Product-specific EuP studies of LOTS 15 to 18

The relevance of other environmental aspects in addition
to the use phase energy consumption of products

Helena Mälkki, Hanna Vanhanen and Jukka Heiskanen

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Nordic Council of Ministers

Ved Stranden 18
DK-1061 København K
Phone (+45) 3396 0200
Fax (+45) 3396 0202

Nordic Council

Ved Stranden 18
DK-1061 København K
Phone (+45) 3396 0400
Fax (+45) 3311 1870

www.norden.org

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Preface

The Ecodesign Directive 2009/125/EC has had the potential to become one of the most influential policy instruments in the fields of integrated product policy (IPP) and Sustainable Consumption and Production. Now being applied to energy-using and energy-related products, it is possible that this kind of regulation will later be applied also for other product groups. That is why it is extremely important to have Nordic co-operation regarding the EU directive.

The Ecodesign directive covers a large number of different environmental aspects, but it is evident that energy consumption is an aspect that has gained most attention in the preparation of the product-specific regulation. The aim of this project was to assess how other environmental aspects than energy have been taken into account in the product specific EuP studies. Four product group studies (i.e. Lots) were selected for closer examination.

The project was initiated by the “Products and Environment group” (PM-group) and later guided and supervised by the “Sustainable Consumption and Production group” (HKP group) of the Nordic Council of Ministers, Ari Nissinen from Finnish Environment Institute acting as the contact person. The HKP group wishes to acknowledge the consultants for the report and their remarks about the product study processes. The report will be used as a background material for the Nordic Ecodesign Workshop 26 November 2010 in Copenhagen and for the further work of the HKP group to promote the ecodesign of all products, services and solutions in our societies.

Please note all table in the publication are numbered according to the original document.

On behalf of the HKP group,

Inger-Grethe England
the chair of the group

Summary

This report deals with the relevance of other environmental aspects in addition to the use phase energy consumption of products and is based on the product-specific EuP studies of lots 15 to 18. The ecodesign directive emphasises all important environmental impacts; ecodesign aims at reducing environmental impacts. Many energy-related products have a significant potential for being improved in order to reduce environmental impacts and achieve energy savings through better design. Energy often plays an important role in causing environmental impacts. It is calculated that energy-related products account for a large proportion of the consumption of natural resources and energy within the Community.

The results consist of the following four product groups:

- Lot 15 Solid fuel small combustion installations
- Lot 16 Laundry Dryers
- Lot 17 Vacuum Cleaners
- Lot 18 Complex set-top boxes

In lot 15 the use phase dominates the life-cycle impacts. The main source of pollution is the amount of the fuel consumed. Only the total impact of production is presented and no distinction is made between the impacts of the materials. Based on the EU Totals, it can be concluded that energy consumption is an important environmental aspect. However, it is not clear what kind of role other environmental aspects play. Also, the environmental impacts of solid fuel SCI's depend on both the type of appliance and the availability of the appliance.

In Lot 16 the most impacting phase is the use phase and the materials have an influence only on the production phase. The use phase is the main contributor to energy consumption throughout all life-cycle phases. The type of energy source (especially for electricity) has a great impact on the pollution type and quantity. The production phase has an important relative impact on heavy metal emissions in water and on water eutrophication. Based on the EU Totals, it can be concluded that energy consumption is an important environmental issue. However, it is not clear what kind of role other environmental aspects have compared with that of energy use.

In lot 17 the use phase clearly has the biggest life-cycle impacts of the product. This concerns particularly the total energy consumption, process water resources, greenhouse gases and acidification emissions into the air. Based on the EU Total System Impact, it can be concluded that energy consumption is an important environmental issue and dominates the use phase.

However, waste (non-hazardous/landfill) dominates in the production phase. It is not clear what kind of role other environmental aspects play.

In lot 18 steel, polypropylene, polyamide and copper were the main contributors to the most significant impacts in the production phase. The materials' acquisition, use and end-of-life phases were all relevant when analyzing the environmental impacts of complex STBs, and will remain a point of focus during the subsequent tasks when evaluating the improvement potential of different options. Regarding the use modes, both the on mode and active standby need further attention, whereas the off mode is of minor relevance.

The studies of Lot 15 to 18 had at least two dominant life-cycle indicators at each phase; the phases were not favourably comparable with each other and not all of the phases were relevant. The preparatory studies were different in spite of the same MEEuP methodology rules. That is why it was difficult to compare the information between the studies. At any rate, the preparatory studies have gathered and compiled a lot of relevant information following the Methodology Study Ecodesign of Energy-using Products (MEEuP). The results of the information rely on existing studies, external sources, literature and inputs from stakeholders.

The principles of the EuP Directive will not be realized if the reduction of energy consumption and improving energy efficiency are the only targets when dealing with improvement potentials. The Directive notes that energy-related products account for a large proportion of the consumption of natural resources and energy within the Community, but the Directive emphasizes that they have a number of other important environmental impacts as well.

Proper and valid data are always very important in order to produce an objective basis for appropriate ecodesign requirements. The product studies lack peer review reports from LCA concerning all the product cases, which would have helped when considering the quality of data and when making sure that all the phases of the product life cycle are equally and totally involved in the assessment. The system boundaries were not available and it was difficult to see the depth and comprehensiveness of the LCA studies behind the presented data.

1. Introduction and aim of the report

Ecodesign Directive 2009/125/EC establishes a framework for setting up ecodesign requirements for energy-related products. The scope of the new Directive covers the older EuP Directive 2005/32/EC for energy-using products and such products that are essential for energy use but do not directly use energy (like windows). The Directive can be seen as potentially being the most influential legal instrument in the field of integrated product policy (IPP, 2001) at the moment because requirements can be set for all relevant environmental aspects of the products. It is evident that energy questions will be sufficiently taken into account in the studies and, ultimately, in the regulation, but it would also be important to check and follow how environmental aspects other than energy will be handled.

The aim of this project was to assess how energy and other environmental aspects have been taken into account in the product-specific EuP studies, using four product groups as examples.

The project focused on product groups that were at a phase in which their study could be followed, for example by participating in some stakeholder meetings. The following ones were selected:

- LOT 15 Solid fuel small combustion installations
- LOT 16 Laundry Dryers
- LOT 17 Vacuum Cleaners
- LOT 18 Complex set-top boxes

Aim of the report

In each product study, there are a number of different tasks, defined for the studies in the MEEUP methodology (MEEUP Methodology Report, 2005). This report is based on the document for Task 5, “Definition of the base case”. From an environmental perspective, this is one of the most important tasks in the preparatory study because the definitions established in Task 5, in addition to the definitions established in Task 1, create the basis for determining the environmental impacts of each product group.

This report examines the handling of different environmental aspects and the arguments that were used in Task 5. They were used to later decide upon the aspects that were focused on in Tasks 6, 7 and 8, which deal with improvement potentials. The aim of the report is to evaluate whether or not all relevant environmental aspects determined in the older as well as in the new Directive (and built upon in the EcoReport tool) were taken into account and

what kind of arguments for and against such relevant environmental aspects included in them were presented in those preparatory studies related to Lots 15 to 18.

The purpose of this report is also to some extent clarify the relationship between the Directive and preparatory studies (Lots 15–18). The aim of the Directive is promotion of sustainable development through free movement of energy using products, environmental protection and increased security of energy supply. Thus the Directive does not deal with environmental impacts but environmental aspects of the product which can be correlated to those impacts. The impacts are substantially influenced by product design related to the aspects. This view creates a basis when trying to clarify the relationship between the Directive and the preparatory studies (Lots 15–18) in general level, i.e. how the environmental aspects have been taken into account in order to optimize the environmental performance of products.

2. Former EuP Directive, MEEUP methodology and preparatory studies

The older EuP Directive (2005/32/EC) and the new Ecodesign Directive (2009/125/EC)

As of November 20, 2009 the Ecodesign Directive EuP was replaced with the new energy-related products Directive (Ecodesign) 2009/125/EC. The older Ecodesign Directive for energy-using products only covered such energy-using products as microwaves, washing machines and televisions. The new Ecodesign-Directive covers products under the older EuP Directive as well as products that are energy-related and do not directly use energy, such as double-glazed windows, taps and showerheads. The Ecodesign Directive will be implemented within each EU member country beginning November 20, 2010. (<http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2005:191:0029:0058:en:PDF>), (<http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:081:0048:0050:en:PDF>)

Beyond its extended scope for new product groups, the new Ecodesign Directive varies but little from the older EuP Directive, and will not affect the enforcement of the implemented measures published to date. The table showing a detailed comparison between these Directives can be found at the TÜV Rheinland Websites.

(http://www.chn.tuv.com/en/index.php?option=com_content&view=article&id=386:new-eup-directive-2009125ec-extended-to-cover-all-energy-related-products&catid=43:service&Itemid=76)

The aim of the Directive (2009/125/EC) is to establish a framework for setting up ecodesign requirements for energy-related products. The Directive notes that energy-related products account for a large proportion of the consumption of natural resources and energy in the Community. Also, the Directive emphasizes that they have a number of other important environmental impacts as well. Action should be taken during the design phase of energy-related products, since it appears that the pollution caused during a product's life cycle is determined at that stage, and most of the costs involved occur at that time. This leads to the conclusion that the ecodesign of products is a crucial factor in the Community strategy on Integrated Product Policy. The Directive also provides instructions regarding consumer information and reminds those involved that in order to maximize the environmental benefits from improved design, it may be necessary to inform consumers about the environmental characteristics and performance of energy-

related products and to advise them on how to use products in a manner which is environmentally friendly.

The Directive is a framework directive, which means that the legal obligations for manufacturers will come with the implementing measures.

MEEUP methodology and criteria for base cases

The EuP preparatory studies follow a methodology established by the Ecodesign of Energy-using Products (MEEuP). The environmental aspects and indicators are included in the MEEuP methodology: the Methodology for Ecodesign of Energy-Using Products Directive (VHK Van Holsteijn en Kemma BV, 2005). The aim of the methodology is to allow those involved to evaluate whether and to what extent various energy-related products fulfil the criteria of the Directive. The methodology is a tool for policy makers and does not directly apply to product manufactures, although the methodology consists of tools, such as the EcoReport, which could be useful for manufacturers too. The methodology should be applied consistently in all preparatory studies for potential product implementing measures.

According to the MEEuP methodology, the base cases must meet certain criteria to be considered relevant and important. It mentions that the least efficient appliances must be removed from the market. The MEEuP methodology lists three criteria which the base cases should meet:

1. Significant volume of sales and trade (> 200 000 appliances placed on the market, that is, sales and stock)
2. Significant environmental impact
3. Significant potential for improvement

Directive Annex 1: environmental aspects

When discussing significant environmental impact, it should be kept in mind that the Directive does not deal with environmental impacts but with the environmental aspects of the product which can be correlated with those impacts and which can be substantially influenced by product design. Those environmental aspects addressed in the Directive (Annex 1) include the following:

- Predicted consumption of materials, of energy and of other resources such as fresh water
- Anticipated emissions to air, water or soil
- Anticipated pollution through physical effects such as noise, vibration, radiation, and electromagnetic fields
- Expected generation of waste material
- Possibilities for reuse, recycling and recovery of materials and/or of energy, taking into account Directive 2002/96/EC

There is also a list of parameters in the Directive (Annex 1) that will be used, as appropriate, and supplemented by others, where necessary, for evaluating the potential for improving the environmental aspects mentioned above.

Structure of preparatory studies

Preparatory studies mandated by the EU commission compile product-group-specific data that serve as background information for the development of appropriate minimum requirements. Preparatory studies will follow the structure of the methodology, which consists of eight tasks:

1. Product definition, standards & legislation
2. Economics & markets
3. Consumer analysis & local infrastructure
4. Technical analysis of existing products
5. Definition of base case
6. Technical analysis of best available technology (BAT)
7. Improvement potential
8. Policy, impact and sensitivity analyses

The following figure (Figure 1) illustrates the procedure for the preparatory studies. (http://www.ecosolidfuel.org/methodology_15.php).

Figure 1. The procedure for the preparatory studies (Bio Intelligence Service S.A.S., 2009).

3. Lot 15 solid fuel small combustion installations (SCI's), Task 5

Definition of Base Case

As an example, we review the base case “Open fireplaces” here. The data has been taken from the report “Lot 15. Solid fuel small combustion installations. Task 5: Base Cases. Working document, June 2009.” (Bio Intelligence Service S.A.S., 2009).

The base case is determined as a base case that is “a conscious abstraction of reality” used to represent a range of products on the market in a life-cycle analysis (Definition of base cases, p. 6). The results of the base cases are based on data extrapolated from the literature. This is why the performance of real appliances can differ substantially from the base case, which is important to remember when making decisions concerning further actions.

Based on the broad range of technical specifications and functionalities of solid fuel combustion installations, eight base cases in Lot 15 have been determined, representing approximately 71% of the total stock (all appliances in use by consumers in Europe in 2009) of appliances (Definition of base case, p. 7). A large number of base cases are allowed based on the MEEuP methodology (MEEUP Methodology Report, p. 132), although it is well recognized that larger numbers of base cases increase the amount of analyses, respectively. The report also considers the fact that base cases do not necessarily represent real products, since determination of base cases is based on three criteria which those base cases have to meet and those criteria are not comprehensive. In the report, it has been also very clearly pointed out why some appliances do not meet the criteria for base cases.

The materials used in open fire places as well as in other solid fuel small combustion installations are not clearly determined. Open fire places are mostly composed of masonry and ceramic materials, expressed in the bill of materials (BOM) as “miscellaneous – concrete”. Each type of material is associated with a default factory process. Therefore, there is no distinction made between the impacts of the materials used and the impacts of their processing at the plant (Description of base case, p. 10). Only the total impact of production is presented (Table 5–3). The report also states that “no materials are assumed to be used for the distribution of the SCI's” (Description of base case, p. 10), and “no materials are assumed to be used during the use of solid fuel SCI's, besides the fuel” (Description of base case, p. 11). Those assumptions are the reasons why the columns “Distribution” and “Use” are missing (Table 5–3).

Table 5–3 from the original document. BOM summary. (Table 5–3, p. 11)

Life Cycle phases			Production	End- of-life		
	Materials	Unit		Disposal	Recycled.	Total
1	Bulk plastics	g	0	0	0	0
2	TecPlastics	g	0	0	0	0
3	Ferro	g	31284	1564	29720	31284
4	Non-ferro	g	0	0	0	0
5	Coating	g	50	3	48	50
6	Electronics	g	0	0	0	
7	Misc.	g	271000	13550	257450	271000
	Total weight	g	302334	15117	287217	302334

The report concludes that the one of the main sources of pollution by solid fuel SCI's is the amount of fuel consumed by those appliances, and, since fuel use is likely to be the most important part of the LCA for solid fuel SCI's, special attention must be given to the environmental impacts of fuels and of their use (Environmental impact from fuel use, p. 16). No doubt the amount of fuel is a very crucial factor when dealing with the environmental impacts of those appliances, but are there other sources of pollution as well and what is the main source of pollution?

Experts have criticized the EcoReport tool in the report and its weaknesses related to the solid fuel types that have been considered. This criticism is quite justifiable, since there are only two solid fuel types, wood logs and wood chips, included in the EcoReport tool. Due to the lack of fuel types, the working group responsible the preparatory study of Lot 15 has performed numerous extra calculations. The report also says that nine out of seventeen environmental indicators are relevant to solid fuel combustions, while others have no impact or very little impact (Environmental impact from fuel use, p. 17), and, thus, those environmental indicators are excluded. However, the report mentions ash and its heavy metal content within the context of hazardous waste. Although it might be true that the concentrations of heavy metals of ash are below the RoHS thresholds, it is certain that those heavy metal concentrations of ash are very dependent on the type and the amount of fuel, as well as on burning conditions, and, thus, the situation is not so simple. At the very least, experts should discuss whether ash should be disposed of or recycled.

Based on the results of the environmental impacts assessment shown in the report (Base case environmental impact assessment, Table 5–18, p. 29), all relevant impact indicators related to the environmental aspects and further environmental impacts are taken into account. The use phase dominated the life-cycle impacts for all nine relevant environmental indicators (see previous chapter). This can be explained by the fuel use (fuel combustion, distribution and processing) that is included in the use phase. The production phase contributed significantly to the waste (non-hazardous/landfill) indicator. The distribution phase contributed significantly to the waste (hazardous/incinerated) when compared to other phases. However, the amount of haz-

ardous waste related to the distribution phase is not in accordance with the sentence that says that “No materials are assumed to be used for the distribution of the SCI’s” (Description of base cases, p. 10). If there is no material used in the distribution phase, what is the source of waste produced during that phase? The end-of-life phase has very little or no impact on the environmental indicators. No one, however, has provided any explanations for the source of waste.

EU Totals: Life Cycle Environmental Impacts

The report also includes Table 5–50 (EU Totals, p. 53), which shows the environmental impacts of the EU stock (produced, in use, discarded). Based on the EU Totals, it can be concluded that the environmental impacts of solid fuel SCI’s are very dependent on both the type of appliance and the availability of the appliance. However, it is not so clear if those numbers are related to each environmental impact, whether large or small; that is to say, it is not clear whether the numbers are relevant or not when discussing environmental aspects and impacts related to them.

4. Lot 16 laundry dryers, Task 5

Definition of Base Case

As an example, we review the base case “Air vented tumble dryer” here. The data has been taken from the report “Ecodesign of Laundry Dryers, Preparatory studies for Ecodesign requirements of Energy-using-Products (EuP) – Lot 16, Final Report, March 2009”. (Ecobilan, 2009)

This final report was prepared by Ecobilan, PricewaterhouseCoopers’ Centre of Excellence for ecodesign and environmental impact assessment of products and services.

The introduction of the report (Introduction, p. 28/432) says that, “A preparatory study provides the first stage of the policy process assessing the existing environmental impacts of specific product groups, identifying and suggesting means to enhance, when acting at its design phase, the environmental performance of a category of EuPs and supplying the necessary outcomes.” Thus, it can be assumed that those existing environmental impacts of specific product groups will be compared to each other; otherwise, it is not possible to determine what environmental impacts, and the environmental aspects related to them, should be stressed when dealing with enhancing the environmental performance of a specific product group.

The report (Definition of base cases, p. 244/432) states that, “In accordance with the MEEuP methodology, the life cycle environmental impacts and life cycle cost (LCC) are evaluated thanks to the EuP EcoReport methodology.” Thus, it can be assumed that environmental aspects are equal and all relevant environmental aspects are included in report Task 5 for Lot 16.

The material composition is an important issue from the environmental aspects point of view. Based on the table 69 from the original document (see table below), an air-vented tumble dryer consists of two main categories of material: bulk plastics and ferrous metal. Thus, it can be assumed that these two materials at least are taken into account when making proposals for enhancing the environmental performance of Product Group 16 (Lot 16).

Table 69 from the original document. Overview of the Bill of Materials (BOM) for the Base Case air vented tumble dryer. (Table 69, p. 250/342)

Life Cycle phases			Production		
Resources Use and Emissions			Material	Manuf.	Total
Materials		Unit			
1	Bulk plastics	g			4625
2	TecPlastics	g			3000
3	Ferro	g			22516
4	Non-ferro	g			842
5	Coating	g			0
6	Electronics	g			1556
7	Misc.	g			1778
	Total weight	g			34317

Based on the results of the environmental impacts assessment (real life conditions) shown in the report (Table 80, p. 257/432), all relevant impact indicators related to the environmental aspects and further environmental impacts are taken into account. However, the total energy consumption of the product and the energy consumption for each phase of the life cycle of the product are emphasized when compared to other environmental impacts.

Table 80 from the original document. (Table 80, p. 257/432)

Life Cycle phases		Production					End-of-life		Total
Resources Use and Emissions		Distribution		Use		Disposal		Recycl.	Total
Materials		Material	Manuf.	Total					
	unit								
1	Bulk plastics			4625		139		4486	4625
2	TecPlastics			3000		90		2910	3000
3	Ferro			22516		1126		21390	22516
4	Non-ferro			842		42		800	842
5	Coating			0		0		0	0
6	Electronics			1556		1556		0	1556
7	Misc.			1778		89		1689	1778
	Total weight			34317		3042		31275	34317
Other Resources & Wastes						debit		credit	
8	Total Energy (GER)	1191	436	1626	486	131		388	-207
9	of which, electricity	156	258	414	1	0		31	-30
10	Water (process)	265	4	269	0	0		20	-20
11	Water (cooling)	559	119	677	0	0		169	-169
12	Waste, non-haz/ landfill	35544	1609	37153	261	2127		119	2009
13	Waste, hazardous/ incinerated	38	0	38	5	229		19	211
Emissions (Air)									
14	Greenhouse Gases in GWP 100	72	24	96	30	13		9	4
15	Ozone Depletion, emissions				negligible				
16	Acidification, emissions	505	105	610	91	34		25	10
17	Volatile Organic Compounds (VOC)	3	0	3	7	2		0	1
18	Persistent Organic Pollutants (POP)	314	19	332	1	15		0	15
19	Heavy Metals	512	43	556	13	49		0	49
	PAHs	79	0	79	17	0		2	-2
20	Particulate Matter (PM, dust)	64	16	80	1094	393		3	393
Emissions (Water)									
21	Heavy Metals	367	0	367	0	11		0	11
22	Eutrophication	10	0	10	0	1		1	0
23	Persistent Organic Pollutants (POP)				negligible				

The report (p. 257/432, see also Figures 130 and 131 in p. 258/432) states that, “First, a focus is made on the energy consumption and particularly on the influence of the drying conditions (Standard Base Case (STBC) against Real Life Based Case (RLBC).”

According to the report, the use phase is the main contributor to energy consumption throughout all life cycle phases, and energy consumption in real life conditions is more important than in standard conditions (p. 258/432). In Figures 130 and 131 from the original document of the report, the total energy consumption (GER) is taken as the reference. The figures show that the use phase is the main contributor to the overall impact. This use phase is responsible for 98 % of total energy consumption. The distribution phase (1% of the overall impact) and end of life phase (0.4%) contribute very little to the overall impact.

Figure 130: Energy consumption over all life cycle phases (GER in MJ) (STBS and RLBC Air vented)

Figure 131: Energi consumption over the life cycle phases (excluding the use phase) (STBC Air vented)

The influence of the different life cycle phases on the air and water impact indicators (Figures 134 and 135, p. 260/432) is as follows:

- Concerning atmospheric pollution and water consumption, the most impacting phase is the use phase (its relative impact, compared to other phases, is between 45% and 95%). Indeed, the type of energy source (especially for electricity) has a great impact on the pollution type and quantity. It is generally considered that in Europe around 20% of the energy is generated by coal, 20% by gas, and 30% by nuclear, and 15% is hydroelectricity. In contrast, the production phase has a more important relative impact on heavy metal emissions in water and on water eutrophication (p. 260/432).

Figure 134: Relative impact on the life cycle phases on air pollution (RLBC Air vented)

Figure 135: Relative impact on the life cycle phases on waste production and water pollution (RLBC Air vented)

Concerning the production phase in particular, the report says that:

- Considering that the production has a significant influence on the environment, the main contributors to the most significant impacts were thought to be steel, polypropylene, polyamide and copper (p. 260–261/432).
- Steel accounts for around 70% of the product composition and up to 50% of the impact on air and water (p. 260/432).
- PP and PA account for 16% of the product composition. They are responsible for around 40% of the energy consumption during the production phase and for up to 10% of the impact relating to 7 impact indicators out of 10 (p. 261/432).
- Copper represents only 2% of the product composition but is responsible for 8% of the global energy consumption during the manufacturing phase, for up to 5% of the global warming potential of the heavy metal emissions in air and in water as well as of the PAC emissions and, finally, for up to 30% of the air acidification potential (p. 261/432).
- It can be noticed that aluminium manufacturing is responsible for the discharge of PAH (Polycyclic Aromatic Hydrocarbons), a substance detrimental to human health (p. 261/432).

Based on the preliminary conclusions of the environmental impact assessment of the base case for the air-vented tumble dryer shown in the report (p. 272/432, see the list below), both the most important life cycle phases and the most important environmental impacts, as well as the bill of materials, are included. However, the report says (p. 272/432) that, “the most impacting phase is the use phase and the BOM has an influence only on the production phase.” The conclusion above is misleading since, based on the environmental impacts assessment (p. 257/432), the use phase is the most impacting phase only when dealing with energy consumption that is not the only environmental aspect taken into account in the environmental impact assessment. The report (p. 272/432) also states that, “In the light of the present conclusions, the analysis of the improvement potential in task 6 and 7 will mainly focus on technologies that reduce the power consumption and improve energy efficiency.” Based on that sentence, environmental aspects are not equal and all existing environmental impacts are not taken into account when dealing with improvement potential. If reducing power consumption and improving energy efficiency are the only targets, the improvement potential of other environmental aspects, except for energy consumption, will be excluded, which goes against the spirit of the Ecodesign directive.

- In terms of energy, the most impacting phase is the use phase. Moreover, the impact of the base case choice is highlighted. Indeed, in real life conditions, energy consumption is always higher.

- Regarding the impacts on air and water, the impact is shared between the production and the use phase.
- Stainless steel is the main contributor to air and water pollution during the manufacturing phase. This impact can mainly be allocated to housing. Indeed, steel is primarily used in housing.
- The use of aluminium is responsible for PAH emissions (substances detrimental to human health).

EU Totals: EU total environmental assessment of air-vented tumble dryers

The report also includes tables that show the environmental impacts of all products sold in the year 2005, during the production, distribution, use, and end-of-use phases of the life cycle. It is said that the total EU Stock (EU 15, 2005)⁹² for tumble dryers is 53,65 million units (p. 275/432), and 27,479 million units of C class air-vented tumble dryers were sold in 2005.

Based on the EU Totals, it can be concluded that energy consumption is an important environmental issue. However, it is not clear what kind of role other environmental aspects are playing when dealing with environmental impacts.

Tables 95 and 96 (see below) show the environmental impacts of the EU 25 total stock of dryers in 2005 (EU Totals, p. 283/432). The air-vented dryer stock is responsible for the emission of 4 mtCO₂ eq. and for the consumption of 8.2 TWh of electricity. The use phase consumes the most energy and, as a result, it also has the strongest environmental impacts in other areas as well (Table 95).

Table 95 from the original document. EcoReport output for the EU25 total stock of air vented tumble dryers in 2005. (Table 95, p. 283/432)

Life Cycle phases		Production				Distribution	Use	End-of-life		Total	
		Material	Manuf.	Total	Disposal			Recycl.	Total		
Resources Use and Emissions											
Materials		unit									
1	Bulk plastics			4					3	4	0
2	TecPlastics			2					2	2	0
3	Ferro			17				1	17	17	0
4	Non-ferro			1				0	1	1	0
5	Coating			0				0	0	0	0
6	Electronics			1				1	0	1	0
7	Misc.			1				0	1	1	0
	Total weight			27				2	24	27	0
Other Resources & Wastes								debit	credit		
8	Total Energy (GER)	1	0	1		0	86	0	0	0	88
9	of which, electricity	0	0	0		0	86	0	0	0	86
10	Water (process)	0	0	0		0	6	0	0	0	6
11	Water (cooling)	0	0	1		0	228	0	0	0	228
12	Waste, non-haz/ landfill	28	1	29		0	100	2	0	2	131
13	Waste, hazardous/ incinerated	0	0	0		0	2	0	0	0	2
Emissions (Air)											
14	Greenhouse Gases in GWP 100	0	0	0		0	4	0	0	0	4
15	Ozone Depletion, emissions			negligible							
16	Acidification, emissions	0	0	0		0	22	0	0	0	23
17	Volatile Organic Compounds (VOC)	0	0	0		0	0	0	0	0	0
18	Persistent Organic Pollutants (POP)	0	0	0		0	1	0	0	0	1
19	Heavy Metals	0	0	0		0	2	0	0	0	2
	PAHs	0	0	0		0	0	0	0	0	0
20	Particulate Matter (PM, dust)	0	0	0		1	3	0	0	0	5
Emissions (Water)											
21	Heavy Metals	0	0	0		0	1	0	0	0	1
22	Eutrophication	0	0	0		0	0	0	0	0	0
23	Persistent Organic Pollutants (POP)						negligible				0

Table 96 from the original document. Summary of the environmental impacts of the EU 25 total stock of air vented tumble dryers in 2005. (Table 96, p. 283/432)

Main life cycle indicators	value	unit
Total Energy (GER)	88	PJ
of which, electricity	8,2	TWh
Water (process)*	6	min.m3
Waste, non-haz/ landfill*	131	kton
Waste, hazardous/ incinerated*	2	kton
Emissions (Air)		
Greenhouse Gases in GWP 100	4	mt CO2eq.
Acidifying agents (AP)	23	kt SO2eq.
Volatile Org. Compounds (VOC)	0	kt
Persistent Org. Pollutants (POP)	1	g i-Teq.
Heavy Metals (HM)	2	ton Ni eq.
PAHs	0	ton Ni eq.
Particulate Matter (PM, dust)	5	kt
Emissions (Water)		
Heavy Metals (HM)	1	Hg/20
Eutrophication (EP)	0	kt PO4
Persistent Organic Pollutants (POP)		

*= caution: low accuracy for production phase

5. Lot 17 vacuum cleaners, Task 5

Definition of Base Case

As an example, we review the base case “Canister domestic vacuum cleaner” here. The data is derived from the Lot 17 report, “Work on Preparatory Studies for Ecodesign, Requirements of EuPs (II), Lot 17 Vacuum Cleaners, TREN/D3/390–2006, Interim Report, Report to European Commission, Restricted Commercial, ED 04902, Issue 2, October 2008” (AEA Energy & Environment, 2008).

The report considers all household and similar use vacuum cleaners for their usage of energy, effect on the environment, use of materials and disposability with consideration to cleaning performance and general use. The base cases have been chosen to be sufficiently broad to cover environmental impacts across the range of vacuum cleaners. The five base cases agreed with one another (p. 44) in the following manner:

- Canister vacuum cleaners (domestic and commercial)
- Upright vacuum cleaners (domestic and commercial)
- Battery operated / cordless vacuum cleaners

Table 15 from the original document. 2005 Stock and Sales Estimates from Stock Modelling. (Table 15, 46/80)

	% share Canister:Upright	Stock (units)	Annual Sales (units)
Canister domestic	85%	273,595,932	36,543,200
Canister commercial	85%	8,840,000	1,105,000
Upright domestic	15%	48,281,635	6,448,800
Upright commercial	15%	1,560,000	195,000
Battery/ cordless	n/a	10,000,000	2,000,000
TOTALS		342,277,567	46,292,000

In this report, the data concerns Domestic Canisters due to the larger stock units and the larger annual sales of these vacuum cleaners (Table 15, p. 46). The average material composition of domestic canister and the results of the environmental impact assessment are shown in Tables 11 and 17 from the original document (Table 11, p. 41 and Table 17, p. 47).

Table 11 from the original document. Average Materials Compositions of Various Vacuum Cleaner Types. (Table 11, p. 41/80)

		Domestic Canister	Commercial Canister	Domestic Upright	Commercial Upright	Battery/ Cordless
Materials	unit					
Bulk plastics	g	4188	5880	3927	4995	3035
TecPlastics	g	695	0	894	1494	426
Ferro	g	1467	1450	1048	1308	1120
Non-ferro	g	478	2250	440	711	1428
Coating	g	8	0	0	0	0
Electronics	g	29	0	0	20	0
Misc.	g	1612	1585	1626	2065	824
Total weight	g	8475	11165	7934	10593	6832

Note 1: Batteries and chargers have been included in the battery/cordless vacuum cleaner compositions.

Note 2: The average total weight for Battery/Cordless types may have been skewed by one device that

There are also pictures of the environmental issues on page 52 of the report (see Fig. 2).

Figure 2. Resource usage and total energy (MJ) of the lot 17 vacuum cleaner cases (AEA Energy & Environment, 2008, p. 52).

According to the report, the use phase of the product clearly has the greatest life-cycle impacts. This concerns in particular total energy consumption, process water resources, greenhouse gases and acidification emissions into the air (p. 52–57). Table 22 shows the percentage of use-phase impacts for the base cases (Table 22, p. 57).

Table 22 from the original document. Percentage of Use Phase Impact of Base Cases. (Table 22, p. 57/80)

	Canister Domestic	Canister Commercial	Upright Domestic	Upright Commercial	Battery/cordless
Other Resources & Wastes					
Total Energy (GER)	87,9 %	91,9 %	88,7 %	92,6 %	79,0 %
of which, electricity (in primary MJ)	97,7 %	98,8 %	97,8 %	98,5 %	96,0 %
Water (process)	86,4 %	95,6 %	86,9 %	95,0 %	84,2 %
Water (cooling)	97,1 %	98,5 %	97,2 %	98,3 %	94,5 %
Waste, non-haz/ landfill	41,7 %	36,6 %	49,4 %	65,2 %	32,3 %
Waste, hazardous/ incinerated	9,2 %	14,9 %	9,8 %	15,4 %	5,0 %
Emissions (Air)					
Greenhouse Gases in GWP 100	85,0 %	90,5 %	86,2 %	90,7 %	75,1 %
Ozone Depletion, emissions	n/a	n/a	n/a	n/a	n/a
Acidification, emissions	86,3 %	87,3 %	88,4 %	93,1 %	81,5 %
Volatile Organic Compounds (VOC)	56,7 %	63,9 %	56,8 %	63,3 %	43,6 %
Persistent Organic Pollutants (POP)	54,0 %	56,2 %	52,5 %	59,4 %	15,8 %
Heavy Metals	45,4 %	56,9 %	46,4 %	66,0 %	29,7 %
PAHs	32,9 %	36,0 %	36,7 %	41,9 %	31,7 %
Particulate Matter (PM, dust)	17,7 %	16,8 %	18,3 %	16,8 %	17,2 %
Emissions (Water)					
Heavy Metals	37,0 %	37,8 %	39,4 %	49,0 %	25,9 %
Eutrophication	31,3 %	59,5 %	29,6 %	60,2 %	39,6 %
Persistent Organic Pollutants (POP)	n/a	n/a	n/a	n/a	n/a

EU Totals: Life Cycle Environmental Impacts

Table 16 shows the environmental impact of all products sold in the year 2005 (p. 46). The report also includes tables (Appendix 1, p. 3) that illustrate the outputs from the EcoReport for the impact of base-case models sold in 2005 over the course of their lifetime (see Table 25).

Based on the EU Impact of Domestic Canister VCs (Total System, Table 25), energy consumption is an important environmental issue and the use phase dominates many of the environmental loads.

Table 16 from the original document. Summary Environmental Impacts EU-Stock 2005. (Table 16, p. 46/80)

Main life cycle indicators	Unit	Canister Domestic	Canister Commercial	Upright Domestic	Upright Commercial	Battery cordless	TOTAL
Other Resources & Wastes							
Total Energy (GER)	PJ	315,92	21,28	55,30	3,73	7,52	403,74
of which, electricity (in primary MJ)	TWh	26,32	1,85	4,64	0,33	0,56	33,69
Water (process)*	min.m3	28,88	2,03	5,08	0,36	0,76	37,11
Waste, non-haz/ landfill	kton	803,35	64,69	118,94	6,30	23,06	1016,33
Waste, hazardous/ incinerated*	kton	71,80	2,96	11,91	0,51	2,92	90,10
Emissions (Air)							
Greenhouse Gases in GWP 100	mt CO ₂ eq.	14,28	0,95	2,50	0,17	0,35	18,25
Acidification, emissions	kt SO ₂ eq.	82,39	5,75	14,19	0,95	1,85	105,13
Volatile Organic Compounds (VOC)	kt	0,23	0,01	0,04	0,00	0,01	0,30
Persistent Organic Pollutants (POP)	g i-Teq.	3,39	0,22	0,62	0,04	0,27	4,54
Heavy Metals	ton Ni eq.	11,07	0,59	1,91	0,09	0,39	14,06
PAHs	ton Ni eq.	2,34	0,12	0,37	0,02	0,07	2,92
Particulate Matter (PM, dust)	kt	30,18	1,21	5,39	0,21	1,23	38,22
Emissions (Water)							
Heavy Metals (HM)	ton Hg/20	4,96	0,33	0,82	0,04	0,16	6,31
Eutrophication (EP)	kt PO ₄	0,35	0,02	0,06	0,00	0,01	0,44

*= caution: low accuracy for production phase

Table 25 from the original document. EU Impact of Domestic Canister VCs sold 2005 over their life time. (Table 25, Appendix 1, p.3)

Life Cycle phases		Production			Distribution	Use	End-of-life		Total
Resources Use and Emissions		Material		Manuf.	Total		Disposal	Recycl.	Total
Materials									
1	Bulk plastics				140		47	93	140
2	TecPlastics				22		8	15	22
3	Ferro				47		14	33	47
4	Non-ferro				15		5	11	15
5	Coating				0		0	0	0
6	Electronics				1		0	0	1
7	Misc.				52		16	36	52
	Total weight				278		90	188	278
Other Resources & Wastes							debet	credit	
8	Total Energy (GER)	19		7	26	4	10	4	5
9	of which, electricity	2		4	6	0	0	0	0
10	Water (process)	3		0	3	0	0	0	0
11	Water (cooling)	18		2	20	0	0	1	-1
12	Waste, non-haz/ landfill	295		22	317	3	102	1	102
13	Waste, hazardous/ incinerated	3		0	3	0	55	0	55
Emissions (Air)									
14	Greenhouse Gases in GWP 100	1		0	1	0	1	0	0
15	Ozone Depletion, emissions						negligible		
16	Acidification, emissions	7		2	9	1	1	0	1
17	Volatile Organic Compounds (VOC)	0		0	0	0	0	0	0
18	Persistent Organic Pollutants (POP)	1		0	1	0	1	0	1
19	Heavy Metals	3		0	3	0	3	0	3
	PAHs	1		0	1	0	0	0	0
20	Particulate Matter (PM, dust)	1		0	1	6	13	0	13
Emissions (Water)									
21	Heavy Metals	2		0	2	0	1	0	1
22	Eutrophication	0		0	0	0	0	0	0
23	Persistent Organic Pollutants (POP)						negligible		

EU Total System Impact

The report also includes Table 30 (Appendix 2, p. 8), which illustrates the output from the EcoReport, for the EU impact of base-case models (produced, in use and discarded) (see Table 30 below).

Based on the EU Total System Impact, it can be concluded that energy consumption is an important environmental issue and dominates in the use phase. However, in the production phase waste (non-hazardous/landfill) dominates. It is not clear what kind of role other environmental aspects are playing when dealing with environmental impacts.

Table 30 from the original document. EU impact of Domestic Canister VCs (Total System). (Table 30, Appendix 3, p. 8)

Life Cycle phases		Production			Distribution	Use	End-of-life		Total
Resources Use and Emissions		Material		Manuf.	Total		Disposal	Recycl.	Total
Materials									
	unit								
1	Bulk plastics				140		47	93	140
2	TecPlastics				22		8	15	22
3	Ferro				47		14	33	47
4	Non-ferro				15		5	11	15
5	Coating				0		0	0	0
6	Electronics				1		0	0	1
7	Misc.				52		16	36	52
	Total weight				278		90	188	278
							debit	credit	
Other Resources & Wastes									
8	Total Energy (GER)	19		7	26	4	10	4	5
9	of which, electricity	2		4	6	0	0	0	0
10	Water (process)	3		0	3	0	0	0	0
11	Water (cooling)	18		2	20	0	0	1	-1
12	Waste, non-haz/ landfill	295		22	317	3	102	1	102
13	Waste, hazardous/ incinerated	3		0	3	0	55	0	55
Emissions (Air)									
14	Greenhouse Gases in GWP 100	1		0	1	0	1	0	0
15	Ozone Depletion, emissions					negligible			
16	Acidification, emissions	7		2	9	1	1	0	1
17	Volatile Organic Compounds (VOC)	0		0	0	0	0	0	0
18	Persistent Organic Pollutants (POP)	1		0	1	0	1	0	1
19	Heavy Metals	3		0	3	0	3	0	3
	PAHs	1		0	1	0	0	0	0
20	Particulate Matter (PM, dust)	1		0	1	6	13	0	13
Emissions (Water)									
21	Heavy Metals	2		0	2	0	1	0	1
22	Eutrophication	0		0	0	0	0	0	0
23	Persistent Organic Pollutants (POP)					negligible			

6. Lot 18 complex set-top boxes, Task 5

Definition of Base Case

As an example, we review the base case “Basic complex STB with SD” here. The data is taken from the final report “Lot 18, Complex set-top boxes, Final Report, December 2008” (Bio Intelligence Service S.A.S., 2009).

Base case 1 represents a complex STB with a basic set of features. The product, which describes this market segment best according to the results of Task 4, is, in terms of BOM (Table 5–5), actually the Wisi OR 41 DVB-S-CI set-top box.

Table 5-5 from the original document. Base Case 1 – BOM summary. (Table 5-5, V-4)

Life Cycle phases		Production			USE	End-of-life			Total
Resources	Use and Emissions	Material	Manuf.	Total		Disposal	Recycl.	Total	
Materials	unit								
Bulk plastics	g			199		179	20	199	0
TecPlastics	g			27		24	3	27	0
Ferro	g			864		242	622	864	0
Non-ferro	g			73		20	52	73	0
Coating	g			13		4	10	13	0
Electronics	g			341		172	168	341	0
Misc.	g			428		120	308	428	0
Total weight	g			1944		761	1183	1944	0

Energy data for the on mode and active standby is derived from the statistical analyses presented in Task 4 (see Table 4-15, IV-28). Typical power consumption for Base Case 1 is as follows:

- on mode 10 W
- active standby mode 5 W

Base case environmental impact assessment

The detailed analyses (Table 5-10) show that:

- at least two life-cycle indicators dominate at each phase,
- the phases are not favourably comparable to each other, and
- the results do not allow making a robust assessment regarding which life-cycle phase is the most relevant, although it can be concluded that for example material acquisition dominates (> 60%) for the following life-cycle indicators: waste (non-hazardous/landfill), heavy

metals, PAHs and eutrophication. The use phase dominates ($> 70\%$) for the following life-cycle indicators: total energy (GER) and electricity, greenhouse gases and acidification. The production phase is less important, although it contributes roughly $1/3$ of the VOCs. The end-of-life phase dominates ($> 50\%$) for the following life-cycle indicators: waste, hazardous/ incinerated and particulate matter emissions to air.

Table 5-10 from the original document. Base case 1 – Life Cycle Impact. (Table 5-10, V-8).

Life Cycle phases		Production		Distribution	Use	End-of-life		Total
Resources Use and Emissions		Material	Manuf.	Total		Disposal	Recycl.	Total
Other Resources & Wastes								
Total Energy (GER)	MJ	239	68	307	77	2518	credit	2918
of which, electricity	MJ	88	16	103	0	2516	20	2599
Water (process)	ltr	147	4	151	0	169	18	302
Water (cooling)	ltr	86	18	104	0	6707	4	6807
Waste, non-haz/ landfill	g	6067	145	6212	64	2978	57	9866
Waste, hazardous/ incinerated	g	276	1	277	1	371	22	689
Emissions (Air)								
Greenhouse Gases in GWP 100	kg CO2 eq.	15	4	19	6	110	3	137
Ozone Depletion, emissions	mg R-11 eq.					negligible		
Acidification, emissions	g SO2 eq.	154	23	176	19	649	17	837
Volatile Organic Compounds (VOC)	g	1	1	2	0	1	0	3
Persistent Organic Pollutants (POP)	ng i-Teq.	9	2	12	0	17	0	33
Heavy Metals	mg Ni eq.	138	6	144	3	45	2	207
PAHs	mq Ni eq.	20	1	21	3	5	2	27
Particulate Matter (PM, dust)	g	13	6	19	8	81	1	122
Emissions (Water)								
Heavy Metals	mg Hg/20	113	0	113	0	17	11	124
Eutrophication	g PO4	4	0	4	0	0	0	4
Persistent Organic Pollutants (POP)	ng i-Teq.					negligible		

EU Totals: Life Cycle Environmental Impacts

The report (V-21) says that, ‘The total life cycle impacts for Base Cases 1 – 6 and Product Case 7 are summarised in Table 5-24 (reference year:2007)’ (see table 5-24 below). Total energy (GER) consumption of the EU stock (produced, in use, discarded) for the reference year 2007 is 74 PJ, of which electricity is 6.2 TWh.

Table 5-24 from the original document (modified). Lifecycle indicators – totals for complex STBs (2007). (Table 5-24, V-21)

Main life cycle indicator	unit	value							Product	
		Base Case 1	Base Case 2	Base Case 3	Base Case 4	Base Case 5	Base Case 6	Base Case 7	Totals	
Total Energy (GER)	PJ	41,4	2,15	16,28	2,59	0,68	4,20	6,23	73,54	
of which, electricity	TWh	3,39	0,18	1,44	0,21	0,06	0,37	0,54	6,19	
Water (process)*	min.m3	4,72	0,23	1,44	0,30	0,07	0,38	0,61	7,74	
Waste, non-haz/ landfill*	kton	165,71	11,7	55,70	8,96	3,01	13,76	19,35	278,19	
Waste, hazardous/ incinerated*	kton	12,25	0,65	2,76	0,76	0,16	0,67	1,93	19,19	
Emissions (Air)										
Greenhouse Gases in GWP 100	mt CO2eq.	1,99	0,10	0,74	0,12	0,03	0,19	0,28	3,46	
Acidification, emissions	kt SO2eq.	12,21	0,63	4,50	0,78	0,20	1,18	1,72	21,22	
Volatile Organic Compounds (VOC)	kt	0,06	0,00	0,014	0,003	0,001	0,003	0,01	0,09	
Persistent Organic Pollutants (POP)	g i-Teq.	0,53	0,03	0,17	0,03	0,01	0,04	0,05	0,86	
Heavy Metals (HM)	ton Ni eq.	3,55	0,17	0,83	0,19	0,04	0,19	0,17	5,15	
PAHs	ton Ni eq.	0,46	0,04	0,17	0,04	0,01	0,05	0,05	0,82	
Particulate Matter (PM, dust)	kt	2,15	0,12	0,51	0,13	0,03	0,13	0,25	3,32	
Emissions (Water)										
Heavy Metals (HM)	ton Hg/20	2,18	0,10	0,47	0,13	0,03	0,13	0,13	3,17	
Eutrophication (EP)	kt PO4	0,08	0,00	0,015	0,004	0,001	0,003	0,005	0,11	

In the report (V-23) it is said that ‘The materials acquisition, use and end-of-life phases are all of relevancy when analyzing the environmental impacts of complex STBs, and will be in focus during the subsequent tasks when evaluating the improvement potential of different options. Regarding the use modes, both on and active standby need further attention, whereas off off mode is of minor relevancy.’

According to the report ‘The base cases will serve as a point of reference when evaluating the improvement potential (Task 7) of various design options identified in Task 6.

7. Normalisation and aggregation in product EuP studies

Methods for comparing the different environmental impacts have been only shortly discussed in the EuP methodology. Comparison of the categories would be useful for ecodesign in practise. The MEEUP Project Report phrases it this way:

- “The equivalence factors are in relatively familiar units per category. They can only be use “horizontally”, i.e. to make comparisons between the environmental impacts of products per category.”
- “The equivalence factors cannot be used “vertically”, i.e. to sum between categories. In other words, they do not provide a quantification of the “overall” environmental impact – could also be solved in a more qualitative way, e.g. by assessing whether a product is within the top-ten X categories.”
- “Some guidance regarding the weighting or normalisation between categories would be very useful for Ecodesign in practice – if the methodology would not provide this guidance, decision makers themselves would simply sum up the data “as is” to arrive at tan ad-hoc- single value indicator of the environmental impact.”

Here we use the normalisation by Tukker et al. 2006, used in the EIPRO study. Normalisation is described in the following way:

- “The normalisation step refers to European totals as have been established by van Oers et al. (2001), adapted to the EU-25 and 2003 as van Oers”. These emission data have been forced on the US based emission factors for all economic activities so that total emissions of total consumption, public and private together by necessity are equal to “van Oers”. For this European total, the characterised scores are per impact category. The scores for each product are expressed as a share of this total; that is in LCA terminology “normalised”. Thus, for each product, eight normalised scores result, one for each impact category. Table 5.1.1 gives the normalisation values used. Note that the (normalised) scores of the three themes related to ecotoxicity have been averaged to one score on “ecotoxicity” (Technical Report EUR 22284 EN).

The normalisation values used in the EIPRO study were as follows (Tukker et al. 2006).

Table 5.1.1 from the original document. Normalisation values for the EU-25 used in the EIPRO study. (Table 5.1.1, p. 97)

Theme	Norm. value	Unit
Abiotic depletion	1,33E+10	kg antimony eq./yr
Global warming GWP100	4,71E+12	kg CO ₂ eq./yr
Ozone layer depletion ODP steady state	3,69E+07	kg CFC-11 eq./yr
Human toxicity HTP inf.	1,91E+12	kg 1,4-dichlorobenzene eq./yr
Freshwater aquatic ecotoxicity FAETP inf.	1,29E+12	kg 1,4-dichlorobenzene eq./yr
Marine aquatic ecotoxicity MAETP inf.	5,74E+15	kg 1,4-dichlorobenzene eq./yr
Terrestrial ecotoxicity TETP inf.	2,64E+11	kg 1,4-dichlorobenzene eq./yr
Photochemical oxidation (high NO _x)	3,84E+10	kg ethylene eq./yr
Acidification (incl. fate, average europe total, A&B)	4,31E+10	kg SO ₂ eq./yr
Eutrophication (fate not incl.)	1,05E+10	kg PO ₄ --- eq./yr

For weighting, Tukker et al. used the following approach, which we use here:

“For aggregation of the scores per impact category into an overall score, as used or ordering products in graphical surveys, the weights as used in the Dutch environmental policy for the oil and gas producing industry (NOGEPA) have been used, see Table 8 below. For impact categories not present there, an average over all impact categories has been used” (Technical Report EUR 22284 EN).

Table 5.1.2 from the original document. Weighting factors for aggregate environmental score (percentages). (Table 5.1.2, p. 97)

ADP Guinee et al. 2002	GWP100 Houghton et al., 2001	ODP steady state (WMO, 1992, 1995 & 1999)	HTP inf. Huijbregts, 1999 & 2000	ETP average over three ecotox themes	POCP Jenkin & Hayman, 1999; Derwent et al. 1998; high NO _x	AP Huijbregts 1999; average Europe total, A&B	EP Heijungs et al. 1992	
5	35	5	17	7	9	7	15	100

An example of indicators in the MEEUP methodology

Please see Appendix VII: Example double and single value indicators in MEEUP Project Report (VHK Van Holsteijn en Kemma BV, 2005).

In terms of the possibility of summarizing, for example the various toxicity categories as one TOX-factor (covering human and eco-toxicity), the TOX-factor (in mg, per kg air or water) could look like this:

$$\text{TOX} = 30,000,000 \cdot \text{POP}_{\text{air}} + 1000 \cdot \text{Ha}_{\text{air}} + 1,000 \cdot \text{HM}_{\text{water}} + 1,000 \cdot \text{PAH}_{\text{air}} + 0.3 \cdot \text{EP}_{\text{water}} + 0.3 \cdot \text{AP}_{\text{air}} + 0.1 \cdot \text{PM} + 0.05 \cdot \text{VOC}_{\text{air}} \quad [1]$$

Using the average GWP (climate change impacts) and TOX-factor over the “basket” of all materials and energy in the Unit Indicator table would result in a single eco indicator “GWTOX” for EuP, expressed in an mg/kg of air or water:

$$\text{GWTOX} = \text{GWP} + 75 \cdot \text{TOX}, [2]$$

where GWP is the global warming potential in mg CO₂-equivalent (IPCC values) and the TOX in an mg/kg of air or water is the toxicity factor derived from the previous formula.

Table 1. 'TOX' per unit (in mg per kg air or water), total.

LOT 16	LOT 17	LOT 18
5 180 539 12	1 098 755 3	471 702 1

Tables 1 – 2 show that, when looking at the level of separate appliances (i.e. per unit); the laundry dryers (LOT 16) have larger environmental impacts in terms of TOX and GWTOX than vacuum cleaners (LOT 17) and complex set-top boxes (LOT 18). This holds true also for the total stock of the appliances within the EU, for which vacuum cleaners and complex set-top boxes have smaller 'GWTOX' indicator values than laundry dryers (Table 3).

Table 2. Ecoindicator 'GWTOX' per unit (mg/kg air or water).

LOT 16	LOT 17	LOT 18
2 358 540 400 14	491 406 616 5	172 377 649 1

Table 3. Ecoindicator 'GWTOX' by total Market and Stock data (EU 25, 2005)

LOT 16	LOT 17	LOT 18
56 604 969 588 4,7	11 948 669 806 1,0	16 513 778 798 3,4

The pie charts (Figure 3) show that the use phase dominates for each of these appliances (that is to say, Lots). In the case of Lot 15 (picture is not shown), the use phase dominates to an even greater degree. However, the impacts of 6.8%, 10% and 19.7% of production (Figure 3) can also, at least in principle, mean that there are environmental aspects that are remarkable regarding improvement potential.

Figure 3. The eco-indicators for LOTS 16 – 18.

8. Conclusions for each product group

The four product studies focused on in this report are those of LOT 15 Solid fuel small combustion installations, LOT 16 Laundry Dryers, LOT 17 Vacuum Cleaners and LOT 18 Complex set-top boxes.

This project has been a very interesting task in many ways. It gave an understanding of how complicated procedures and enormous efforts are needed to prepare ecodesign requirements for products or families of products which correspond to a significant volume of sales and trade in the intra- EU market and which involve a noteworthy environmental impact. It was wonderful also to use our own expertise in analyzing the preparatory studies. The work was also exhilarating because the products are common in our daily life.

LOT 15: Solid fuel small combustion installations

The results of the base cases are based on data extrapolated from the literature, and that is why the performance of real appliances can vary substantially. This may have an influence when defining ecodesign requirements.

No distinction is made between the impacts of the materials used in open fireplaces as well in other solid fuel small combustion installations and the impacts from their being processed at the plant. Only the total impact of production is presented.

The main sources of pollution are the amounts of fuel consumed. The fuel use is likely to be the most important part of the LCA for solid fuel SCI's. Special attention should be given to the environmental impacts of fuels and their use. But only two solid fuel types (wood logs and wood chips) have been considered. This is one weakness of the EcoReport tool and, consequently, we needed to perform many extra calculations due to that lack. Nine of seventeen environmental indicators were relevant to solid fuel combustions, while others having no impact or very little impact were excluded. Ash and its heavy metal content depend greatly on the type and the amount of fuel as well as on burning conditions. This should be discussed further.

The use phase dominated the life-cycle impacts. The production phase contributed significantly to the waste indicator. The distribution phase contributed significantly to waste when compared to other phases. However, the amount of hazardous waste related to the distribution phase is not in accordance with the sentence that says that, "No materials are assumed to be used for the distribution of the SCI's". The end-of-life phase had very little or no impact on the environmental indicators, and there is no explanation for that.

Based on the EU Totals, it can be concluded that energy consumption is an important environmental issue. However, it is not clear what kind of role other environmental aspects are playing. It can also be concluded that the environmental impacts of solid-fuel SCI's are very dependent on both the type of appliance and the stock of the appliance. However, not so clear are those numbers related to each environmental impact, whether large or small; that is to say, it is not clear whether they are relevant or not when discussing environmental aspects and impacts related to them.

LOT 16: Laundry Dryers

The most impacting phase is the use phase and the materials have an influence only on the production phase. The use phase is the main contributor to energy consumption throughout all life-cycle phases, and in real life conditions energy consumption is more important than that in standard conditions. In the use phase, the larger impacts concerned atmospheric pollution and water consumption and its relative impact, compared to other phases: they were between 45% and 95%. The type of energy source (especially for electricity) has a great impact on the pollution type and quantity. The production phase has a more important relative impact on heavy metal emissions in water and on water eutrophication.

Based on the EU Totals, it can be concluded that energy consumption is an important environmental aspect. However, it is not clear what kind of role other environmental aspects have compared with energy use..

LOT 17: Vacuum Cleaners

According to the preparatory study, the use phase of the product clearly has the largest life-cycle impacts. This concerns particularly the total energy consumption, process water resources, greenhouse gases and acidification emissions into air.

Based on the EU Total System Impact, it can be concluded that energy consumption is an important environmental issue and dominates in the use phase. However, waste (non-hazardous/landfill) dominates in the production phase. It is not clear what kind of role other environmental aspects are playing

LOT 18: Complex set-top boxes

In the production phase the main contributors to the most significant impacts were steel, polypropylene, polyamide and copper. Steel accounts for around 70% of the product composition and up to 50% of its impact on air and water. Copper represents 30% of the product's air acidification potential.

The materials acquisition, use and end-of-life phases are all of relevance when analyzing the environmental impacts of complex STBs, and will be a point of focus during subsequent tasks when evaluating the improvement potential of different options. Regarding the use modes, both the on and active standby mode needs further attention, whereas the off mode is only of minor relevance.

9. General conclusions

Generally, it can be concluded from the studies of Lots 15 to 18 that at least two life-cycle indicators dominate at each phase, that the phases are not favourably comparable to one another and that not all of the phases are relevant

The preparatory studies are different, in spite of the same MEEuP methodology rules. This is one reason why it is difficult to compare the information between the studies. Anyway, the preparatory studies have gathered and compiled a great deal of relevant information following the Methodology Study Ecodesign of Energy-using Products (MEEuP). The results rely on existing studies, external sources, relevant literature and inputs from stakeholders.

Proper and valid data are always very important in order to produce an objective basis for appropriate ecodesign requirements. The product studies lack peer review reports from LCA concerning all the product cases, which would have helped when considering the quality of data and when making sure that all the phases of the product life cycle are equally and totally involved in the assessment. The system boundaries were not available and it was difficult to see the depth and comprehensiveness of the LCA studies behind the presented data.

The principles of the EuP Directive will not be realized if reducing energy consumption and improving energy efficiency are the only targets when dealing with improvement potentials. The Directive notes that energy-related products account for a large proportion of the consumption of natural resources and energy in the Community, but the Directive emphasizes that they also have a number of other important environmental impacts. Other environmental impacts come also from the production phases, including material processing, even though, in these studies, the use phase dominates many impacts due to the nature of the use patterns of the products and their energy needs.

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Sammanfattning

Den här rapporten handlar om relevansen av andra miljöaspekter än energi-användningen hos produkter och bygger på produktspecifika EuP- studier av del 15 till 18. Ekodesigndirektivet framhåller alla viktiga miljökonsekvenser och ekodesign syftar till att minska miljöpåverkan. Många energirelaterade produkter kan förbättras för att minska miljöpåverkan och för att uppnå energibesparingar genom en bättre design. Energi är ofta en starkt bidragande faktor när det handlar om miljöpåverkan. Det har beräknats att energirelaterade produkter står för en stor del av förbrukningen av naturresurser och energi i gemenskapen.

Resultaten består av följande fyra produktgrupper:

- Del 15 – mindre förbränningsanläggningar med fasta bränslen
- Del 16 – tvättmaskiner
- Del 17 – dammsugare
- Del 18 – avancerade boxar för mottagning

Inom del 15 dominerar användningsfasen påverkan under livscykeln. Den huvudsakliga föroreningskällan är mängden förbrukat bränsle. Endast den totala effekten av produktion presenteras och det görs ingen åtskillnad mellan konsekvenserna av de olika materialen. Baserat på EU-sammanfattningar kan man dra slutsatsen att energiförbrukningen är en viktig miljöaspekt. Det är dock oklart vilken roll andra miljöaspekter spelar. Men miljöpåverkan från mindre förbränningsanläggningar som drivs med fasta bränslen beror på typ och tillstånd för apparaten.

Inom del 16 påverkar användningsfasen mest och material påverkar endast under produktionsfasen. Användningsfasen är den största bidragsfaktorn till energiförbrukningen under hela livscykeln. Typen av energikälla (speciellt för el) har en stor inverkan på typ och mängd av föroreningar. Produktionsfasen har en viktig relativ inverkan på utsläpp av tungmetaller i vatten och på vatteneutrofiering. Baserat på EU-sammanfattningar kan man dra slutsatsen att energiförbrukningen är en viktig miljöaspekt. Det är dock oklart vilken roll andra miljöaspekter spelar jämfört med energiförbrukningen.

Inom del 17 har användningsfasen tydligt den största påverkan under produktens livscykel. Detta gäller i synnerhet den totala energiförbrukningen, användningen av vattenresurser, växthusgaser och försurande utsläpp. Baserat på sammanlagd systempåverkan kan man dra slutsatsen att energiförbrukningen är en viktig miljöaspekt som dominerar under användningsfasen. Men under produktionsfasen dominerar avfall (icke farligt/avfall). Det är inte klart vilken roll andra miljöaspekter spelar.

Inom del 18 är stål, polypropylen, polyamid och koppar de huvudsakliga bidragsfaktorerna till påverkan under produktionsfasen. Materialanskaffning, användning och kassering hade betydelse vid miljöpåverkande analyser av avancerade boxar, och det kommer att vara i fokus under senare bedömningar av förbättringspotential av olika alternativ. Gällande användningslägen kräver både påslagna lägen och standbylägen ytterligare granskningar. Läget av är däremot av mindre intresse.

Studierna av delarna 15 till 18 hade minst två indikatorer för livscykeln som dominerade i varje fas. Faserna var mindre lämpliga att jämföra med varandra och alla faser inte var relevanta. De förberedande studierna skiljde sig åt trots samma regler för MEEuP-metoder. Därför var det svårt att jämföra informationen mellan studierna. Men de förberedande studierna har samlat in och sammanställt en hel del relevant information utifrån MEEuP (Methodology Study Ecodesign of Energy-using Products). Informationsresultaten förlitar sig på befintliga studier, externa källor och information från berörda parter.

Principerna för EuP-direktivet kan inte uppfyllas om en minskad energiförbrukning och en förbättrad energieffektivitet är de enda målen när det handlar om möjliga förbättringar. Direktivet konstaterar att energirelaterade produkter står för en stor del av förbrukningen av naturresurser och energi i gemenskapen, men i direktivet betonas även att de också har en rad andra viktiga miljökonsekvenser.

Det är alltid mycket viktigt att ha rätta och representativa data för att kunna ta fram objektiva kriterier för ecodesign. Produktutredningar saknar peer review rapporter om LCA omfattande alla produkter, som hade hjälpt vid evaluering av datakvalitet och vid säkerställning att alla faser av produktens livscykel är likvärdigt och i sin helhet tagna i hänsyn vid evalueringen. Systemgränserna var okända och det var svårt att inse djupet och övergripandet av de bakomliggande LCA utredningarna som hade lagt grunden till presenterad data.