Development of European Ecolabel and Green Public Procurement Criteria for Imaging Equipment

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1. Objective

This working document gives a general overview of the environmental performance of imaging equipment products and follows the previous work of this project undertaken in Task 1 Product Definition and Scope and Task 2 Economic and Market Analysis. The aim of this document is to identify the key environmental thematic areas regarding the environmental performance of imaging equipment. Moreover, criteria areas linked to these environmental thematic areas are proposed. These criteria areas shall be the basis for the Ecolabel and Green Public Procurement (GPP) criteria developed hereafter.

2. Background

The purpose of this project is to develop the evidence base from which EU policymaking in the area of imaging equipment (office devices with one or more of the following functions: printing, copying, faxing, scanning) can be developed. In this report, EU Ecolabel and GPP criteria will be devised for imaging equipment in line with Ecolabel Regulation 66/2010 and Communication COM (2008) 400 ''Public Procurement for a Better Environment''.

Imaging equipment is together with computers the typical information technology (IT) products found in an office setting. Imaging equipment includes devices which are not only used in a professional environment but are also sold for use at home. The total EU stock of imaging equipment is assessed to be as high as 145 million products.

Imaging equipment has been identified as a product group with significant environmental improvement potential, which can be realised through ecological criteria development for Ecolabels and GPP. Ecolabels for imaging equipment exist on the Member State level. On the EU level, Ecolabel criteria are not available but EU Green Public Procurement criteria are found in the European IT toolkit. These would be revised based on the outcome of this project.

In line with the previous findings of Task 1 Product Definition and Scope and Task 2 Economic and Market Analysis, a product is included in the 'imaging equipment' product category if it is used in an office setting (private or professional) and its main function is:

- to produce a printed image (paper document or photo) through a marking process either from a digital image (provided by a network/card interface) or from a hardcopy through a scanning/copying process.
- to produce a digital image from a hard copy through a scanning/copying process.

Within the scope of this study are products which are marketed as printers, copiers, multifunctional devices (MFD) including MFD-fax machines as well MFD-scanners. The inclusion of further devices is under discussion. The exact terms and definitions used(e.g. printer, copier, MFD, etc.) are presented in Task 1 and are equal to the ones used by the Energy Star label, in the current EU Green Public Procurement criteria and with the terms used in the EU Ecodesign Preparatory Study on imaging equipment. These definitions are also used worldwide by numerous Ecolabel schemes.

In this working document, scientific findings on the environmental performance assessment of imaging equipment from peer reviewed papers and scientific reports are presented. These outcomes are complemented with the evidence from environmental assessments carried out by existing Ecolabel schemes and imaging equipment manufacturers. Relying on this scientific and evidence basis and in respect of the requirements set in the Ecolabel Regulation 66/2010 and in the GPP communication, the key environmental thematic areas regarding the environmental performance of imaging equipment are identified.

The Ecolabel and GPP criteria areas proposed for discussion will focus on these key environmental thematic areas. Moreover, a first proposal of determining the first draft criteria and exploring the different options is also presented. However, it should be highlighted that an exact formulation of either the Ecolabel or GPP criteria together with performance and/or limit values is not included in this phase but will be prepared as input for the second ad hoc working group (AHWG) meeting.

This exercise has been launched as a shortened procedure according to Ecolabel Regulation 66/2010 Annex I.B. It was intended to develop the Ecolabel criteria based on existing labelling schemes, mainly the German Blue Angel criteria. Although for administrative reasons the criteria development has changed to the standard procedure, the close link to the Blue Angel has been maintained.

3. Framework requirements of EU Ecolabel Regulation and GPP Communication

Based on EC Regulation 66/2010 [1] the Ecolabel criteria should be market oriented and limited to the most significant environmental impacts of products during their whole life cycle. The Ecolabel criteria shall be based on the best environmentally performing products available on the EU market. Indicatively, the criteria shall correspond to products that are in the top 10 – 20 % with respect to environmental performance. The exact percentage shall be defined on a case by case basis. Flexibility on this is necessary. While the most environmentally-friendly products are promoted, the consumers shall be provided with sufficient choice.

The criteria should be based on scientific evidence and take into consideration the latest technological developments. In determining Ecolabel criteria, the following shall be considered:

- the most significant environmental impacts (e.g. impacts on climate change, nature and biodiversity, energy and resource consumption, the generation of waste, emissions to environmental media, use and release of hazardous substances).
- the substitution of hazardous substances by safer substances, as such or via the use of alternative materials or designs, wherever technically feasible.
- the potential to reduce environmental impacts due to durability and reusability of products.

Moreover, the criteria shall be based on the most significant environmental impacts of the product and be expressed as far as reasonably possible via technical key environmental performance indicators of the product.

Furthermore, the developed Ecolabel criteria shall take into account relevant community policies and work done on other related product groups. In this respect, for the imaging equipment product group, the Ecodesign study on imaging equipment [2] as well as the Ecolabel criteria on similar product groups, e.g. computers and laptops, are of particular relevance.

The approach and procedure of the GPP criteria development is similar and closely related to the one used for the development of the Ecolabel criteria. The basic concept of GPP relies on having clear, verifiable, justifiable and ambitious environmental criteria for products and services, based on a life-cycle approach and on scientific evidence. Therefore, the background information – the scientific and evidence basis regarding the product group – is the same for both policy instruments and is given in the draft preliminary report [3].

However, as the application and purpose of the Ecolabel and of the GPP criteria differ in the GPP criteria, some additional issues should be taken into account. Nevertheless, these issues are not directly related to the environmental performance of the product under study but rather reflect some specific needs of GPP.

In particular, in GPP criteria is the following are required: an estimation of the public procurement market, public procurement expenditure, an evaluation of the costs to public procurers and a demonstration of the ways in which life cycle costing (LCC) are calculated. Moreover, the net environmental balance between the environmental benefits and burdens, including where appropriate social and ethical aspects, e.g. by making reference to related international conventions and agreements such as relevant ILO standards and codes of conduct, should be taken into consideration. Such references to related international conventions and agreements related to social and ethical concerns are also applicable to Ecolabel criteria. The GPP criteria should take into account different stages of the tendering procedure and as presented in Task 1, the GPP criteria will be broken down into 'core' and 'comprehensive' criteria.

It should be emphasised at this point that based on the outcome of this project, the current available GPP criteria on imaging equipment as found in the GPP toolkit [4] will be revised.

4. Environmental performance of imaging equipment

4.1. Environmental performance of imaging equipment with life cycle assessment

In this Section 4.1 background information regarding the environmental performance of imaging equipment along the life cycle is presented. The LCA-based environmental assessment of a product covers all the environmental impacts of the processes which are directly or indirectly involved in the product life cycle from cradle to grave. Thus, this includes the phases of raw material extraction, production, distribution, use, recycling/raw material recovery and disposal. As such, not only is the environmental performance of a single product investigated but the environmental performance of the product system or more precisely of product systems which together combined could provide the determined function are also investigated. In the case of imaging equipment, the function investigated is one or more of the following: printing, copying, sending and/or receiving a fax, and creating a digital image via scanning. Furthermore, in the product life cycle the product systems (from cradle to gate) of the imaging equipment device and of the consumed paper, energy and ink or toner in the use phase (see also Task 1, Section 5) are actually investigated.

In this section the findings of the Ecodesign study on imaging equipment [2] in which a life cycle based assessment is made as well as the recent findings of a streamlined LCA on imaging equipment made on behalf of the Danish Environmental Agency [5] will be presented. It is important to highlight is that both studies refer to the environmental performance of the overall European EU-27 stock of imaging equipment which is assessed based on an analysis of representative average products.

4.1.1. Findings of the Ecodesign preparatory study on imaging equipment

The recently finalised preparatory Ecodesign study on imaging equipment [2] provides an overview of the overall environmental impact of imaging equipment throughout Europe. The environmental performance of the product group was assessed using a streamlined life cycle assessment approach. In the environmental assessment, the outcomes are calculated referring to the actual product lifetime in use and the European stock.

In particular, the environmental assessment undertaken by the Ecodesign study follows the methodology of MEEuP [6]. Economic and market data were analysed and information was gathered on the product stock and sales volumes of the product group across the community market. The gathered information data about user behaviour allows for the identification of use patterns and the determination of the product lifetime. In a later step, representative average products (base cases) were determined. In their totality, the base cases represent the overall product group. A streamlined life cycle inventory of the base case was then conducted followed by an environmental assessment.

In the environmental performance assessment in line with the MEEuP method the environmental impact categories and environmental aspects given in Table 1 were investigated:

Table 1. Environmental impact categories and environmental impact aspects investigated in Ecodesign Preparatory studies.

Environmental Impact Categories	Environmental aspects
• Global warming potential • Acidification potential • Ozone depletion emissions • Eutrophication	• Energy (gross energy requirement, electricity and feedstock) • Water (process and cooling) • Waste (hazardous and non-hazardous) • Volatile organic compounds (VOC) • Persistent organic compounds (POP) • Heavy metals (in air and water) • Polycyclic aromatic hydrocarbons (PAH) • Particulate matter (PM)

The environmental assessment results of each base case refer to the overall environmental impacts throughout the product life cycle (from cradle to grave) for all the respective imaging products which are currently in use in the EU-27 and refer to their lifetime in use.

It should be taken into account that the MEEuP methodology focuses on energy consumption and the product use phase. In the case of imaging equipment, these seem to be the most relevant aspects. However, some aspects were not captured, for instance the ink production (due to data gaps) or advanced material composition because the assessment is made on a representative typical product.

Moreover, the environmental impacts are expressed in both environmental impact categories and in environmental impact aspects. Therefore, in the first case the impacts on equivalent values of the indicator used are calculated, e.g. as CO_2-equivalents for global warming potential and in the second case as mass values of materials and/or hazardous substances, e.g. water volume, PAHs, PM, etc. Therefore the interpretation of the outcomes and especially the comparison between impact categories and impact aspects is not always straightforward. However, the results give a good general overview of the important thematic areas regarding the environmental performance of the product groups.

In the Ecodesign Preparatory Study six representative imaging equipment products were investigated. The selection and classification of these products were based on functionality (SFDs and MFDs), user pattern (private use or professional use) and performance characteristics (image colour, image creation speed and technology). In particular, the investigated base cases were:

1. monochrome electro-photographic MFD-copiers for use in working environments (medium speed of 26 ipm)
2. colour electro-photographic MFD-copier for use in working environments (medium speed of 26 ipm)
3. monochrome electro photographic printer used in working environments (high speed of 32 ipm)
4. colour electro-photographic printer used in working environments (high speed of 32 ipm)
5. colour inkjet MFD-printer used in a personal environment (low speed 20 ipm)
6. colour inkjet MFD-printer used in a working environment (low speed 20 ipm).

It is important to emphasise at this point that the base cases represent average products found in the Community market and not the best performing products. The technical parameters of the base cases were calculated based on average values of real products. These outcomes could serve as a reference baseline of the performance of average products. However, the performance of Ecolabelled products needs to exceed the performance of the base cases. In any case the results of the Ecodesign base cases can serve for the identification of key environmental thematic areas to which the Ecolabel and GPP criteria shall refer.

Regarding the composition of material for each of the six case studies mentioned the tables indicating the used bill of materials are listed in Annex 1. In general the used chassis (e.g. frame, screws) and most mechanical parts (e.g. rollers, clutches) are considered ferrous metals such as galvanised steel. The electro-mechanics (e.g. stepper motors, wires) are a mix of ferrous and non-ferrous metals with copper as the dominant material mass. The aluminium content varies in the individual products. Plastics are used in the full spectrum of bulk and Tec plastics for housing functionality (e.g. covers, trays, cartridges) and small mechanical parts (e.g. spacers, gear wheels, blends, buttons). Depending on the particular function and technical requirements (e.g. thermal and mechanical stability), manufacturers usually have the option to utilise different bulk and Tec plastics. Bulk plastics PS and ABS, as well as Tec plastics PC are the most commonly used materials. Glass is mainly found in the scanner lamp and plate. LCDs, ICs and populated electronic boards are listed under various electronics input categories while motors (e.g. small stepper motors) were partly allocated to the database category of 44-big caps & coils. However, a more detailed 'component-material' correlation was limited due to restrictions in the used modelling database [2].

An excerpt from the environmental performance of the investigated MFD-copier as performed in the Ecodesign study using MEEuP is given in Figure 1. Similar outcomes are also available for the other base cases. At this point it is important to highlight the fact that based on the outcomes of the different base cases and despite the fact that the profile of the environmental performance among the different base cases differ, the identified key environmental thematic areas are the same. The environmental performance profile of the other base cases together with the inventory tables used are provided in Annex 1. In Figure 1 the values of the investigated environmental aspects are given in two forms: the first takes into account the paper consumption during the product life cycle, and the second neglects these impacts. This differentiation was made because the very high environmental impact of office paper would hamper a deeper investigation of the impacts of other parameters. The results in Figure 1 are presented as contribution percentage for each product life cycle phase per investigated environmental impact category and aspect. The environmental impact categories and aspects are given in Table 1.

Based on Figure 1 it can be identified that for the majority of the environmental impact categories and aspects, the contribution of the use phase is dominant followed by the manufacturing phase. An important finding from the environmental assessment is that in the life cycle of imaging equipment for the overall environmental performance, paper consumption has the most dominant role followed by energy consumption in the use phase. The high importance of paper consumption is related to the larger demands of energy in the paper production phase.

Indicatively, in the first base case (monochrome MFD-copier in a working environment), the consumption of paper was assumed to be 87 880 pages for each of the six years of the product lifetime. Extrapolating and summing up the results for the overall total energy consumption of the stock of copiers, printers and MFDs as modelled in this study shows that for the reference year 2005, the consumption of paper is responsible for 80 % (or 586 PJ) of the total EU energy consumption related to the life cycle of imaging equipment. This immense contribution to overall energy consumption also affects significantly the other environmental impact categories as significant environmental impacts are related to the energy production phase. This emphasises the need for efficient use of paper towards a final reduction of the total amount of its consumption.

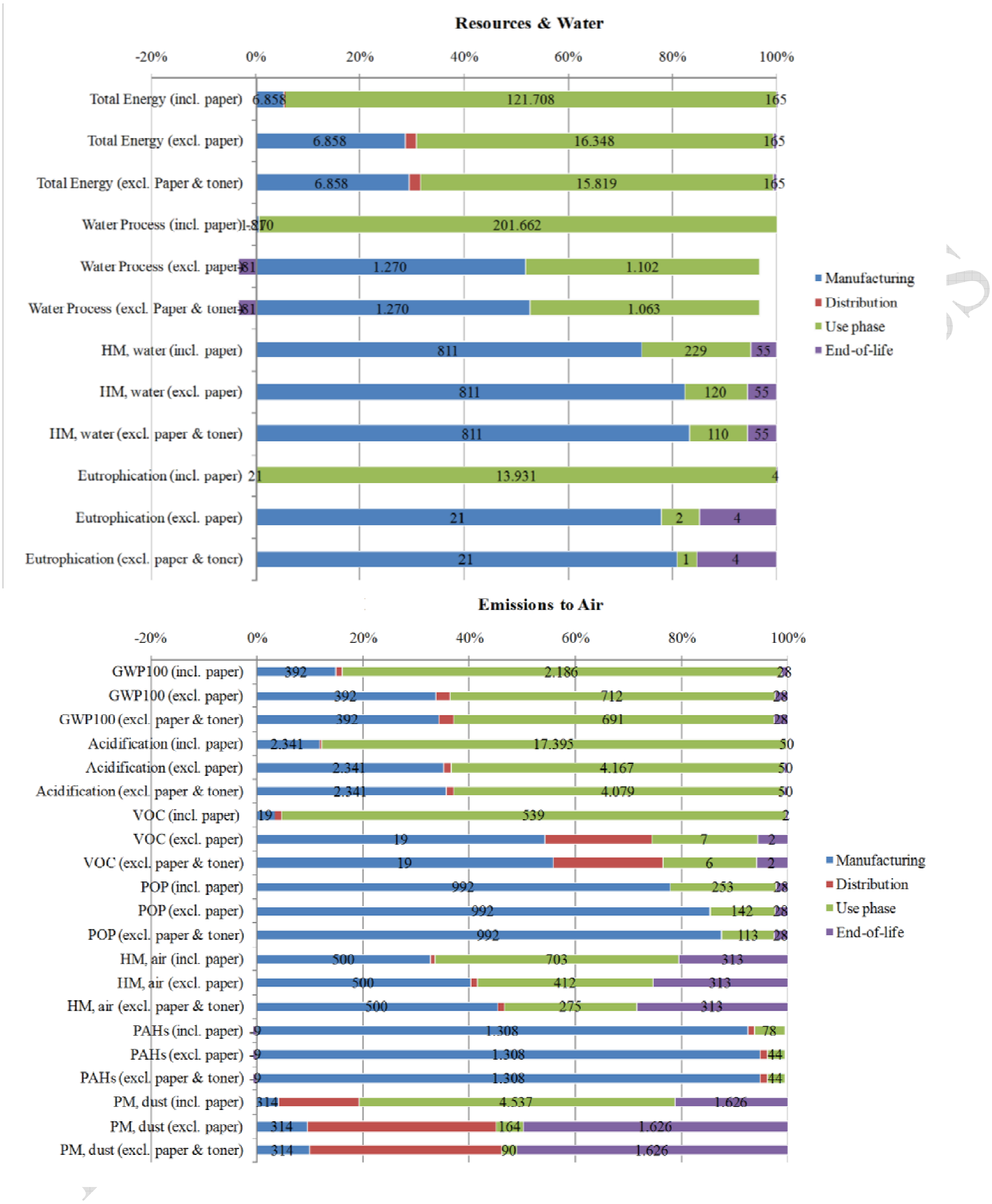

Figure 1 Environmental assessment of an MFD-copier life cycle based on the MEEuP Ecodesign methodology

Source: Ecodesign Preparatory Study on Imaging Equipment [2]

One choice to reduce paper consumption is when printing and copying is made on both paper sides (duplex image reproduction). This aspect is taken into account in all the Ecolabel schemes (see draft Task 1, Section 6) by setting one Ecolabel criterion on the basis of the feasibility of duplex printing and/or copying. However, we should emphasise the fact that the consumption of paper is a parameter which depends more on user behaviour and less on the design of a printer or a copier. For instance, despite the automated duplex printing and copying capability of a imaging equipment, it is eventually up to the user to apply this function or not.

The next most important aspect regarding the life cycle environmental performance of imaging equipment as found in the preparatory Ecodesign study is energy consumption in the use phase. It was assessed that energy consumption in the use phase accounts for approximately 2/3 of the total energy consumption of imaging equipment during product lifetime (energy consumption related to paper use is not considered). Thus, a better environmental performance can be achieved by energy efficient products. The consumption of less energy is also beneficial with respect to the other investigated environmental aspects, due to the lower pollutant emissions in the energy production phase. An additionally important aspect on this is that most of this energy is not consumed during image reproduction but during the inactive mode (standby losses). Among the different types of imaging equipment, especially high standby losses are found from fax machines as they reach up to 90 % of the total electricity consumption during their lifetime [7, 8].

The electricity consumption in the use phase is an aspect which is dependent on the product design (different from the aforementioned strong user dependent paper consumption aspect). Therefore for all currently available imaging equipment, Ecolabel criteria of Member States (e.g. Blue Angel and Nordic Swan) and of third countries (e.g. EcoMark, etc.) as well the GPP criteria have a special focus on the energy efficiency requirements of the product. As mentioned before in Task 1, Section 9, the majority of the different Ecolabel schemes require compliance with the energy efficiency requirements of the Energy Star label.

In addition, it is important to identify which materials or processes used in the manufacturing process contribute the most to the environmental impacts of the imaging equipment life cycle. Based on the findings for the example of the MFD-copier, significant contributions are found for galvanised steel (the modelling input in the MEEuP method is '21-St sheet') and polystyrene (5-PS).

In this case study, galvanised steel amounts to almost 36 kg and 56 % of the total product weight. Steel is used for frame structures, rollers and other mechanical parts.

According to the MEEuP methodology, this 'non-hazardous waste' category reflects the waste generation during ore extraction and metal processing. Ferrous metals on the other hand have a high recycling potential, which partly compensates for their overall environmental impacts. In particular, galvanised steel shows considerable emissions to air. The concentration of steel in the product dominates the POP (94 %), GWP (33 %), and VOC (33 %) impact categories.

Polystyrene (PS) (in which both PPE and PPS are included) is the second largest material fraction by weight. PS amounts to 7.5 kg or roughly 12 % of the total product mass. The environmental impact of PS is strongly related to the high PAH (polycyclic aromatic hydrocarbons) concentration, which is an indicator for toxicity, measured in Ni equivalents. In this case study, polystyrene amounts to 70 % of the total PAHs.

4.1.2. Danish Environmental Agency LCA study on imaging equipment

A study of the Danish Environmental Agency [5] conducted by environmental and LCA experts was undertaken in 2009 in which environmental screening LCAs for different product groups with available preparatory Ecodesign studies were made. Among these studies was also the Ecodesign Preparatory Study on Imaging Equipment.

In this case, a streamlined LCA was performed using the LCA software tool SimaPro, referring to process data from the LCI Ecoinvent database and investigating a number of environmental impact categories (the LCIA "stepwise 2006" method covering 15 environmental impact categories was applied). In general this LCA study was conducted based on the same main assumptions made in the respective Ecodesign study. Thus, the analysis is again based on average imaging devices and not on the best performing products.

Regarding the environmental screening of the imaging equipment product group this study concludes that the environmental impact of imaging equipment comes from the consumption of paper, the consumption of toner and the electricity consumption during use. The environmental impacts associated with the consumption of toner differ based on whether the toner is for black/white printing or for colour.

Moreover, another outcome highlighted in this report is that although the energy efficiency of office imaging equipment is generally at a good level, under real life conditions, the energy efficiency potential of imaging equipment is not necessarily fully exploited due to a potentially suboptimal use by the consumer. Furthermore, it is suggested that the focus should be put on designing toners with fewer overall environmental impacts.

In Figure 2 and Figure 3 the overall environmental impacts for several environmental impact categories during the life cycle of a laser printer for black/white and respectively colour printing are indicatively presented. In general the overall outcomes referring to the environmental performance of printers are also considered to be applicable for copiers and MFDs. These findings are presented referring to the use of the printer per kg of printed paper and not referring to the total consumption of paper in the imaging equipment life cycle. This is because the overall environmental impacts associated with paper consumption are immense compared with the impacts associated with other factors. Nevertheless, expressing the outcomes per kg of consumed paper makes an investigation of other contributing parameters feasible.

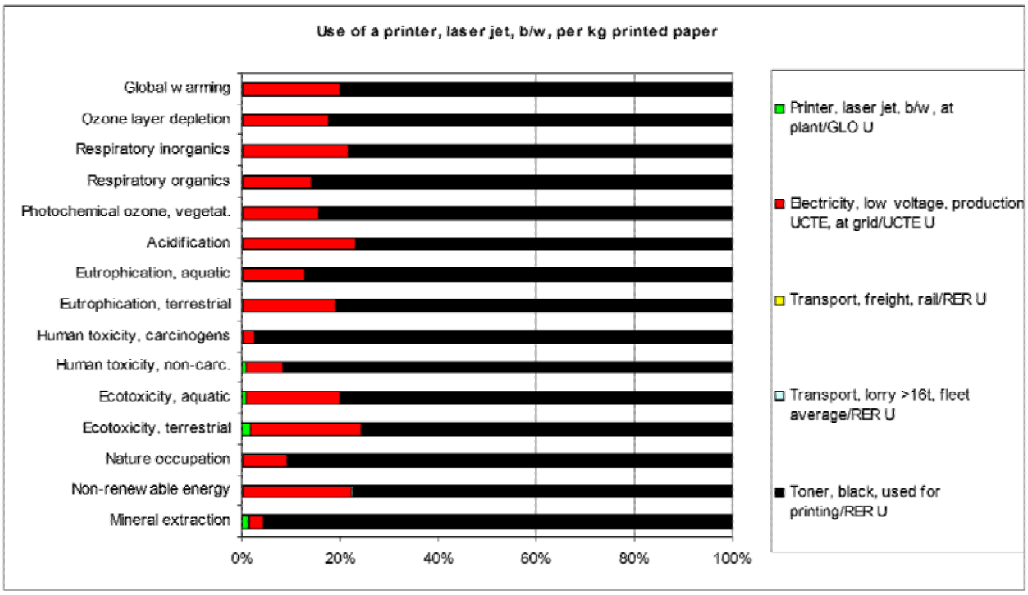

Figure 2. Environmental impacts for the life cycle of a laser printer for black/white printing per kg printed paper.
Source: [5]

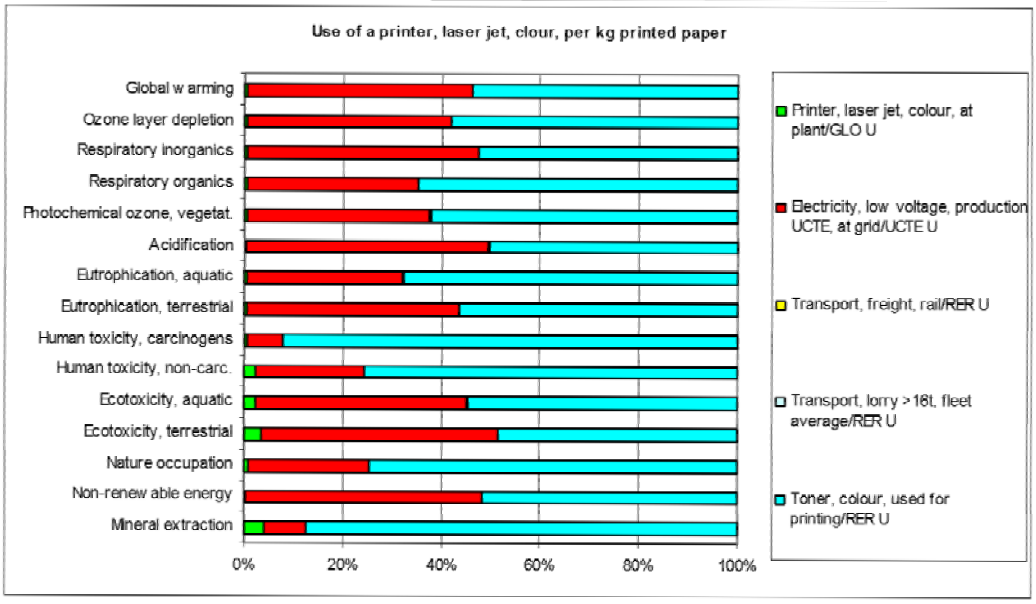

Figure 3. Environmental impacts for the life cycle of a laser printer for colour printing per kg printed paper.
Source: [5]

Based on Figure 2 and Figure 3 it can be concluded that when using a printer, the electricity consumption is significant for most of the environmental impacts (exclusion: mineral extraction). The significance of the production of the printer itself is considered relatively low. On the contrary the environmental impacts associated with the toner are relatively high. The environmental impacts from the production of toner mainly come from the production of the toner module, the toner (powder), the production of aluminium and the electricity for manufacturing the toner.

In Figure 4 the environmental impacts associated with the production of a laser printer for black/white printing are presented. In Figure 4 the contribution per environmental impact category of each process involved is also given.

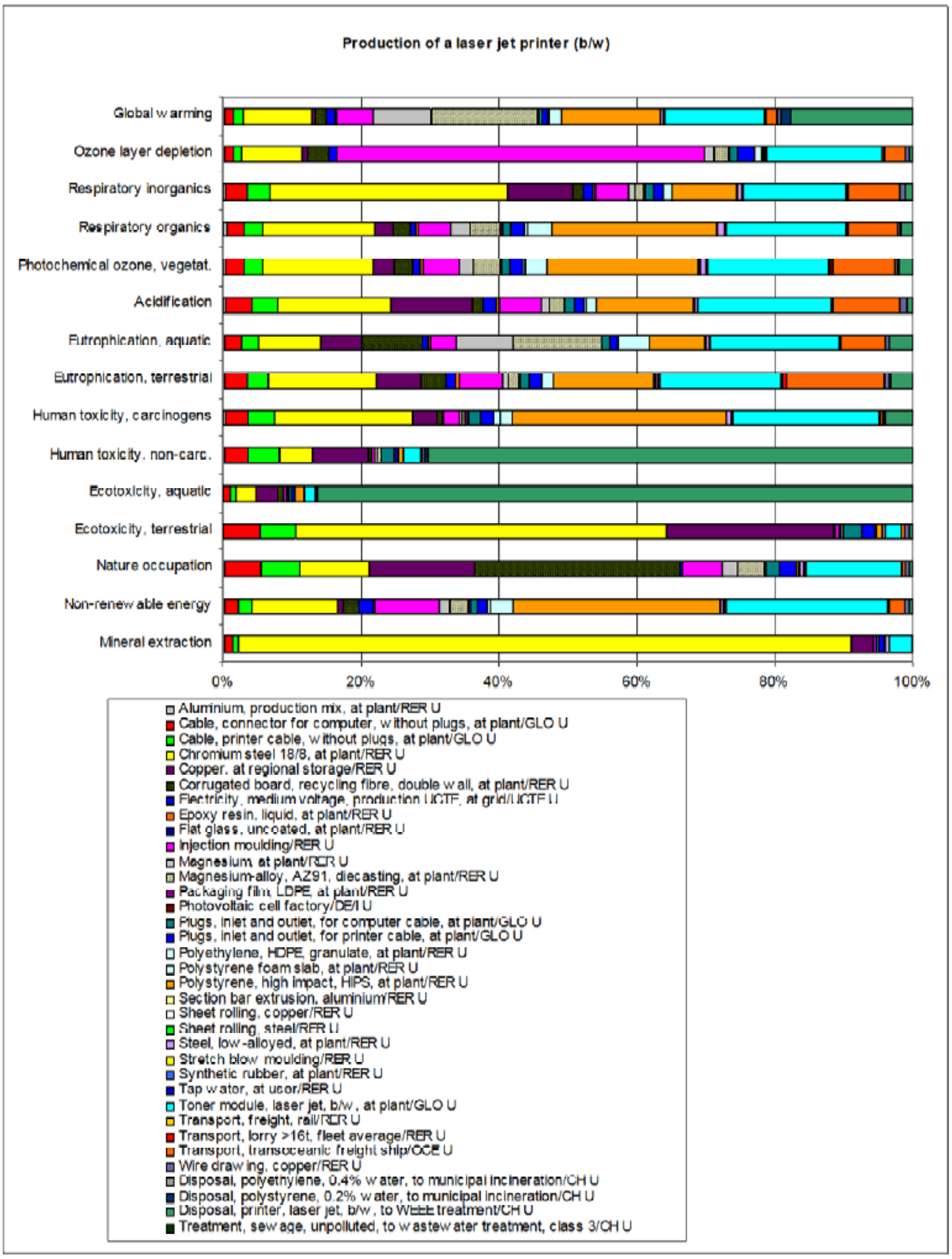

Figure 4. Environmental impacts for the production of a laser printer and contribution of each involved process
Source: [5]

This study concludes that the environmental impacts from the production of a printer mainly come from the production of chromium steel (18/8), polystyrene and the toner module. As presented in Figure 4, chromium steel marked with yellow is a major contributor to the impact categories of mineral extractions, to terrestrial ecotoxicity and to respiratory organics. Polystyrene which is marked in Figure 4 with orange contributes significantly to the impact category of human toxicity/carcinogens, to photochemical ozone and to non-renewable energy. Moreover, the impacts associated with the toner module (marked with green colour in Figure 4) dominate the categories of aquatic, human toxicity/non-carcinogens. In addition injection moulding contributes significantly to ozone layer depletion. The final disposal of the printer contributes significantly to human toxicity (non-carcinogen) and ecotoxicity (aquatic). These contributions are mainly due to emissions of antimony, dioxins, arsenic and copper.

It can be concluded that based on the findings of the Danish Environmental Protection Agency, the environmental performance of imaging devices along the life cycle is strongly related to the paper consumption, the energy efficiency of the device and the consumption of toner or ink (which was a factor not covered in the Ecodesign study).

At this point it should be mentioned that apart from substituting hazardous materials used in the toner or ink, another well established strategy to reduce the overall environmental impacts associated with these consumables is refilling and/or remanufacturing toner and ink cartridges. In this case, the design of the cartridges has a significant role. Both aspects are addressed in the Ecolabel criteria as described in Task 1 and would also be an area of focus in the development of EU Ecolabel and GPP criteria.

4.1.3. Conclusions of life cycle assessment findings

LCA is a decision support tool in which alternative options can be compared in a system approach which covers the whole product life cycle. The main advantage of determining the environmental performance with an LCA approach is that it avoids shifting environmental problems between product life cycle stages (e.g. better performance in the production phase but worse in the use or recycling phase, etc.) as well as between environmental impact categories.

In the aforementioned studies of Ecodesign and of the Danish Environmental Protection Agency (Section 4.1.1 and 4.1.2) the performance of imaging equipment was assessed, and the areas of significant environmental concern and the environmental hot-spots were identified.

The areas of significant environmental concern can be summarised as:

- paper consumption,
- energy efficiency in the use phase
- consumption of toner and ink.

The most significant factor is paper consumption followed by the energy efficiency during operation and the impacts associated with toner and ink consumables.

These two LCA studies also identify the materials and the processes which have a major contribution to the overall environmental impact of the life cycle product system. In particular these are the production of chromium steel (18/8), polystyrene and the toner module. In addition, injection moulding which contributes to ozone layer depletion and the disposal of the product contributes significantly to human toxicity (non-carcinogen) and ecotoxicity (aquatic). The contributions to these are mainly due to emissions of antimony, dioxins, arsenic and copper. In addition, based on the Ecodesign Study, the galvanised steel and polystyrene (as modelled in MEEuP 21-St steel and 5-PS, in the latter are PPE and PPS included) as well as electronics are the materials with considerable overall contribution. Polystyrene has a significant impact in the category of polycyclic aromatic hydrocarbons (PAHs) emissions while galvanised steel in persistent organic compounds (POP), in global warming potential (GWP) and volatile organic compounds (VOC). Electronics despite their very low weight in the final imaging device their environmental impacts in the manufacturing phase dominate in 9 out of the 16 investigated environmental categories in the Ecodesign LCA analysis.

It is important to emphasise that LCA can also be used in comparative assertions. In this case the overall life cycle environmental performance of one or more imaging equipment devices against alternative options is analysed. In such a type of LCA analysis, it is feasible to compare several alternative scenarios like the substitution of materials or components, different user behaviour (e.g. double-sided printing, more users per printer, etc.), different energy efficiency levels of the devices, different recycling and reuse scenarios, different end-of-life scenarios and other managerial options (e.g. longer product durability, better logistics, less packaging, etc.). Such kinds of LCAs are often conducted by imaging equipment manufacturers and are used to assess the undertaken environmental improvement measurements.

However, in the comparative LCA analyses assumptions are made which are dependent on the purpose of the study (as these are explicitly defined in the goal and scope phase of LCA in line with the ISO 14040 standard). LCA results are strongly based on these assumptions. Thus, in comparative LCAs the interpretation of outcomes needs to take into account that the validity of the assumptions is not always ensured.

4.2. Environmental performance of imaging equipment with respect to indoor air emissions

As previously mentioned, using LCA for the environmental performance avoids shifting environmental problems between product life cycle stages as well as between environmental impact categories and therefore supports sound decisions in product environmental management. However, the current lack of knowledge and data especially regarding some specific environmental impact categories does not allow a LCA to capture all environmental impacts. LCAs investigate the major environmental impact categories in a generic way for all the processes involved in the product system life cycle.

In the case of the environmental performance of imaging equipment, one relevant environmental impact category not covered through a common LCA based approach are indoor air emissions. LCA researchers recognised the importance of indoor air exposure concluding that the indoor exposure should be routinely addressed within the LCA. Thus, there are currently ongoing activities on establishing the methodological framework for integrating the environmental impact category of indoor air quality in an LCA [9].

It has been known for many years that imaging equipment is a source of indoor air pollutants. There are several reports and investigations worldwide on indoor emissions related to imaging equipment. Office equipment has been found to be a source of ozone, particulate matter, volatile organic compounds (VOCs) and semivolatile organic compounds (SVOCs) [10].

In a review study of Destaillats *et.al.* [11] laser and inkjet printers, MFDs, and photocopiers were investigated with respect to their emitted indoor pollutants. In this study volatile organic chemicals (VOCs), ozone, particulate matter and semi-volatile organic compound (SVOCs) emission data are reported and are reproduced here in table 2 and Table 3. Emissions are reported for both idle and operation mode of the imaging device.

Table 2. Review of reported data on indoor air emissions of laser, inkjet printers and MFDs

Chemical	Laser printers([a,b])		Ink-jet printers([a])		All-in-one office machines([a])	
	Chamber concentration (ppbv)		Chamber concentration (ppbv)		Chamber concentration (ppbv)	
	Idle	In operation	Idle	In operation	Idle	In operation
VOCs						
Freon 12	0.48—0.52	0.61—0.66	0.36	0.43	0.3	0.45
Methyl chloride	0.53—0.60	0.71—0.82	0.48	0.55	0.52	0.62
Freon 11	0.24—0.29	0.25—0.28	0.23	0.24	nd.	0.27
Methylene chloride	0.38—0.42	0.46—0.58	0.57	0.61	0.69	0.74
Chloroform	0.96—1.07	1.17—1.31	0.81	0.94	0.74	0.96
Benzene	0.52—0.57	0.77—0.84	0.42	0.41	0.52	0.52
Toluene	14—15	15—16	6.22	6.43	7.9	8.2
Tetrachloroethene			0.23	0.21	0.52	0.43
Ethylbenzene	1.4—2.1	2.0—3.0	1.2	1.26	1.5	1.6
m.p-Xylene	1.2	1.6—1.7	0.86	0.92	0.9	0.9
Styrene	2.7—4.0	3.2—5.3	1.14	1.43	1.2	1.9
o-Xylene	0.9—1.0	2.0—2.3	0.69	0.68	0.58	0.58
1,4-Dichlorobenzene			0.34	0.32	0.34	0.35
1,3-Dichlorobenzene			0.34	0.32	0.34	0.35
1,2-Dichlorobenzene			0.21	0.21	0.26	0.22
1,2,4-Trichlorobenzene			0.86	0.63	0.23	0.2
Hexachlorobutadiene			0.37	0.36	0.88	0.64
ΣVOC		300—1400 (20—60m)				
Ozone						
Ozone		9—10 1—13 (20m)		5—6		6
Aerosol particles						
PM_{10}		65		20—38		41

When available, the duration of operation (min) is indicated in parenthesis.
([a])Lee, S.C., Lam, S., Fai, H.K., 2001. Characterization of VOCs,ozone, and PM10 emissions from office equipment in an environmental chamber. Building and Environment 36, 2001
([b]) Smola, T., Georg, H., Hohensee, H., Health hazards from laser printers? Gefahrstoffe Reinhaltung der Luft 62, 2002

Source: Destaillats *et.al.* [11]

Table 3: Review of reported data on indoor air emissions of copiers

Chemical	Emission rate ($\mu g\ h^{-1}$ unit^{-1})	Chamber concentration ($\mu g m^{-3}$)		Reference
		Idle	In operation	
VOCs				
Toluene	110—760			([a])
	540—2000			([b])
Ethylbenzene	<50—28000			([a])
	23000—29000			([b])
		4.1	552—608	([c])
m, p-Xylene	100—29000			([a])
	22000—29000			([b])
		4.5	467—515	([c])
o-Xylene	<50—17000			([a])
	12000—15000			([b])
Styrene	300—12000			([a])
	6300—8400			([b])
Styrene+o-Xylene		3.1	354—390	([c])
Isopropylbenzene	150—160			([b])
n-Propylbenzene	<50—2100			([a])
	360—460			([b])
		<0.4	7.8	([c])
Benzaldehyde	<100—3800			([a])
	980—1500			([b])
		1.3	25—26	([c])
	<50—330			([a])
	500—730			([b])

		1.3	16—18	(c)
1,2,4-Trimethylhenene		0.6	3.6—4.2	(c)
ButylbenLene		<0.4	14—15	(c)
Acetophenone		1.6	11—13	(c)
Methoxyethylbenzene		0.9	6.6	(c)
C9-ester		<0.5	23	(c)
Butenylbenzene		1.1	28—37	(c)
n-Decane	<50—450			(a)
2-Ethyl-1-hexanol	130—14000			(a)
Limonene	<50—1100			(a)
n-Nonanal	1100—3900			(a)
n-Undecane	62—2000			(a)
n-Dodecane	75—960			(a)
Formaldehyde	<500—2600			(a)
	1900—3200			(b)
	<500—1200			(a)
Acetaldehyde	510—1300			(b)
Acetone	<100—2800			(a)
Propionaldehyde	<100—260			(a)
2-Butanone	<100—380			(a)
	n.d.—600			
	<100—840			(a)
Butyraldehyde	n.d.—410			(b)
Valeraldehyde	<100—540			(a)
n-Hexanal	100—1200			(a)
	n.d.—950			(b)
ΣVOC		49	1630—1900	(c)
Ozone				
Ozone	1300—7900			(a)
	1700—3000			(b)
Aerosol particles				
PM (respirable fraction)	1420—2950	6—11	19—22	(c)

(a) Leovic, K.W., Sheldon, L.S., Whitaker, D.A., Hetes, R.G., Calcagni, J.A., Baskir, J.N., Measurement of indoor air emissions from dry-process photocopy machines. Journal of Air and Waste Management Association 46, 1996
(b) Leovic, K., Whitaker, D., Northeim, C., Sheldon, L., Evaluation of a test method for measuring indoor air emissions from dry-process photocopiers. Journal of Air and Waste Management Association 48, 1998
(c) Brown, S.K.,. Assessment of pollutant emissions from dry process photocopiers. Indoor Air 9, 1999

Source: Destaillats et.al. [11]

Laser printers and photocopiers have been found to generate ozone in varying amounts while toner and paper dust from printing devices may become airborne, generating respirable particles that include ultrafine aerosols. Printers and photocopiers have also been reported as sources of VOCs, which are derived, at least in part, from the toner that is heated during printing. Among all emissions presented in Table 2, reported levels of VOCs have been highest from laser printers and, although the difference is generally small, the levels were higher during operation than in idle mode. Toxicological effects or potentially significant consequences due to these emission have been described in the literature e.g. ozone and particulate matter have been associated with occupational symptoms such as eye, nose or throat irritation, headache and fatigue [12].

Similar results were also reported from other researchers. In Table 4 recent findings from investigations in indoor air emissions from imaging equipment are summarized. These results complement the previously shown information and go into more detail in investigating the different parameters which affect the indoor emissions from imaging devices.

Table 4. Recent investigations and findings in indoor air emissions from imaging equipment

Summary	Reference
Lee et al investigated different types of imaging equipment including fax machines, laser printers, inkjet printers, scanners and photocopiers. Several pollutants were analysed covering volatile organic compounds (VOCs), total VOCs, ozone and respirable particles (PM_{10}). The VOCs were further analysed and separated in fractions of toluene, ethylbenzene, m,p-xylene and styrene. The emissions varied from 0.2 to 7.0 µg/print.	S.C. Lee, Sanches Lam, Ho Kin Fai, "Characterization of VOCs, ozone, and PM10 emissions from office equipment in an environmental chamber", *Building and Environment*, 36, 2001
Naoki Kagi et al. in their study on laser and inkjet printers confirmed the emissions of VOCs, ozone and ultrafine particles. The results in this research confirmed an increase in the concentration of ozone from 1.5 to 1.6 ppb and ultrafine particle during printing. Especially for the case of around 50nm particles, particulate concentration increased greatly during printing. Styrene and ozone were detected from the laser printer and alcohols were detected from the inkjet printer. The concentrations on styrene and xylenes slightly increased to 200 – 3000 mg/m^3 in the printing process for the laser printer. The source of styrene from the laser printer was the toner and the source of pentanol from the ink-jet printer was the ink.	Naoki Kagi, Shuji Fujii, Youhei Horiba, Norikazu Namiki, Yoshio Ohtani, Hitoshi Emi, Hajime Tamura, Yong Shik Kim, "Indoor air quality for chemical and ultrafine particle contaminants from printers", *Building and Environment*, 42, 2007
Antti J. Koivisto et al. in a recent study on ultrafine particle emissions from printing by simulating the indoor air conditions suggested that a print job increases ultrafine particle concentrations to a maximum of 2.6 x 10^5 cm^{-3}.	Antti J. Koivisto, Tareq Hussein , Raimo Niemelä, Timo Tuomi, Kaarle Hämeri, " Impact of particle emissions of new laser printers on modeled office room", *Atmospheric Environment,* 44, 2010
In the research of *Congron He et al* a positive correlation between the laser printer emissions of $PM_{2,5}$ and the temperature of the printer’s roller was confirmed. Based on the results of this study which was carried out on 30 laser printers almost all printers were shown to be high particle number emitters (e.g. over 1.01 x10^{10} particle/min) and ozone while colour printing generated more $PM_{2,5}$ than monochrome printing.	Congrong He, Lidia Morawska, Hao Wang, Rohan Jayaratne, Peter McGarry, Graham Richard Johnson, Thor Bostrom, Julien Gonthier, Stephane Authemayou, Godwin Ayoko, "Quantification of the relationship between fuser roller temperature and laser printer emissions" *Journal of Aerosol Science,* 41, 2010

4.3. Environmental performance of imaging equipment with respect to release of hazardous substances and post consumption lifecycle phase (reuse, recycling, end-of-life management)

Ecolabel Regulation 66/2010 stipulates that in the determination of the Ecolabel criteria the substitution of hazardous substances by safer substances shall be considered. This substitution can be as such or via the use of alternative materials or designs, wherever it is technically feasible and this together with the potential to reduce environmental impacts due to durability and reusability of products.

The relevance of these aspects for the product group of imaging equipment is evident, e.g. from the discussion on the similar product group-personal computers and laptops. Background information is available from researchers working on behalf of governments, manufacturers of imaging equipment, producers of ink and toners and independent experts in research institutes and universities.

Scientific evidence on the aspects of imaging equipment reuse, recycling, end-of-life management as well identification of hazardous substances is presented in the following Section. It needs to be taken into account that generalisations and an extrapolation of the findings is not always straightforward because of the case-specific validity of the assumptions made and the potential restrictions in quantifying the calculated environmental benefits. Nevertheless, this background information, which identifies the relevant actions regarding the environmental management of imaging equipment devices, is considered sufficient to support the ecological criteria development in line with the requirements of Ecolabel Regulation 66/2010.

4.3.1. Release of hazardous substances from imaging equipment

Discarded electrical and electronic products (often called e-waste), is recognised as one of the fastest growing waste streams. Based on estimations these items already constitute 8 % of municipal waste [13]. The imaging equipment product category together with its consumables is also subsumed in e-waste. The increasing volumes of e-waste, in combination with the complex composition of these items and the resulting difficulties in treating them properly, are causes of concern. The hazardousness of e-waste is well recognised and the knowledge on these hazards and the resulting risks associated with different treatment options is expanding.

In a recent study by Tsydenova, *et al*. [14] the chemical hazards associated with the treatment of electrical and electronic equipment waste including imaging equipment have been investigated. The reviewed studies collectively reveal that e-waste contains a number of hazardous substances. Heavy metals and halogenated compounds are of particular concern. Hazardous substances are often concentrated in certain e-waste components and/or parts. Thus, improper handling and management of e-waste during recycling as well as other end-of-life treatment options may pose potentially significant risks to both human health (e.g. in the working environment of recycling facilities) and the environment.

In the case recycling facilities, improper handling and management of e-waste pose potentially significant environmental risks. The current scientific evidence suggests that the major hazards during e-waste recycling are associated with the size reduction, the separation and the pyrometallurgical treatment steps [14]. Shredding causes the formation of dust originated from plastics, metals, ceramic, and silica (glass and silicon dust). Additive chemicals like BFRs used as flame retardants embedded in electrical and electronic equipment are also released during shredding. Pyrometallurgical treatment generates fumes of heavy metals (especially low melting point metals such as Hg, Pb, Cd, etc.). Besides, if the feedstock contained PVC or other plastic with flame retardants like BFRs (PBDEs, TBBPA, PBBs, HBCDs, etc.), pyrometallurgical treatment may lead to the formation of mixed halogenated dioxins and furans (PXDD/Fs, where X = Cl, Br).

The data on emissions of the chemicals of concern in the indoor air working environment at e-waste recycling facilities are currently limited, thus generalisations can not be made. Nevertheless, there is evidence that workers of electronic dismantling sites are exposed to higher levels of BFRs than the general population as a result of processing BFR treated plastics [14].

End-of-life treatment options for e-waste, i.e. incineration and landfilling are associated with potential risks. Examples are the formation of polyhalogenated dioxins and furans and the emissions of metal fumes during the incineration of e-waste while in leaching or gases of landfills, various hazardous substances, mainly heavy metal are detected.

Townsend, *et al.* [15] tested printers and found that lead concentrations in the leachates exceeded the rate of 5 mg/L in at least one case. The authors concluded that the results provided sufficient evidence that discarded electronic devices which contain printer wiring boards with lead-bearing solder have a potential to be hazardous wastes of lead. Moreover, Osako *et al.* [16] showed the presence of BFRs in leachate from landfills. Higher concentrations of BFRs (PBDEs and TBBPA) were detected in the landfills that had crushed e-waste. Besides the leaching of substances in landfills, there is also a risk of the vaporisation of hazardous substances. This can occur in the case of mercury in which both the leaching and vaporisation of metallic mercury and methylated mercury are of concern. Dimethyl mercury which is an organic form of mercury, has been detected in landfill gas at levels 1000 times higher than the background reference concentration measured in the open air [17].

Components and hazardous substances in e-waste can contain a large number of hazardous substances, including heavy metals (e.g. mercury, cadmium, lead), substances used as flame retardants (e.g. pentabromophenol, polybrominated diphenyl ethers (PBDEs), tetrabromobiphenol-A (TBBPA) etc.), etc.

There are certain common components and/or parts of electrical and electronic appliances that contain the majority of the hazardous substances found in the following components listed in Table 5. The list in Table 5 is non-exhaustive and presents the main hazardous components and substances commonly found in imaging equipment.

Table 5. Main hazardous components and substances commonly found in imaging equipment waste streams

Component	Substance of concern	Device and /or product part
Gas discharge lamps	Hg in phosphors	Backlights of LCDs
Printed circuit boards	Pb, Sb in solder Cd, Be in contacts Hg in switches BFRs in plastics	In several parts
Plastics	PVC, BFRs	Wire insulation, plastic housing, circuit boards
Batteries	Cd in Ni–Cd batteries, Pb and Hg	Batteries

Source: [14]

Stakeholders are welcome to provide additional information on this Section

4.3.2. Improved environmental performance of imaging equipment due to reuse, recycling and end-of-life management

One of the most successful resource efficiency strategies is to reuse a product as a whole or a part of it. In the overall category of reuse, remanufacturing is often included. Remanufactured products and product components, in principle, serve the same function and are of the same quality as new products.

By utilising recovered product parts after the consumption product life cycle phase, remanufacturing is able to reduce the environmental and economic costs of manufacturing and disposing of products and components. With remanufacturing, a much smaller fraction of the end-of-life resources goes to disposal and/or to material recycling. In addition, intelligent remanufacturing systems provide the opportunity for product upgrades. Therefore, apart from resource conservation, remanufacturing also has a positive effect on extending product life (durability of the product).

However, often it is the case that the level of reduction in resource intensity that could be achieved by efficient and intelligent remanufacturing systems is not quantified taking into account the product life cycle. Furthermore, remanufacturing also has additional system requirements that are not always taken into account. For example, additional packaging and transport are necessary to return products for remanufacturing. Energy, water and materials are also required during the remanufacturing process. Therefore it is essential to consider the entire product life cycle system when assessing and quantifying the environmental benefits of remanufacturing.

In a study of Xerox Corporation's remanufacturing system in the example of a photocopier, the overall life cycle environmental benefits of remanufacturing are investigated and analysed as presented by Wendy Kerr *et. al.* [18].In this case it is reported that remanufacturing can reduce resource consumption and waste generation over the life cycle of a photocopier by up to a factor of 3, with the greatest reductions if a product is designed for disassembly and remanufacturing.

In particular, in this study, four remanufactured and non-remanufactured Xerox photocopiers were compared throughout their life cycle. The investigation covered both a copier with a modular design for disassembly and remanufacturing (copier modules); and a copier model which was not explicitly designed for remanufacturing. The environmental impacts results are delivered on a life cycle inventory level (e.g. waste going to landfill, water consumption, energy consumption, etc.) without applying LCIA methods in which the inventory results are linked to environmental impact categories (e.g. human toxicity, eutrophication).

The results of the remanufacturing case study of Wendy Kerr *et. al.* [18] are summarised in Table 6 in which it can be seen that for the modular designed copier, the environmental savings range from 38 to 68 % among the different environmental impact aspects investigated whereas for the other photocopier model, savings are in the range of 19 to 35 %. The success of applying the modular remanufacturing strategy on imaging equipment by Xerox was the reason for its further development and wider scale implementation, which is reported in the 2009 Environmental, Health & Safety Report of Xerox (see also Section 4.6) [19].

Table 6. Environmental savings by the remanufacturing of copiers

Environmental impact aspect	Photocopier non-modular design		Photocopier modular design	
	Product life cycle with remanufacturing compared to product life cycle without remanufacturing		Product life cycle with remanufacturing compared to product life cycle without remanufacturing	
	Environmental savings %	Reduced by a factor of	Environmental savings %	Reduced by a factor of
Materials consumption (kg)	25	1.3	49	1.9
Energy consumption (MJ)	27	1.4	68	3.1
Water consumption (L)	19	1.2	38	1.6
Landfilled waste (kg)	35	1.5	47	1.9
CO_2 equivalents (kg)	23	1.3	65	2.9

Source: [18]

Stakeholders are welcome to provide additional information on this Section

4.4. Environmental performance of imaging equipment with respect to noise

Noise pollution is an environmental impact category which, similar to the case of indoor air pollution, can not be captured by a product environmental assessment based on an life cycle assessment. The sources of noise as well as the modelling of noise pollution when this is investigated for complex large product systems is currently not sufficient enough and therefore is considered non-operational in the context of LCA methodology.

Nevertheless, in the frame of developing ecological criteria for Ecolabel and GPP noise pollution is considered relevant for the product group of imaging equipment. In this case noise pollution is restricted to the noise produced during the operation of an imaging device. Acoustics of a product is recognised as an important parameter for both end-users and product designers and is related to sound and vibration. Quiet operation of imaging equipment should not be considered only as a single advantage of the product. Noise is often an underestimated threat that can cause a number of short and long term health problems.

In common use, the word noise means any unwanted sound [20]. Noise pollution can affect health, yet the effects are very difficult to quantify. Some of the potential adverse effects can be summarised as:

- Annoyance. It creates annoyance to the receptors due to sound level fluctuations.
- Physiological effects. The physiological features like breathing amplitude, blood pressure, heart-beat rate, pulse rate, blood cholesterol are effected.
- Loss of productivity. Noise has negative impacts on cognitive performance. For attention and memory, a 5 dB(A) reduction in average noise level results in approximately a 2 – 3 % improvement in performance.
- Nervous system. It causes pain, ringing in the ears, feeling of tiredness, thereby effecting the functioning of human system.
- Sleeplessness. It affects sleepiness by inducing people to become restless and lose concentration during their activities.

Annoyance is the most widespread problem caused by environmental noise. Annoyance reflects the way that noise affects daily activities. It has been estimated by the WHO that 20 % of the population is exposed to levels exceeding 65 dB(A) during the daytime which is a value close to the noise levels caused by operating printers and/or copiers. Some groups are more vulnerable to noise. Chronically ill and elderly people are more sensitive to disturbance. The noise exposure time is also a significant parameter which becomes even more important if we consider working environments with many imaging devices operating at the same time, e.g. copy/print centres as then the overall effective sound level is higher.

The effects of noise on humans indoors and in low levels similar to the ones produced by imaging devices are not easily quantifiable but are possible to be detected. In a study of Gary W. Evans, *et. al* [21]low-level noise in open-style offices was investigated. The findings indicate higher levels of stress and lower task motivation of the participants exposed to noise. However, the participants did not perceive their stress.

Noise levels for office environments recommended by the WHO or similar organisations are not available at present. However, the WHO guidelines for community noise recommend less than 30 A-weighted decibels (dB(A)) in bedrooms during the night for a sleep of good quality and less than 35 dB(A) in classrooms to allow good teaching and learning conditions. In addition, for night noise the WHO recommends less than 40 dB(A) of annual average outside of bedrooms to prevent adverse health effects from night noise. In the past several years, epidemiological evidence was accumulated supporting the hypothesis that persistent noise stress increases the risk of cardiovascular disorders including hypertension and ischaemic heart disease [22].

Although noise impacts are very difficult to quantify, in many Ecolabel schemes, one of the environmental impact categories addressed is noise. For instance in the EU Ecolabel criteria for the product group of personal computers one criterion refers to noise requirements during operation. Blue Angel and Nordic Swan Ecolabel criteria for imaging equipment also include noise as an environmental impact category area.

Moreover, imaging equipment manufacturers have focused on reducing unwanted noise, e.g. by introducing a feature that allows users to adjust the sound level of the printer. Some printers have the option of quiet mode in which the operating noise level of printers can be additionally lowered by three decibels. Other alternatives are to avoid beep sounds while typing hard-on buttons.

Stakeholders are welcome to provide additional information on this Section

4.5. Environmental thematic areas addressed in Ecolabel schemes and other relevant schemes

Based on the analysis of Task 1 regarding the Ecolabel schemes at the Member State level, the key actors are Blue Angel from Germany and Nordic Swan from the Nordic countries. These two schemes together with the Japanese Eco Mark are also considered among the most important ones globally. Moreover, it was found that in many other

Ecolabel schemes, criteria originating from these two schemes are used by cross-referencing. Ecolabel criteria of Blue Angel, Nordic Swan and Eco Mark are harmonised.

Furthermore as presented in Task 1 Section 11 another relevant activity undertaken in the US is the development of the IEEE 1680.2 [23]. This standard defines environmental performance standards for imaging equipment and is currently under development. Similar to the Ecolabel scheme this standard intends to provide a clear and consistent set of performance criteria for the design of imaging equipment, and to provide an opportunity to secure market recognition for efforts to reduce the environmental impact of these electronic products. The US Environmental Protection Agency (EPA) manages this activity. This label is based on self-declaration, but after the product enters into the market a third party verification system is foreseen.

In Table 7 the thematic areas addressed by the Blue Angel and Nordic Swan Ecolabel Schemes with the thematic areas addressed in the IEEE 1680.2 on imaging equipment are listed.

Table 7. Thematic areas addressed in the Ecolabel schemes of Member States and in relevant international standards

Blue Angel and Nordic Swan Ecolabel	US IEEE 1680.2 Standard
• Energy in use phase • Substance emissions o Electrophotographic devices o Inkjet devices o User information on substance o Products of identical design • Noise • General requirements o Recyclable design o Material requirements o Marking of plastics o Batteries o Printing paper o Double-sided printing and copying o Photoconductor drums o Guarantee of repairs o Maintenance of equipment o Product take-back o Packaging • Requirements for toners and inks as well as for modules and containers for toner and ink o Modules and containers for toner and ink o Material-related requirements for	• Energy conservation o Energy Star and others • Environmentally sensitive material o Compliance with RoHs and others • Material selection o Recycled content • Design for end-of-life o Easy for recycling • Product longevity/lifecycle extension o Warranties, spare parts • Packaging o Recyclable and recycled content • End-of-life management o Take-back and recycling • Corporate performance o EMS, environmental policy report

toners for use in electrophotographic devices and inks for use in inkjet devices	

A comparison of the two columns in Table 7 shows large overlaps. For example the common overall thematic area of energy conservation is addressed in both schemes. Checking the subcategories of IEEE 1680.2 standard we can find that almost all the areas are also included in the Member states' Ecolabels. One exception is the category of the corporative performance criteria which are not considered relevant for an Ecolabel ISO type II declaration. Acoustic performance as well indoor air emissions from imaging equipment are found to be considered relevant in the Ecolabel schemes, contrary to the current form of the IEEE 1680.2 criteria considerations.

4.6. Environmental thematic areas addressed by imaging equipment manufacturers

There are numerous producers of imaging equipment. An indicative list of important manufacturers and the country of origin as given in Task 2 is presented in Table 8; the list is non-exhaustive.

Table 8. Manufacturers of imaging equipment (non-exhaustive list)

Manufacturers of imaging equipment			
Brother JPN	Fuji Xerox USA/JPN	NEC JPN	Samsung Korea
cab GmbH Germany	Fujifilm JPN	Nikon JPN	Sanyo JPN
Canon JPN	Fujitsu JPN	NRG (Ricoh) UK (JPN)	Sharp JPN
Copystar USA	Hewlett-Packard USA	Océ NL	Tally Genicom USA
CPG International Italy	Hitachi JPN	Oki JPN	TA Triumph-Adler DE
Datamax USA	IBM USA	Olivetti Italy	Toshiba JPN
Dell USA	Konica Minolta JPN	Panasonic JPN	Toshiba TEC JPN
AMT Datasouth USA	Kyocera Mita JPN	Philips NL	Utax Germany
Eastman Kodak USA	Lanier Ricoh USA/JPN	Pitney Bowers USA	Xerox USA
Epson JPN	Lexmark USA	Printronix USA	
Olympus JP	Polaroid US	Ricoh JPN	

The European market is dominated by companies from the US as well from the Far East, mainly Japan. However, of special importance is that despite the numerous companies operating, the market is dominated by only a few manufacturers. In particular, as presented in Task 2, a market analysis report for Europe showed that in 2006 in the case of printers just five companies, namely Hewlett-Packard, Canon, Epson, Lexmark and Brother covered 86 % or the overall market.

Table 9 presents the environmental thematic areas related to the performance of imaging equipment as addressed by some manufacturers.

Table 9. Indicative thematic areas addressed in environmental reports of imaging equipment manufacturers

Manufacturer	Environmental thematic areas addressed	Efforts, innovation and achievements
Ricoh	New material design	Development of biomass resins Since 2002 began developing biomass plastic components as materials for copiers. In 2005 was used plastic with 50% biomass content in the main component of a multifunctional digital copier. In 2008 released a model which employs a newly developed plastic component with roughly 70% biomass content In 2009 released a model, equipped with a biomass toner (25% biomass content)
	Easy to recycle design	Material design easy-for-recycling Marking of plastics. Requirements of surface cover. Promotion of recycled copier business. Recycling information system
	Material design, reuse and recycling	Reduction in size/weight of products and a longer product lifecycle, enhancement of reuse and recyclability, promotion of closed loop material recycling, increasing production and sales of recycled copiers and the reduction of packaging materials. Increased quantity of reused parts, resources collected from used products and re-circulated. Commercialise biomass toners. Inner loop recycling. Recycling rate in 2009 for copiers 98 % and toner cartridges 99 % (data is not restricted to Europe)
	Energy efficiency	"Quick start up technology".The recovery time from the energy-saving mode is reduced to less than 10 seconds For monochrome multifunctional copiers,
	Paper consumption	PO BOX printing
	Reduce the use of environmentally sensitive substances	Achieved Blue Angel Ecolabel indoor air emissions criterion requirements for 17 copiers released in 2009
Canon	New material design	Use of biomass plastics with high flame retardance level
	Material design, reuse and recycling	Introduction of returnable packaging material Closed-loop packaging recycling. Packaging is collected and reused after unpacking. Use recycled plastics for internal parts.
	Energy efficiency	Canon on demand fixing technology
	Reduced package size	Example inkjet printers packaging 11 %reduced
	Promotion of toner cartridge collection and recycling	
Lexmark	Energy efficiency	Use of "Instant Warm-Up Fusing" technology into the color laser products. New products use 28 to 50 % less energy Eco-Mode, optimizes energy efficiency Energy efficient galvo printhead.
	Paper consumption	
	Toner cartridge efficient use	High-yield and extra high-yield cartridges

	Product recyclability and chemicals in product components	Complies with international legislation that restricts the use of substances such as lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls (PBB) and polybrominated diphenyl ether (PBDE) flame retardants as outlined (RoHS). Since 2006 all Lexmark products, including the ink and toner cartridges (which are not included in the scope of the RoHS), have been fully compliant with the RoHS directive. Efforts to substitute 98 % of PVC packaging of inkjet cartridges To date, Lexmark has safely eliminated the use of brominated flame retardants in the covers and chassis of our laser and inkjet printers A minimal concentration of solvents is used in inks. Methyl alcohol or ethylene glycol are not used in inks.
	Product acoustics	All of Lexmark's laser printing products meet the noise requirement in the Blue Angel Ecolabel specification. All laser products announced in the fall of 2008 were designed with a Quiet Mode feature that allows users to adjust the sound level of their printer to meet their personal preferences
	Product packaging	
	End of life	Product durability and upgradeability Product take-back and collection strategies. Cartridge collection program and reuse and material recovery
brother	Energy efficiency	Improve energy conservation during use
	Reuse and Recycle	Collection and recycling Easy to recycle at the end of life
	Packaging and distribution	Reducing product packaging and waste. Reducing CO_2 emissions in distribution and transport
	Hazardous materials	Products do not contain hazardous materials as defined under the European RoHS directive and in accordance to the Brother Group hazardous chemical listing in the Green Procurement Standard. Products are made via eco-friendly processes.
	End of life management	Areas of focus: size and weight, parts reuse/recyclability, disassembly/dismantling, avoidance of difficult-to-disassemble structures, integration of resin materials, packaging materials' size, weight and recyclability. Material labelling
epson	Commitment to Recycling	Benefits of reusing the main unit. Inclusion of all products in the resource reuse and recycling loop
	Energy-saving design	The power consumed during use accounts for a large portion of a product's total environmental impact across its life cycle. With this in mind, we set energy-saving performance goals for each product and work to ensure steady progress
	Resource saving	Environmental goals are set for: recyclable rates (the ratio of total product weight calculated as recyclable based on a product's design

		drawings), reducing the cost of disassembly and sorting and finding ways to reduce impacts by making products smaller and lighter.
	Elimination of harmful substances	Epson standards specify substances that are prohibited from inclusion in products and substances whose inclusion must be controlled. Information on these substances is gathered in a database to help ensure safety in all processes, from design and procurement to mass production. REACH Compliance.
	Reducing transport CO_2 emissions	Green Purchasing of Production Materials
	Product design	The PX-W8000 large-format printer uses nearly odourless water-based ink, meaning it can be used in any office without a special ventilation system and is compliant with the Energy Star programme
		The TM-T88V thermal receipt printer consumes approximately 15% less total power per year*1 than the TM-T88IV (2006) Paper-saving features*2 reduce paper use by up to 30%
	Paper consumption	Save paper by not printing Scans images directly to a memory card and transfers them to a PC. Creates a double-sided print from two source sheets. Prints up to four pages on a single sheet with double-sided, and multi-page printing Reduces paper waste. Fits web pages to the width of the paper. Save energy. Prints directly from a memory card, no PC required
	Collection and Recycling	Epson's applies a toner and ink cartridge collection system, and "used ink cartridge pick-up"
Xerox	Energy efficiency	80% of eligible new products launched met the 2007 Energy Star (version 1.0) standard.
	Reducing hazardous materials	Worldwide hazardous waste volumes were decreased 10 % from 2007 and 96 % was beneficially managed. Reduced the use of PBTs in Xerox supply chain through adherence to Xerox's chemical use standards for all suppliers and Electronic Industry Citizenship Coalition's. Code of Conduct requirements for xerox's 50 key global suppliers, representing 90% of cost, by 2012. In 2009, developing systems and processes to provide a complete accounting of materials throughout the value chain that will support progress toward zero PBT
	Ink/toner cartridge design	Investing in "cartridge-free" solid ink technology that produces up to 90 % less waste from supplies and packaging than conventional office color printers
	Reuse and recycling	Maintaining over 90 % reuse or recycling of recovered Xerox equipment and supplies offerings. Xerox achieved >90% reuse or recycle rate for 106 million pounds of postconsumer equipment

		and supplies waste, bringing the total landfill avoidance to 2.2 billion pounds since 1991

Note. The list is indicative and not exhaustive
Source: [24], [25], [26], [27], [19]

Comparing the findings in Table 9 between manufacturers we can conclude that all of them pay special attention to:

- Energy efficiency,
- Prevention and/or restriction of hazardous substances,
- Develop recycling and reuse of materials and components, end of life management,
- Ink and/or toner design and packaging.

In the majority of the cases the thematic areas of noise and paper consumption are also addressed.

5. Conclusions on key environmental thematic areas for imaging equipment

Based on the outcomes of the previous findings, we can identify from the LCA based studies that key environmental areas are:

- Paper consumption
- Energy efficiency during operation
- Ink and toner consumables

Furthermore, based on product oriented environmental investigations we can identify the following key environmental thematic areas:

- Indoor air emissions
- Noise emissions during operation

Moreover, we can identify that regarding the product design developments in all the Ecolabel criteria for imaging equipment, in similar schemes (e.g. EPEAT program in US) and in the environmental management programs undertaken by the imaging equipment manufactures additional key environmental areas are:

- Substitution of hazardous substances and materials
- Promotion of reuse, recycling and sound end of life management

Therefore, the proposed key environmental thematic areas for which the development of the Ecolabel and GPP criteria shall focus on are:

1. Energy efficiency during operation
2. Paper consumption
3. Indoor air emissions
4. Noise emissions during operation
5. Design of product: Preventing the use of hazardous substances and materials
6. Design of product: Promotion of reuse, recycling and sound end-of-life management
7. Ink and toner consumables.

6. Development and preliminary proposal of Ecological criteria for Ecolabel and GPP

After identifying the key thematic areas in Section 5, in this Section 6 a first list of draft criteria is proposed. Each criterion is linked to a key environmental thematic area. The rationale underlying the criteria is also presented. Different options for each criterion are identified. Moreover, the key parameters affecting the final impact of each criterion are identified. However, corporative criteria as well as criteria associated with requirements on information for the end user are in this phase partly presented. This criteria proposal is to a great extend build on the knowledge and evidence gained on Member State Ecolabel schemes and in particular on the Blue Angel. However, adaptations to and harmonization with other Member State labels should not be excluded. A few criteria are proposed for the first time for discussion.

At this stage, the proposed criteria are not formulated and no limit values are introduced. However, the criteria options which are references from the available Ecolabel or energy label criteria are presented as originally given in the respective documents (e.g. Blue Angel Ecolabel criteria version May 2009, Energy Star version 1.1.) together with the available reference benchmarks. It is important to emphasise that these benchmarks are indicative and should serve for orientation. The potential for setting more ambitious limits in terms of environmental performance will be explored during the progress of the project. As mentioned before, the Blue Angel and Nordic Swan Ecolabel criteria on imaging equipment are harmonized and in many cases the criteria are identical or with minor differences.

6.1. Criterion on energy efficiency

Based on the findings of Ecodesign preparatory study as given in Section 4.1 in the majority of the environmental impact categories the use phase is the product life cycle phase with the highest contribution. In the use phase, the overall environmental performance of the imaging equipment devices is associated with the paper and with the energy consumption. The energy efficiency of the product is a feature associated with the product design and significant environmental impacts can be avoided if more energy efficient devices are used.

With regard to the findings of the preparatory Ecodesign study in the example of an MFD-printer the contribution of electricity during the printer life time to the overall energy consumption is after paper the most significant parameter as it reaches up to 81 % (it is approximately 17 000 MJ out of total 20 800 MJ without counting the energy consumption associated to paper use).

The energy efficiency is addressed in all the available Ecolabel criteria on the product group of imaging equipment as well in the EU GPP criteria. Among the several Ecolabel schemes the most common criterion of energy efficiency is compliance to the requirements set by the Energy Star label. An alternative to the Energy Star is the energy efficiency criterion developed by Blue Angel.

Option 1. Compliance to Energy Star criteria version 1.1.

Relevant parameters on this criterion are:

- Determination of imaging equipment classification for which the TEC, OM, DFE requirements are defined.
- TEC, OM (e.g. maximum default delay times to sleep mode, maximum standby mode consumption and functional adders' limit values determination per imaging equipment device) and DFE requirements.

Option 2. Energy efficiency criterion of Blue Angel Ecolabel on imaging equipment

The Blue Angel sets requirements on the following:

- Limit for the power consumption P_i of the device for the time after the end of the printing and/or copying process (e.g. based on the three level limit curve are defined limits per level P_1, P_2 and P_3).
- Limits on return times (t_{iR}) between energy saving mode to ready mode (as defined in the method t_{1A}, t_{2A} and t_{3A})
- Limits on activation times t_{aA}, t_{bA} which is defined as the time between the end of the printing process and the start of the device's sleep mode.

Option 3. New Energy Star efficiency requirements (update not finalised yet)

The energy efficiency requirements of the available Energy Star criteria are from version 1.1. The revision of these Energy Star requirements is ongoing. If the new Energy efficiency requirements are released in time then these could be proposed for specifying the energy efficiency performance level for the energy efficiency criterion within the Ecolabel. The ambitious level of a newly released version of energy Star label is expected to aim at a high level of ambition regarding energy efficiency.

Option 4. Development of energy efficiency requirements based on current Energy Star version 1.1.

Another alternative option in setting the energy efficiency requirements is to develop a new methodology explicitly for the purpose of the Ecolabel. Such a method can use parts of the current Energy Star, version 1.1 and/or the Blue Angel methodology and can also be based on the analysis of available data to conclude on the energy efficiency benchmarks.

Relevant parameters on the energy efficiency criterion option are:

- The classification of the imaging equipment for the TEC, OM and OM of devices' adder values
- Determination of TEC and OM values, maximum default delay times

- Power consumption (P_i) of the device after the end of the printing and/or copying process
- the return time (t_{iR}) between energy saving mode to ready mode
- the activation times t_{aA}, t_{bA} which are defined as the time between the end of the printing process and the start of the device's sleep mode.

6.2. Criterion on paper consumption

Based on the information presented in Section 4.1 and as analysed in the introduction of Section 6.1 the highest environmental impact along the life cycle of an imaging device is associated with the consumption of paper. Therefore, determinations of the Ecolabel criteria which are associated with the reduction of paper consumption are of major importance. In this context it has to be seen that the consumption of paper is a parameter which depends more on user behaviour and less on the design of a printer or a copier. Nevertheless, imaging equipment design could also influence user behaviour (i.e. automated double-sided printing and copying, etc.) and presented criteria mainly refer to this aspect. Raising the user awareness towards a more efficient use of paper, including double-sided printing, is an issue that can be addressed in the criterion targeted at consumer information.

6.2.1. Double sided paper printing and/or copying performance

One efficient way to reduce the consumption of paper is to print and/or copy on both sides of a paper sheet. A criterion on this aspect is defined and used in all of the Ecolabel criteria found on imaging equipment (as presented in Task 1, Section 6.2) as well as in the current version of green public procurement criteria [4] and in the Energy Star criteria. The relevant double sided printing and/or copying criterion of GPP toolkit, the respective criterion of Blue Angel and the one of Energy Star are can be used as basis for the respective EU Ecolabel.

Option 1. GPP criterion on duplex printing

Option 2. Blue Angel double sided printing and copying

Option 3. Energy Star duplexing requirement

The previous presented GPP and Ecolabel criteria options do not differ much. Both options set requirements for automatic duplex unit to the imaging equipment with high operating speed (in particular over 45 ipm). The devices with lower image creation speed should have either a manual or a software based option for double sided printing and/or copying. In both schemes there is no differentiation made among the imaging equipment based on colour or monochrome printing functionality. In the Blue Angel for the case of EP copiers performing in speeds of 21-44 ipm the feasibility to be equipped with a duplex unit and the provision of relevant user information is additionally requested.

The Energy Star criterion on duplexing is similar to the Ecolabel and GPP criteria. However, in Energy Star the imaging equipment devices based on colour or monochrome printing or copying are differentiated. Color copiers, MFDs, and printers have more strict requirements as in this case devices with speed equal or over to 40 ipm (instead of 45 ipm which is for monochrome functioning devices) have to comply with a standard feature of automatic duplexing at the time of purchase. Similarly differences are found for the imaging devices with mid-speed capability as in the one case i.e. for colour printers is referred to ranges of 20 – 39 ipm while for monochrome printers is referred to ranges of 25 – 44 ipm.

A relevant parameter on this criterion is determination of imaging equipment categories for which the automatic duplex unit is required.

6.2.2. Criterion on the capability of using recycled paper

Paper recycling contributes to the reduction of resources and is therefore promoted in many Ecolabel schemes (e.g. Blue Angel). Imaging equipment products are the main products in which office paper is used. Therefore, in this context it is considered relevant to set requirements regarding the capability of imaging devices to use recycled paper. Such a criterion is available in the Blue Angel scheme.

Option 1. Blue Angel printing paper criterion

6.2.3. Criterion on immediate cancelation of image creation (e.g. printing and/or copying)

Paper consumption is one of the most significant parameters with respect to the environmental performance of an imaging device along its lifecycle. Therefore, the identification of more ways to prevent and/or reduce paper consumption is of key importance.

Often imaging equipment users start a printing and/or copying process which later needs to be canceled. If the process cancelation takes place very fast then considerable paper amounts can be saved. In addition, an early imaging creation cancelation leads to the avoidance of energy and ink or toner consumption.

Furthermore, fast reaction of the imaging device is considered a significant user-friendly feature. The user benefits when a wrong print or copy process is stopped on time as potentially large amount of wasted paper, energy and ink or toner volume is saved. User friendliness is considered as a competitive market attribute of a product, important for both consumers and manufacturers.
This criterion proposal is not found in the current Ecolabel criteria of Member States.

Possible relevant parameters which will be taken into account while setting a criterion on printing and/or copying cancelation are the following:

- total consumption of paper after the user activated the cancelation
- reaction time between activation of print/copy cancelation and of final stop of the process
- image creation speed (ipm)
- cancelation of a print and/or copy job when additional print/copy jobs are pending
- cancelation when the image device is operating in a network
- cancelation using a hard on-button or via software
- differentiation between black/white and colour prints and/or copies
- differentiation between double sided printing and/or copying

Possible benchmarks for imaging equipment performance in terms of image creation cancelation are proposed to be measured in number of page(s) printed/copied after the cancelation has been activated. The rationale for this relies on the fact that the highest impact in the life cycle of an imaging equipment device is associated with paper consumption. Furthermore, testing the compliance of an image device regarding for this aspect is considered simple, straightforward and low cost.

Stakeholders are asked to provide supportive information on this criterion option

6.3. Indoor air emissions

As analysed in Section 4.2 imaging equipment devices are sources of indoor air pollutants. Imaging equipment has been found to be a source of ozone, particulate matter, benzene, styrene, volatile organic compounds (VOCs) and semivolatile organic compounds (SVOCs) (under the terms VOCs and SVOCs are covered numerous substances). All these substances are harmful and raise risks for the human health.

According to this background information the amount of the emitted substances is time dependent. Heating and printing processes intensify the release (emission) of such substances.

Restrictions on the indoor air emissions from imaging equipment are addressed in many Ecolabel schemes worldwide applying a precautionary principle rather then quantifying the impacts of human exposure. The actual overall decrease of the indoor air quality is also dependent on the user behaviour (e.g. number of prints and copies) and obviously from the room conditions. The Blue Angel's criterion on indoor substance emissions from imaging equipment is the most widely applied and is used from other schemes like the Nordic Swan.

Option 1. Blue Angel criterion on substances emissions

In the Blue Angel criterion the following substances and substance groups are taken into account:

- total volatile organic compounds TVOC
- benzene
- styrene
- ozone
- dust

The volatile organic compounds are determined as summary parameters TVOC (total volatile organic compounds) contrary to benzene, styrene, ozone and dust which are determined as single emission compounds or parameters. Determination of emission rates is made in ready mode of the equipment as well as during continuous printing.

Extension of the list of investigated pollutants can be expected by including measurements on ultrafine particulate matter emissions. A potential inclusion of this aspect in the revised Ecolabel criteria of Blue Angel on imaging equipment can be expected. A test standard for measuring ultrafine particle was released in 2010 by ECMA [28].

6.4. Noise emissions during operation

For the imaging equipment product group noise pollution has been identified as one of the key environmental areas relevant for Ecolabel and GPP criteria. In this case, noise pollution is restricted to the noise during the operation of an imaging device. The acoustics of a product is recognised as an important parameter for both end-users and product designers and is related to sound and vibration. Quiet operation of an imaging equipment device should not be considered a single advantage of a product. Noise is an underestimated threat that can cause a number of short and long term health problems and in a working environment, evidence has been found that it reduces productivity (see also Section 4.4).

As presented in Section 4.4, the evidence of noise impacts is very difficult to quantify. Therefore, the restrictions on noise pollution rely on the proactive principle and aim to identify and addresses the top 10-20 % products in terms of performance.

In many Ecolabel schemes one of the environmental impact categories addressed is noise. For instance in the EU Ecolabel criteria for the product group of personal computers one criterion refers to noise requirements during operation. However, in general the overall noise pollution of computers compared with that of imaging devices is much lower.

The proposed options for a criterion on noise are given below.

Option 1: Noise emissions restriction based on the Blue Angel criterion

Option 2: Noise emissions restriction based on Nordic Swan criterion

In both Ecolabel schemes, Blue Angel and Nordic Swan the declared A-weighted sound-power level L_{WAd} is measured on the basis of EN ISO 7779:2001.

The methodology applied in the Blue Angel and the Nordic Swan criterion on noise is the same. However, the Blue Angel criteria are more comprehensive compared to the criterion proposed by Nordic Swan. The measurements are on dB(A) levels.

6.5. Design of materials: Preventing the use of hazardous substances and materials

Ecolabel Regulation 66/2010 stipulates that in the determination of the Ecolabel criteria the substitution of hazardous substances by safer substances shall be considered. This substitution can be as such or via the use of alternative materials or designs, wherever it is technically feasible and this together with the potential to reduce environmental impacts due to durability and reusability of products.

The content of hazardous substances is addressed in Member State labeling schemes such as Blue Angel or the Nordic Swan but also in non-EU schemes. Slightly different approaches are applied. The point of departure for the development of Ecolabel and GPP criteria for imaging equipment will be the provisions as stipulated in Ecolabel Regulation 66/2010 in article 6.6 and 6.7 [1].

These will be adapted to the product group aiming at the highest degree of harmonization with relevant Member States schemes. Additionally, the relevant criteria development as applied in similar product groups under the European Ecolabel schemes, e.g. personal computers, will be considered as an option to build on for the product group of imaging equipment.

Option 1. Develop a criterion on the basis of Ecolabel Regulation 66/2010, article 6.6 and 6.7. Build on experience gained in similar product groups under EU Ecolabel

For specific parts and components of imaging equipment, the approach as described in option 1 will be applied as well. However, specific criteria from established Member States schemes will be taken into account. These criteria include the following:

6.5.1. Hazardous substances used in plastics of casings and casing parts

Option 1 Blue Angel criterion on material requirements for plastics of casings, casing parts

6.5.2. Hazardous substances in plastics used in printed circuit boards

Option 1. Blue Angel material requirements for the plastics used in printed circuit boards

6.5.3. Batteries content restriction and free take back

Option 1. Batteries content restriction based on Blue Angel Ecolabel

6.5.4. Chemicals used during production

Option 1. Nordic Swan criterion on chemical used during production

6.5.5. Restriction of hazardous materials in photoconductor drums

Option 1. Blue Angel restriction of hazardous materials in photoconductor drums

6.6. Design of materials: Promotion of reuse, recycling and sound end of life management

Ecolabel Regulation 66/2010 stipulates that in the determination of the Ecolabel criteria the potential to reduce environmental impacts due to durability and reusability of products shall be considered. Environmental benefits can be achieved with reuse and remanufacturing as significant amount of wastes is reduced and resources can be conserved (as laid out in Section 4.3.2). Thus, the promotion of this environmental strategy is important. In line with article 6.3 of Ecolabel Regulation 66/2010 [1] and based on the reference of Blue Angel Ecolabel criteria the following options are presented.

Option 1. Blue Angel criterion on recyclable design

6.6.1. Marking of plastics

Option 1. Blue Angel criterion marking of plastics

6.6.2. Guarantee of repairs and maintenance of equipment

Option 1. Guarantee of repairs and maintenance of equipment based on Blue Angel

6.6.3. Product take back requirement

Option 1. Blue Angel product take-back criterion

6.6.4. Packaging requirements

Option 1. Blue Angel requirements on packaging material

6.7. Criteria related to ink and toner consumables

The consumption of ink and toner cartridges has a significant contribution to the overall environmental impact of imaging equipment devices along their life cycle as presented in the findings of Section 4.1. In this respect in the current Ecolabels of the Member States (e.g. Blue Angel and Nordic Swan) as well as in the Ecolabels worldwide (see also Task 1 Section 6) the substitution of hazardous substances and the promotion of reuse and recycling of ink and toner cartridges is one of the areas of focus.

The presence of hazardous substances in ink and toner modules increases significantly the overall environmental impact of the imaging equipment product life cycle. Their substitution with environmental safer substances should be promoted in line with the EU Ecolabel Regulation 66/2010 requirements (see also Section 3).

Reuse and material recycling strategies on ink and toner cartridges has been applied for many years in order to contribute to resource conservation and to waste reduction. In the framework requirements set by the EU Ecolabel Regulation 66/2010 one of the issues addressed is the potential to reduce environmental impacts due to durability and reusability of products.

With regards to the treatment of hazardous substances in ink and toner consumables a similar approach as in criterion proposal "6.5. Design of materials: Preventing the use of hazardous substances and materials" is chosen.

6.7.1. Restriction on hazardous substances and materials found in a) toner and/or ink and b) toner and/or ink cartridges

Option 1. Develop a criterion on the basis of Ecolabel Regulation 66/2010, article 6.6 and 6.7. Build on experience gained in similar product groups under EU Ecolabel

Option 2. Blue Angel criterion on hazardous substances found in toner and ink cartridges

6.7.2. Promote design for recycling and/or reuse

Option 1. Blue Angel criterion on recyclable design and reuse of toner and ink cartridges

Products must accept remanufactured toner and/ ink cartridges.

6.7.3. End of life management related to take back requirements

Option 1. Blue Angel criterion on toner and ink cartridges take-back requirements

6.7.4. Requirements for products with combined toner cartridges

Option 1. Nordic Swan criterion for products with combined toner cartridges.

6.7.5. Other criteria proposal related to the toner and ink consumables

The use of consumables for imaging equipment, like toner cartridges and toner containers differs among the imaging equipment devices. Large differences even between comparable models can be found which provide the same function e.g. in one printer 4 toners are used whereas in another printer with the same performance 17 toner cartridges and 3 drum units are used.

The use of high number of different consumables is associated with higher environmental impacts for the transportation, increases the produced waste and can hamper reuse and recycling.

Stakeholders are asked to comment if they consider it useful to develop a criterion on this area

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