly be due to the need for copper wiring as well as the limited production numbers given the still high diversity of charger types.

As no specific design-related improvement options for better energy efficiency could be identified, a cost calculation is based on approximate purchase price and efficiency improvement potential.

The discussion about “excessive cost” follows a simplified Life-Cycle Cost analysis (LCC), to compare savings stemming from lower energy consumption with possible increases in purchase price. For wireless chargers for consumer electronics, Table 83 below sums up the LCC performed.
The induced additional costs due to efficiency improvements are dependent upon a number of factors, including general technological development. Also purchase price will likely change significantly with the broader introduction of the technology (e.g. being implemented by default in mobile phones). The higher efficiency is today more of a research and development and market dominance question with regard to prevailing technologies than simple costs for specific improvement options.

### 21.3.2 Suitability of Ecodesign measures or Energy labelling

Several factors favour the establishment of Ecodesign requirements:

- Wireless chargers are already today close to being a mass market product;
- Energy efficiency is important and not regulated elsewhere;
- Only few technological variants will likely emerge; and
- Measurement standards should be similar to those for external power supplies.

Several obstacles for possible Ecodesign measures should be noted:

- There is still a rapid technological development;
- Best Available Technologies are not yet clear; and
- Universal wireless transmittance standards for basic technologies are still lacking.

Generally, Ecodesign seems the more appropriate instrument as compared to energy labelling, similar to regulation on external power supplies. However, given the rapid technological development and the needed flexibility for further innovation, energy labelling could be introduced as bridging regulation before more stringent Ecodesign requirements are introduced, dependent upon universally applicable measurement standard(s).
21.3.3 Conclusion for Ecodesign

In principle, Ecodesign requirements are an appropriate tool for addressing energy efficiency of wireless chargers, similar to the existing regulation on External Power Supplies. In fact, given the close relation of these product groups, and should wireless chargers be deemed of interest, it is advisable to include them in the scope of the External Power Supplies Regulation, based on a dedicated preparatory study.

21.4 Industrial competitiveness

21.4.1 Market structure

Market for wireless charging/ power is still forming. Different alliances have formed encompassing a range of companies from various backgrounds, e.g. wireless technology developers, consumer electronics manufacturers, retailers, automotive, furniture, etc., indicating the cross-cutting potential of this product group.

Hence, a clear market structure is not yet established. At the moment established manufacturers (particularly mobile phone) introduce devices alongside smaller accessory providers.

Major developers and manufacturers of wireless charging technology include Powermat, Energizer, ConvenientPower, Witricity, Fulton.

The diversity of approaches may make it more difficult to come to common ground on energy efficiency. However, a possible Ecodesign/Energy labelling regulation may also stimulate early development of standards towards higher efficiency and favouring more energy efficient solutions.

21.4.2 Innovation and employment

Innovation is the crucial aspect with regard to possible Ecodesign measures. Wireless charger technologies still undergo rapid innovation, driven by various demands:

- Flexibility of charging circumstances;
- Fast charging times;
- Technological flexibility/ compatibility; and
- Size.

Energy and resource efficiency does not seem to be a primary driver in innovation, though it could follow from e.g. the ambition to reduce charging times. Energy and resource efficiency could hence lag behind other innovation.

Introducing Ecodesign/ Energy labelling requirements could boost innovation if carefully considered, planned and announced ahead to allow for technological adjustment and requirements slowly increased in line with technological possibilities. This is especially applicable for already introduced innovations, e.g. placing mobile phones on charging mats for recharging. As product variants are similar around the world, related innovation could stimulate increased energy efficiency beyond Europe alone.

However, if Ecodesign requirements limit the scope of possible new technological options or true innovations then these may have an adverse effect.
Generally, increased efficiency is probably favourable for adaptability of wireless charging/ power to a range of different applications, even beyond wireless charging for consumer electronics. Early competence in this aspect of wireless charging can secure long term market access.

Many wireless chargers on the market today are imported from outside Europe. Expertise in efficiency could help increase general technological expertise in Europe and hence stimulate job creation here. However, estimating effects on jobs must remain vague.

21.4.3 International competition

Wireless charging is pursued by a range of different companies and organisations. Markets are still forming. Likely, wireless charging will very much function as a global market, closely related to manufacturing and development of electronic components, manufacturing hence likely often outside Europe.

Introducing Ecodesign requirements could stimulate local research and development, securing a better position in future competition.

21.4.4 Conclusion for Ecodesign

A close monitoring of technological innovation and developments is advisable should Ecodesign requirements be introduced. Ecodesign requirements are most appropriate for those technological systems that are already introduced in various devises and already undergo innovation cycles.

Ecodesign requirements or in a bridging manner Energy labelling should be carefully considered, planned and announced ahead to allow for technological adjustment and requirements slowly increased in line with technological possibilities. In that manner such requirements could also inform further standardisation of wireless charging technologies, e.g. faster integration of different power supply components instead of multiple steps that each entail conversion losses.

Standardisation of wireless charging technologies seems crucial for their future market penetration rates. Lack of standardisation may also lead to multiple parallel technologies on the market. Hence, standardisation could also reduce future resource use by reducing the need for multiple end-use devices.

Altogether, possible Ecodesign measures may positively stimulate industrial competitiveness.

21.5 Product group summary and recommendations

Table 84 below presents a simplified scoring of the four main sections above, for the product group “wireless chargers for consumer electronics”.

Table 84: Overall scoring of the “wireless chargers for consumer electronics” product group

<table>
<thead>
<tr>
<th>Product group</th>
<th>Other environmental impacts</th>
<th>Regulatory coverage</th>
<th>Appropriateness of Ecodesign</th>
<th>Appropriateness of Energy labelling</th>
<th>Industrial competitiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wireless chargers for consumer electronics</td>
<td>++</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
</tr>
</tbody>
</table>
The more “+” there are in the assessment, the more favourable it is for Ecodesign Regulation or Energy labelling to be implemented.

Ecodesign could play an important role in ensuring minimum energy efficiency of wireless chargers for consumer devices and hence a range of possible future variants of power supply.

Ecodesign is an appropriate instrument for ensuring minimum energy efficiency if it is:

- Implemented in such a way that innovation in the market is not adversely effected or at best even stimulated; and
- Measurement standards for external power supplies can be adapted to wireless charging power conversion or alternative measurement standards can be developed.

More specifically:

- Minimum requirements on energy efficiency could be set and announced ahead of time to allow for innovation;
- Energy labelling could serve as a “bridging regulation” to stimulate energy efficiency without limiting innovation; and
- For battery containing variants, requirements for easy retractability of battery at end-of-life could be established (possibly through a horizontal measure for consumer devices or similar)

Should this product group be considered for future Ecodesign regulation, it is advisable to address these issues in the next revision of the Commission Regulation (EC) for External Power Supplies (No 278/2009). Given their separate underlying technology from conventional external power supplies, a dedicated preparatory study could probably best provide the basis for elaborating detailed requirements.
22. Conclusions

22.1 Role and limitations of this study

The aim of the present study is to support the European Commission in the choice of product groups for the Ecodesign Working Plan 2015-2017. It is the first step in a longer process at the end of which Regulations for individual product groups may be adopted. Each step of the process allows for further stakeholder input. Figure 8 provides a simplified overview of the process.

![Figure 8: From the Working Plan Study to Regulation](image)

This study is an overview study that has assessed a broad range of product groups within a limited timeframe and budget. It is therefore subject to some limitations:
• Data availability: Detailed and reliable data, e.g. on sales and trade, energy and resource consumption, improvement potential or other environmental impact could not be retrieved for all product groups. Therefore, estimates had to be made in many cases. In other cases, data was only available from one source so that no cross-check was possible;

• Data matching: When data from different sources were used, it did often not match. Different timeframes, regional coverage, indicators and methods limited comparability;

• Time restrictions: Even topics such as regulatory coverage, where the information is in principle available, could generally not be explored in depth due to time restrictions; Prognosis uncertainty: Prognoses rely on models that in turn rely on assumptions that may be challenged; especially for dynamic markets and technologies, prognoses for a long period are uncertain; and

• Assessment uncertainty: Some assessments, such as appropriateness of Ecodesign or Energy Labelling, necessarily imply a subjective and qualitative element, both because many different aspects need to be considered and weighed, and because they involve value judgements.

The team has addressed these limitations in the following ways:

• Giving ranges where appropriate: Where data were scarce, data from different sources did not match or assumptions for models could be varied, several variants were considered and ranges were given;

• Assessing reliability of estimates: For the core indicator “energy savings”, an assessment of the reliability of the estimates was provided for each product group; and

• Cross-validation of expert judgements: Assessments that imply a qualitative element have been discussed in the study team, and input from stakeholders, external experts and the Commission has been sought.

The team believes that these approaches serve to make the conclusions more robust. However, some inherent limitations, as described above, remain. Especially, 2020 savings are of a theoretical nature, based on the projected 2020 stock, and do not account for the fact that policy measures will probably not be in place early enough to reap the full savings. On the other hand, 2030 savings are not included in the conclusions for some fast evolving product groups due to their high uncertainty. Should the Commission decide to include a product group in the Working Plan, a deeper analysis of individual product groups can be conducted in dedicated Preparatory Studies.

22.2 Final product matrix

Table 85 and Table 86 give a simplified overview of the 16 product groups assessed in Task 4. Also, the team’s assessment of the appropriateness of the PG for Ecodesign or Energy Labelling Measures is provided:

• Appropriateness of Ecodesign: A high rating means that Ecodesign Regulations are a suitable instrument for reaping the potential benefits. Considerations taken into account were for example: Is the product a standardized mass market product? Do design- or information-related improvement potentials exist? Is there sufficient spread of performance? Is the product strongly integrated into a system? Would excessive cost occur? (for more detail see section 1.3); and

• Appropriateness of Energy Labelling: A high rating means that Energy Labelling is a suitable instrument for reaping the potential benefits. Considerations taken into account were for example: Is energy in use phase a major environmental impact? Is there an information deficit on energy consumption? Is there sufficient spread of performance? (for more detail see section 1.3).
Table 85 ranks product groups by Primary Energy Savings in 2020, Table 86 by Primary Energy Savings in 2030. In cases where a range of estimates has been given for the possible energy savings in Task 3, the most likely estimate has been presented and chosen for the ranking. The level of confidence for the estimates has also been provided.

Both tables have certain limitations. 2020 savings in Table 85 are theoretical savings based on the projected 2020 stock. They do however not take into account the fact that policy measures would need time to be developed and implemented, so that first regulations would probably not be in place before 2018 and can therefore, depending on product lifetime, affect 2020 stock only to a limited degree.

In 2030, stock turnover will have occurred except for lifts and it can be expected that projected savings can be realized partially or fully by policy measures, depending on the degree of autonomous improvement. On the other hand, Table 86 does not include estimates for all product groups, as 2030 estimates imply a high uncertainty for fast evolving product groups. However, it can be expected that savings for these PGs are considerably higher in 2030, up to four times for some product groups (see Task 3 for details).

Table 85: Overview of product groups, ranked by theoretical 2020 primary energy savings potential

<table>
<thead>
<tr>
<th>Product Group Name</th>
<th>Primary Energy Savings 2020 (Use Phase, TWh)</th>
<th>Level of confidence for energy savings estimates</th>
<th>Appropriateness of Ecodesign</th>
<th>Appropriateness of Energy Labelling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hand dryers</td>
<td>13.8(^a)</td>
<td>+++</td>
<td>+++</td>
<td>++</td>
</tr>
<tr>
<td>Electric Kettles</td>
<td>11.9(^b)</td>
<td>++</td>
<td>+++</td>
<td>+++</td>
</tr>
<tr>
<td>Building Automated Control Systems</td>
<td>11.3</td>
<td>++</td>
<td>++</td>
<td>++</td>
</tr>
<tr>
<td>Signage displays</td>
<td>6.5(^c)</td>
<td>++</td>
<td>++</td>
<td>++</td>
</tr>
<tr>
<td>Hair dryers</td>
<td>4.9(^d)</td>
<td>++</td>
<td>+++</td>
<td>+++</td>
</tr>
<tr>
<td>Mobile phones / smartphones</td>
<td>3.5(^e)</td>
<td>++</td>
<td>+++</td>
<td>+</td>
</tr>
<tr>
<td>Lifts</td>
<td>3.3</td>
<td>++</td>
<td>++</td>
<td>+</td>
</tr>
<tr>
<td>High pressure cleaners</td>
<td>2.5</td>
<td>++</td>
<td>+++</td>
<td>+</td>
</tr>
<tr>
<td>Refrigerated containers</td>
<td>2.4</td>
<td>++</td>
<td>++</td>
<td>++</td>
</tr>
<tr>
<td>Wireless chargers for consumer electronics</td>
<td>2.2</td>
<td>+</td>
<td>+++</td>
<td>+++</td>
</tr>
<tr>
<td>Greenhouse</td>
<td>2.1</td>
<td>+</td>
<td>+</td>
<td>+++</td>
</tr>
</tbody>
</table>
### Table 86: Overview of product groups, ranked by 2030 primary energy savings potential

<table>
<thead>
<tr>
<th>Product Group Name</th>
<th>Primary Energy Savings 2030 (Use Phase, TWh)</th>
<th>Level of confidence for energy savings estimates</th>
<th>Appropriateness of Ecodesign</th>
<th>Appropriateness of Energy Labelling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic toasters</td>
<td>2.1(^f)</td>
<td>++</td>
<td>+++</td>
<td>++</td>
</tr>
<tr>
<td>Gateways</td>
<td>1.7(^g)</td>
<td>++</td>
<td>++</td>
<td>+</td>
</tr>
<tr>
<td>Base stations</td>
<td>0.9</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Free-standing hot beverage vending machines</td>
<td>0.6</td>
<td>++</td>
<td>++</td>
<td>+</td>
</tr>
<tr>
<td>PV inverters</td>
<td>0.6</td>
<td>++</td>
<td>++</td>
<td>++</td>
</tr>
</tbody>
</table>

\(^a\) With technology change (warm air to jet air). Without technology change, savings would be 3.0 TWh.

\(^b\) Most likely value of a range of 11.9 - 20.3 TWh.

\(^c\) Most likely value of a range of 4.1 - 6.5 TWh.

\(^d\) Most likely value of a range of 3.6 - 6.3 TWh.

\(^e\) Total energy savings over the life cycle given a 3 months lifetime extension. Use phase primary energy savings would be 1.9 TWh.

\(^f\) Most likely value of a range of 2.1 – 6.2 TWh

\(^g\) This figure accounts for Gateways and ONTs.

Columns 3-5: + - low, ++ - medium, +++ - high; The more “+” there are in the assessment, the more favourable it is for Ecodesign Regulation or Energy labelling to be implemented.
<table>
<thead>
<tr>
<th>Product Group Name</th>
<th>Primary Energy Savings 2030 (Use Phase, TWh)</th>
<th>Level of confidence for energy savings estimates</th>
<th>Appropriateness of Ecodesign</th>
<th>Appropriateness of Energy Labelling</th>
</tr>
</thead>
<tbody>
<tr>
<td>PV inverters</td>
<td>4.6</td>
<td>++</td>
<td>++</td>
<td>++</td>
</tr>
<tr>
<td>High pressure cleaners</td>
<td>2.8</td>
<td>++</td>
<td>+++</td>
<td>+</td>
</tr>
<tr>
<td>Domestic toasters</td>
<td>2.1&lt;sup&gt;d&lt;/sup&gt;</td>
<td>++</td>
<td>+++</td>
<td>++</td>
</tr>
<tr>
<td>Free-standing hot beverage vending machines</td>
<td>0.6</td>
<td>++</td>
<td>++</td>
<td>+</td>
</tr>
<tr>
<td>Base stations</td>
<td>n.a.</td>
<td>n.a.</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Gateways</td>
<td>n.a.</td>
<td>n.a.</td>
<td>++</td>
<td>+</td>
</tr>
<tr>
<td>Mobile phones / smartphones</td>
<td>n.a.</td>
<td>n.a.</td>
<td>+++</td>
<td>+</td>
</tr>
<tr>
<td>Signage displays</td>
<td>n.a.</td>
<td>n.a.</td>
<td>+</td>
<td>++</td>
</tr>
<tr>
<td>Wireless chargers for consumer electronics</td>
<td>n.a.</td>
<td>n.a.</td>
<td>+++</td>
<td>+++</td>
</tr>
</tbody>
</table>

<sup>a</sup> With technology change (warm air to jet air). Without technology change, savings would be 2.7 TWh.

<sup>b</sup> Most likely value of a range of 12.1 - 21.8 TWh.

<sup>c</sup> Most likely value of a range of 3.6 - 6.3 TWh.

<sup>d</sup> Most likely value of a range of 2.1 – 6.4 TWh.

Columns 3-5: + - low, ++ - medium, +++ - high; The more “+” there are in the assessment, the more favourable it is for Ecodesign Regulation or Energy labelling to be implemented.

Annex 4.A provides a fuller overview of the product groups, including sales and stock data as well as the product group’s rating on additional criteria that might impact the decision to include it in the Working Plan:

- Other environmental impacts (including resource efficiency): A high rating means that relevant environmental impacts are present that could, in principle, be addressed by means of Ecodesign or Energy Labelling measures. Although a quantitative estimate for resource savings could not be given for most product groups, this rating includes the question whether relevant resource savings could be achieved (for more detail see section 1.3);

- Policy gaps: A high rating means that existing instruments (including mandatory ones as well as voluntary ones such as labels, public procurement rules or industry SRIs) do not seem sufficient to reap the expected energy savings and / or address the other environmental impacts (for more detail see section 1.3); and

- Industrial competitiveness: A high rating means that Ecodesign measures would be beneficial to industrial competitiveness (while a low rating means it would be adverse, and a medium rating...
that the evidence is indecisive). Aspects considered were for example: Would Ecodesign measures create a (cost or administrative) barrier for SMEs? How would they affect the position of European industry vis-à-vis competitors from third countries?

No overall ranking is provided on purpose. This way, the different criteria can be used in order to discuss in a transparent way about different considerations and political priorities that might impact the decision to include a product in the Working Plan.

22.3 Putting the new product groups in context: the reminder list

During the 2015-2017 period, other work will have to be done in the realm of Ecodesign and Energy Labelling besides dealing with new product groups. A number of revisions are outstanding or planned, and some product groups would be suitable for uptake in these revisions. Also, previous working plans list PGs that have not yet been fully tackled (see for planned revisions and outstanding PGs from previous Working Plans Task 1 report). Finally PGs have been considered as first or second priority in previous Ecodesign Working Plan studies but have not ended up in a Working Plan (see for these PGs Task 2 report).

These are all reasons that the respective PGs have not been the object of Task 3 of the present Working Plan study. This does, however, not mean that such PGs are irrelevant or should not be prioritised for further action.

It was out of the scope of the present study to assess the savings potentials of these “previous” PGs and compare them to the savings potentials of the “new” PGs. However, a “reminder list” has been compiled presenting such PGs. The reminder list can be used as a decision making tool for the Commission in order to consider “previous” PGs along with “new” PGs and decide on its priorities.

The reminder list contains:

- A list of upcoming revisions in the period 2015-2017, including suggestions for new PGs that might be included in such revisions;
- From Task 2.2, Step 1, PGs that have been suggested as first or second priority in any of the previous Working Plan Studies but which have not been included in a Working Plan or for which no Preparatory Study has been launched so far. At the same time, they are considered to have relevant improvement potential, and the evidence provided by the second Working Plan study is deemed to be sufficiently detailed so that they did not need to be explored further in the present study;
- From Task 2.1, portable ovens as a product that has been in the scope of a Preparatory Study but was not included in the scope of the Regulation, even though their saving potential is significant. The next planned review of ovens for cooking is not however until 2021. Therefore, portable ovens would merit earlier reconsideration;
- PGs from the conditional list of the second Working Plan for which no preparatory study has been launched so far, and no final decision has been taken to not launch one;
- Possible topics that could be addressed in future updates of existing Voluntary Agreement; and
- For information, also upcoming revisions outside the time span 2015-2017 have been listed.

This list is proposed as a decision-making tool that would help with setting priorities between the PGs in the reminder list and the new PGs, and with deciding what should happen to the PGs listed therein (e.g. should they be included in the Working Plan 2015-2017, should a dedicated Preparatory Study be launched, or should they be included in the revision of an existing Implementing Measure).

The reminder list is to be found in Annex 4.B.
22.4 Dealing with non-energy aspects

It becomes increasingly clear that the products with highest energy savings potentials have been covered. Savings potentials for new product groups are becoming smaller. At the same time, it is being increasingly explored to what degree the instrument of Ecodesign could be used to deal with non-energy issues, specifically with issues related to resource efficiency and materials use.

To address these questions, an approach has been developed in the present study that is laid down in more detail in the Supplementary Report on Material Aspects. It resides on two pillars:

• To identify potential “conditional” Ecodesign requirements that could be applied to certain “classes” of product groups. However, the feasibility and environmental benefit of such requirements would have to be explored for individual product groups in dedicated preparatory studies; and

• To identify potential horizontal approaches and measure.

This approach has been applied for both resource efficiency (including durability and recyclability aspects) and hazardous substances.

22.4.1 Resource efficiency

A table of potential conditional Ecodesign requirements has been developed. It includes, for example, the following types of requirements:

• Durability: Direct quality or durability requirements; requirements on safe data storage or removal, information requirements on disassembly and repair; and

• Recyclability: Marking of specific components, fast and easy disassembly

The measures and applicable product groups are described in more detail in Chapter 2.5 of the Supplementary report.

Furthermore, the following horizontal measures are proposed:

• Marking of devices containing components with specific materials such as critical raw materials. An illustrative example would be the marking of devices containing rare earth permanent magnets (e.g. motors, generators, fans, pumps, elevators, machines). They would be marked with respect to permanent magnets: Does the device contain permanent magnets? If yes, which type (e.g. SmCo, FeNdB).

• Battery powered electronic devices: Easy extraction of rechargeable batteries in the recycling facility (not identical with the easy removability during use required by the battery directive). Furthermore, it could be envisaged to introduce a requirement on extractability by the user. The EU Battery Directive requires battery removability but does not require that batteries can be easily replaced by users. Having batteries changed by manufacturers, for instance, may result in significant cost and time effort which will in turn encourage disposal of functioning products which could be used for much longer. Although stakeholders argue that removeability by the user may result in more damage and / or require thicker batteries and therefore increase resource use, such claims have not been backed by data so far.

22.5 Hazardous substances

For dealing with hazardous substances, in principle a horizontal approach is suggested: A mechanism should be in place that refers relevant hazardous substances-related issues, if identified during the Ecodesign process, to the RoHS or REACH processes, while avoiding problem shifting.
However, as there are certain gaps in the RoHS Directive and REACH regulation, conditional Ecodesign requirements are also suggested. Maximum concentrations and/or information requirements could be envisaged in the following cases:

- PGs that are out of RoHS scope (e.g. coal or wood fired; indirect ErP), but contain a substance that is contained in RoHS Annex 2;
- PGs that contain SVHC while the individual concentration is below the REACH threshold; but the absolute amount in the article is high (due to high weight of article); and
- PGs that contain hazardous substances where it would make sense to give product-specific information on the safe use, disposal or recycling.

### 22.6 Other potential horizontal measures

#### 22.6.1 Energy using equipment in means of transport

The study has looked into the potential of energy-using products that are being used on board of means of transport. These are not yet covered by fuel efficiency legislation: During fuel efficiency tests, such additional energy using devices are, as a default, switched off. It is unclear whether they are in scope of the Ecodesign Directive, but they could well be because they are not means of transport themselves. The Commission’s Frequently Asked Questions on Ecodesign indicates that products which can also be used in a stationary way are within scope of the Ecodesign Directive.\(^{237}\)

There might be a significant savings potential. Although the pilot run in this study for refrigerated containers has identified a more modest potential, there are many other applications such as car or train air conditioning or car electronics that may merit further study. It would be important to assess the savings potential for such equipment and clarify the legal issues involved.

#### 22.6.2 Internal combustion engines

Internal combustion engines are used in a variety of equipment, such as garden equipment, construction machinery, or generators. The Ecodesign Regulation on electric motors has shown that a cross-cutting approach on motors can be very effective. In principle, there is no reason why this approach should be restricted to electricity as an energy source. It could therefore be explored whether a similar approach could be beneficial for internal combustion engines. Energy saving technology used in the automotive sector could be used in this sector suggesting that energy saving potential could be significant. Even if such equipment is already subject to other legislation such as the NRMM or Outdoor Noise Directive, this does not specifically address energy consumption but other environmental impacts such as noise or air pollution. Still, the fit with such legislation would have to be carefully explored.

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### 23.1 Annex 4.A: Final product Matrix

<table>
<thead>
<tr>
<th>Product</th>
<th>Level of confidence for energy savings estimates</th>
<th>Sales 2012 ('000 units)</th>
<th>Stock 2020 / 2030 ('000 units)</th>
<th>Other environmental impact (including resource efficiency)</th>
<th>Policy gaps</th>
<th>Appropriate-ness of Ecodesign</th>
<th>Appropriate-ness of Energy Labelling</th>
<th>Industrial competitiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base stations</td>
<td>++</td>
<td>260</td>
<td>962 / n.a</td>
<td>+</td>
<td>++</td>
<td>+</td>
<td>+</td>
<td>++</td>
</tr>
<tr>
<td>Building Automated Control Systems</td>
<td>++</td>
<td>18,000</td>
<td>184,000 / 190,000</td>
<td>++</td>
<td>+++</td>
<td>++</td>
<td>++</td>
<td>+++</td>
</tr>
<tr>
<td>Domestic toasters*</td>
<td>++</td>
<td>67</td>
<td>775 / 750</td>
<td>+</td>
<td>++</td>
<td>++</td>
<td>+</td>
<td>++</td>
</tr>
<tr>
<td>Electric Kettles</td>
<td>++</td>
<td>23,400</td>
<td>119,000 / 122,000</td>
<td>++</td>
<td>++</td>
<td>+++</td>
<td>+++</td>
<td>++</td>
</tr>
<tr>
<td>Free-standing hot beverage vending machines</td>
<td>++</td>
<td>67</td>
<td>775 / 750</td>
<td>+</td>
<td>++</td>
<td>++</td>
<td>+</td>
<td>++</td>
</tr>
<tr>
<td>Gateways</td>
<td>++</td>
<td>n.a</td>
<td>148,000 / n.a</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>+</td>
<td>++</td>
</tr>
<tr>
<td>Greenhouse covers</td>
<td>++</td>
<td>20,000 ha greenhouses</td>
<td>136,000 ha / 136,000 ha</td>
<td>++</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+++</td>
</tr>
<tr>
<td>Hair dryers*</td>
<td>++</td>
<td>26,000</td>
<td>120,000 / 120,000</td>
<td>+</td>
<td>++</td>
<td>+++</td>
<td>+++</td>
<td>++</td>
</tr>
</tbody>
</table>

* Other environmental impact not applicable for these products.
<table>
<thead>
<tr>
<th>Product</th>
<th>Level of confidence for energy savings estimates</th>
<th>Sales 2012 ('000 units)</th>
<th>Stock 2020 / 2030 ('000 units)</th>
<th>Other environmental impact (including resource efficiency)</th>
<th>Policy gaps</th>
<th>Appropriate-ness of Ecodesign</th>
<th>Appropriate-ness of Energy Labelling</th>
<th>Industrial competitiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hand dryers**</td>
<td>+++</td>
<td>1,000</td>
<td>7,200 / 8,500</td>
<td>++</td>
<td>+++</td>
<td>+++</td>
<td>++</td>
<td>++</td>
</tr>
<tr>
<td>High pressure cleaners</td>
<td>++</td>
<td>9,065</td>
<td>98,970 / 109,430</td>
<td>+++</td>
<td>++</td>
<td>+++</td>
<td>+</td>
<td>++</td>
</tr>
<tr>
<td>Lifts</td>
<td>++</td>
<td>110</td>
<td>4,950 / 5,200</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>+</td>
<td>++</td>
</tr>
<tr>
<td>Mobile phones / smartphones</td>
<td>++</td>
<td>256,000</td>
<td>625,000 / n.a.</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
<td>+</td>
<td>+++</td>
</tr>
<tr>
<td>PV inverters</td>
<td>++</td>
<td>17 GW</td>
<td>150 GW / 480 GW</td>
<td>++</td>
<td>+++</td>
<td>+++</td>
<td>++</td>
<td>++</td>
</tr>
<tr>
<td>Refrigerated containers</td>
<td>++</td>
<td>80 (in 2013)</td>
<td>1,295 / 1,578</td>
<td>++</td>
<td>+++</td>
<td>++</td>
<td>++</td>
<td>+++</td>
</tr>
<tr>
<td>Signage displays*</td>
<td>++</td>
<td>202</td>
<td>14,026 (including video projector replacement) / n.a</td>
<td>++</td>
<td>+++</td>
<td>++</td>
<td>++</td>
<td>++</td>
</tr>
<tr>
<td>Wireless chargers for consumer electronics</td>
<td>+</td>
<td>5,274 (in 2010)</td>
<td>313,000 / 920,000</td>
<td>++</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
</tr>
</tbody>
</table>

* Range: most likely value has been highlighted in red.
** Without / with technology phase-out.
### 23.2 Annex 4.B: Reminder list of product groups

<table>
<thead>
<tr>
<th>Product group name</th>
<th>Source</th>
<th>Date of revision (if any)</th>
<th>Current status</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Upcoming revisions 2015-2017</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computers and computer servers</td>
<td>Reg. 617/2013</td>
<td>17/07/2017</td>
<td></td>
<td>Check whether inclusion of tablets still makes sense or whether they should be included with mobile devices. Also consider hybrid products (&quot;phablets&quot;). Put a specific focus on resource / material efficiency issues, in line with the recommendations in the &quot;Supplementary report on resources&quot;. For example, consider durability and easy disassembly requirements for notebooks, including quick removability of battery at the recycling facility. Also consider requirement for reliable means to archive or irretrievably remove personal data.</td>
</tr>
<tr>
<td>TVs</td>
<td>Reg. 642/2009</td>
<td>22/08/2012</td>
<td>Revision ongoing</td>
<td>Check product scope. Should signage displays be covered under &quot;monitors&quot; or be treated in a separate measure? Put a specific focus on resource / material efficiency issues, in line with the recommendations in the &quot;Supplementary report on resources&quot;.</td>
</tr>
<tr>
<td>Standby and off-mode consumption</td>
<td>Reg. 1275/2008 (consolidated)</td>
<td>07/01/2016</td>
<td></td>
<td>Consider inclusion standby of professional devices?</td>
</tr>
<tr>
<td>External power supplies</td>
<td>Reg. 278/2009</td>
<td>27/04/2013</td>
<td>Revision ongoing</td>
<td>Consider integration of battery chargers. Battery chargers had been excluded from Regulation 278/2009 due to missing measurement standards. Yet today, new standards seem to be available: - The California Energy Commission (CEC) has an energy efficiency battery charger test procedure; and - The US Department Of Energy (DOE) published a final rule on Energy Conservation Standards for External Power Supplies (including battery chargers), which includes an International Efficiency Marking Protocol for External Power Supplies. Consider inclusion of a minimum power factor for external power supplies as used by:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Computers Energy Star Specification v6.0 Oct 2013 (requires minimum power factor of 0.9 at 100% load for internal power</td>
</tr>
<tr>
<td>Product group name</td>
<td>Source</td>
<td>Date of revision (if any)</td>
<td>Current status</td>
<td>Comments</td>
</tr>
<tr>
<td>-------------------</td>
<td>--------------</td>
<td>---------------------------</td>
<td>----------------</td>
<td>----------</td>
</tr>
<tr>
<td>Air conditioners and comfort fans</td>
<td>Reg. 206/2012</td>
<td>30/03/2017</td>
<td></td>
<td>According to Art. 7 of the Regulation, the review will include resource efficiency, re-use and recycling and the level of measurement uncertainty. It could be envisaged to think about the marking of permanent magnets in motors, as proposed in the Supplementary Report on Resources. Potential products to include: - Fractional horsepower motors below 200 W (VHK 4.35; WP 2 conditional list) - motors wholly immersed into a liquid, should there be a substantial market</td>
</tr>
<tr>
<td>Electric motors</td>
<td>Reg. 640/2009</td>
<td>12/08/2016</td>
<td></td>
<td>Also, wireless chargers may be integrated into this review.</td>
</tr>
<tr>
<td>Circulators</td>
<td>Reg. 641/2009</td>
<td>01/01/2017</td>
<td></td>
<td>According to Art. 7 of the Regulation, the review shall include the assessment of design options that can facilitate reuse and recycling. Drinking water circulators are subject to information requirements in the current Regulation (622/2012). Implementing specific requirements for this product category could be discussed when revising the Regulation. According to Article 7 of the Regulation, the Commission shall review this Regulation before 1 January 2017, in the light of technological progress;</td>
</tr>
<tr>
<td>Fans</td>
<td>Reg. 327/2011</td>
<td>26/04/2015</td>
<td></td>
<td>Potential products to include: - Small fans (&lt; 125 W) (VHK 4.6); as applied in various household and tertiary equipment / appliances; Often included in other appliances such as PCs, cars, hairdryers; but also for ventilation e.g. in tertiary sector - High temperature fans (VHK 4.8); for safety, smoke extraction, exhaust gases, Combustion Fans for Power Stations and Boilers, etc. - other special purpose ventilation - fans above 500 kW should there be a significant market</td>
</tr>
<tr>
<td>Product group name</td>
<td>Source</td>
<td>Date of revision (if any)</td>
<td>Current status</td>
<td>Comments</td>
</tr>
<tr>
<td>------------------------------------------</td>
<td>-------------------</td>
<td>---------------------------</td>
<td>-------------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Water pumps</td>
<td>Reg. 547/2012</td>
<td>16/07/2016</td>
<td>Positive displacement pumps (VHK 4.9; WP 2 conditional list).</td>
<td></td>
</tr>
<tr>
<td>Domestic refrigerators and freezers</td>
<td>Reg. 643/2009</td>
<td>12/08/2014</td>
<td>Omnibus study completed, Preparatory study to be launched in 2014</td>
<td>The omnibus study recommends prioritizes the PG and suggests the review to consider the effects of a new test standard, the use of various correction factors, the inclusion of wine storage appliances and the feasibility of resource efficiency requirements.</td>
</tr>
<tr>
<td>Domestic dishwashers</td>
<td>Reg. 1016/2010</td>
<td>01/12/2014</td>
<td>Tender for preparatory study launched.</td>
<td>The omnibus study suggests that a modest review provides an opportunity might include reconsidering the calculation method for the EEI and removing 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.</td>
</tr>
<tr>
<td>Domestic washing machines</td>
<td></td>
<td>01/12/2014</td>
<td>Tender for preparatory study launched.</td>
<td>The omnibus study prioritizes the PG and suggests investigating the increase of washing cycle duration and decrease of actual wash temperatures, assessing 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.). Furthermore, actual (real-life) loading behaviour by consumers and the trend to increasing washing machine capacity should be considered, as well as the feasibility of resource efficiency requirements. The tender includes washer-driers.</td>
</tr>
<tr>
<td>Non-directional household lamps</td>
<td>Reg. 244/2009</td>
<td>13/04/2014</td>
<td>Omnibus review completed; Stage 6 review for domestic lighting and follow-up study ongoing</td>
<td>The omnibus study prioritizes the group &quot;lighting&quot; and suggests the review to consider a horizontal approach (combining several existing measures on lighting.) For domestic lighting, the missed energy savings from 'misuse' of special purpose lamps for general lighting should be tackled.</td>
</tr>
<tr>
<td>Product group name</td>
<td>Source</td>
<td>Date of revision (if any)</td>
<td>Current status</td>
<td>Comments</td>
</tr>
<tr>
<td>--------------------</td>
<td>--------</td>
<td>--------------------------</td>
<td>----------------</td>
<td>----------</td>
</tr>
<tr>
<td>Tertiary lighting</td>
<td>Reg. 245/2009</td>
<td>13/04/2014</td>
<td>Omnibus review completed; follow-up study ongoing</td>
<td>The omnibus study prioritizes the group &quot;lighting&quot; and suggests the review to consider a horizontal approach (combining several existing measures on lighting.) For tertiary lighting, the topic of ballasts should be considered as well as improvements of minimum lamp efficacy. Impacts on temperature sensitivity and life time should be assessed. The LED lamp type should be included. The consultants suggest that the review takes into account lighting products not yet covered, e.g. Traffic lights (VHK 4.29), other safety and signalling lighting equipment; commercial lighting, underwater lighting (e.g. swimming pools, aquaria), greenhouse lighting.</td>
</tr>
<tr>
<td>Directional lamps, light emitting diode lamps and related equipment</td>
<td>Reg. 1194/2012</td>
<td>03/01/2016</td>
<td>Omnibus review completed; follow-up study ongoing</td>
<td>The omnibus study prioritizes the group &quot;lighting&quot; and suggests the review to consider a horizontal approach (combining several existing measures on lighting.) Groups such as aquarium lighting could be tackled.</td>
</tr>
</tbody>
</table>

### Products that have been first or second priority in a Working Plan Study, but are not included in a WP

<table>
<thead>
<tr>
<th>Product group name</th>
<th>Source</th>
<th>Current status</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Point-of-sale / ATM equipment</td>
<td>VHK 4.23, EPTA 48</td>
<td>Not in a Working Plan</td>
<td>Consider including in a WP.</td>
</tr>
</tbody>
</table>

### Products that have been included in a Preparatory Study but not in a Regulation

<table>
<thead>
<tr>
<th>Product group name</th>
<th>Source</th>
<th>Current status</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Portable ovens</td>
<td></td>
<td></td>
<td>The Lot 22 preparatory study conclusion was to include portable ovens in an implementing measure this was not done. The product group would merit inclusion: Sales are around 10 million / year, stock around 100 million. Energy consumption would be around 16.4 TWh; savings of 3TWh/year might be possible. The only barrier to a regulation is the lack of a standard. Such a standard might be worked out. In principle, there is no technical reason why the energy consumption measurement standard for built-in and range ovens could not be used. Including portable ovens in the review of Reg. 66/2014 would be quite late as the review is only due in 2021. One possible way forward would be to consider the issue along with considering the inclusion of laboratory ovens (ENTR 4) into ENER 22, as suggested by the consultation forum.</td>
</tr>
</tbody>
</table>
### Products in the WP 2 conditional list

<table>
<thead>
<tr>
<th>Product group name</th>
<th>Source</th>
<th>Date of revision (if any)</th>
<th>Current status</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating controls for residential buildings</td>
<td>VHK 4.32</td>
<td></td>
<td></td>
<td>Have been in conditional list of WP 2. No preparatory study has been started, for unknown reasons. Savings, according to VHK study, are substantial. New studies by association eu.bac document even greater savings. We would suggest launching a preparatory study taking into account the new information.</td>
</tr>
<tr>
<td>Lighting Systems</td>
<td>ENER 37 short study</td>
<td>Short study completed, preparatory study to be launched in 2016</td>
<td></td>
<td>Check scope with respect to differentiation from a potential new product group “building controls” which might include both lighting and heating controls. Maybe controls for street lighting would be a separate group.</td>
</tr>
<tr>
<td>Fractional horsepower motors below 200W</td>
<td>VHK 4.35</td>
<td></td>
<td></td>
<td>Could be updated in context of Reg. 640/2009; see upcoming revisions</td>
</tr>
<tr>
<td>Positive displacement pumps</td>
<td>VHK 4.9</td>
<td></td>
<td></td>
<td>Could be updated in context of Reg. 547/2012; see upcoming revisions</td>
</tr>
</tbody>
</table>

### Possible topics to focus on in future reviews of voluntary agreements

<table>
<thead>
<tr>
<th>Product group name</th>
<th>Source</th>
<th>Date of revision (if any)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Imaging equipment</td>
<td></td>
<td></td>
<td>Consumables (cartridges, paper)</td>
</tr>
<tr>
<td>Complex Set Top Boxes</td>
<td></td>
<td></td>
<td>Coverage of products that fall in between CSTB and SSTB because they do provide additional functions but not conditional access, such as OTT and Media Gateway</td>
</tr>
<tr>
<td>Medical imaging equipment</td>
<td></td>
<td></td>
<td>Equipment not yet covered</td>
</tr>
</tbody>
</table>

### Revisions outside the time horizon of the Working Plan 2015-2017

<table>
<thead>
<tr>
<th>Product group name</th>
<th>Source</th>
<th>Date of revision (if any)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Space and combination heaters</td>
<td>Reg. 813/2013</td>
<td>26/09/2018</td>
<td></td>
</tr>
<tr>
<td>Water heaters</td>
<td>Reg. 814/2013</td>
<td>26/09/2018</td>
<td></td>
</tr>
<tr>
<td>Product group name</td>
<td>Source</td>
<td>Date of revision (if any)</td>
<td>Current status</td>
</tr>
<tr>
<td>----------------------------------------</td>
<td>-----------</td>
<td>---------------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>Domestic ovens, hobs and range hoods</td>
<td>Reg.66/2014</td>
<td>20/02/2021</td>
<td></td>
</tr>
<tr>
<td>Tumble driers</td>
<td>Reg. 932/2012</td>
<td>01/01/2018</td>
<td></td>
</tr>
<tr>
<td>Vacuum cleaners</td>
<td>Reg. 666/2013</td>
<td>02/08/2018</td>
<td></td>
</tr>
</tbody>
</table>