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

JRC IPTS Draft Preliminary Study

Draft Task 1. Product Definition and Scope

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Executive Summary

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 Green Public Procurement (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 consist of typical information technology (IT) products found in an office environment and has been identified as a product group for criteria development. Ecolabels for imaging equipment exist at Member State level. At 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 outcomes of this project. In addition, imaging equipment has been analysed under the framework of the EU Ecodesign Directive as well in the Energy Star label. In the case of Ecodesign, a decision for adopting implementing measures is currently pending in the Commission. It is intended to harmonise the development of Ecolabel and GPP criteria as far as possible.

The implementation of the EU Ecolabel Regulation for imaging equipment, which refers to the 10 – 20 % best environmental performing products, is expected to result in a significant potential for environmental savings, with presumably limited costs and efforts. Up to 87 % of total images reproduction (e.g. prints, copies) are made in a professional environment which gives special importance to the development of GPP criteria as public authorities purchase high numbers of imaging devices. Ecolabel and GPP criteria shall take into consideration the net balance between the environmental benefits and burdens. They shall be based on the most significant environmental impacts which are expressed as far as possible via technical key environmental performance indicators.

In Task 1 the report aims to: define the product group, determine the scope of the study and provide all the relevant background information for gaining a general overview of the product group.

The outcomes of Task 1 could be summarised as follows:

1. Product definition. The product group of imaging equipment is defined by adopting the terms and definition used in Energy Star label which matches the one used in the current EU Green Public Procurement criteria as well as the respective one used in the EU Ecodesign Preparatory Study. This definition is also used worldwide by numerous Ecolabel schemes. Imaging equipment involves the products marketed as office printers, copiers, multifunctional devices, scanners, digital duplicators, fax and mailing machines.
2. Scope of the study. The scope of the study is not strictly determined yet. The final determination of the scope of the study and the products investigated will be made in agreement with DG ENV and the EU Ecolabel Board and possibly at a later stage when market information (from Task 2) and stakeholder input becomes available.

   It can be assumed that printers, copiers and multifunctional devices are definitely within the scope of EU Ecolabel criteria and GPP criteria. For other imaging equipment products the inclusion in the scope needs further discussion.

On the one hand, in the case of scanners and fax machines it is considered that their use and sales as single functioning devices will drop in the future as there is a strong trend towards multifunctional devices. On the other hand, digital duplicators and mailing machines are products which producers showed little interest in for Ecolabelling and with much lower sales compared with the rest of the imaging equipment.

Moreover, a broader scope with a possible inclusion of imaging equipment consumables, ink and toner cartridges might be under consideration. Despite the fact that these consumables are separately marketed, thus are a standalone product group, in the overall environmental performance of imaging equipment when investigated from a life cycle point of view the use of ink and toner cartridges becomes relevant. In addition in case of GPP criteria the consumables have an important role in the operational costs.

3. General relevant background knowledge. We could summarise the findings as follows:

   3.1. Imaging equipment technical aspects. The product group can be classified in several subgroups based on the used marking technologies, functionality and performance characteristics.

   3.2. General indications on key environmental aspects. Paper consumption, energy consumption, use of hazardous substances, indoor air emissions, noise pollution, product reuse and recyclability are indicatively the key environmental aspects of the environmental performance of imaging equipment.

   3.3. Ecolabels and GPP criteria. The key Ecolabel schemes are Blue Angel from Germany and Nordic Swan from the Nordic countries. These schemes are also worldwide key actors. Based on these Member State Ecolabels the EU Ecolabel Regulation 66/2010 could be applied in a shortened procedure as described in Annex I.B. of the legislation. The two Ecolabel schemes are harmonised to each other. Revision of the criteria is ongoing. The main difference is found in the criteria regarding the evaluation of the energy efficiency. In Blue Angel an in-house developed methodology is applied whereas Nordic Swan references conformity either to Blue Angel or to Energy Star. Another difference is found in the product coverage. Nordic Swan has a broader product group definition including fax machines, scanners and digital duplicators. The current EU Green Public Procurement criteria are described in the EU IT toolkit. The environmental aspects covered are identical to the ones of the aforementioned Ecolabels. The GPP criteria are classified into core and comprehensive categories. The latter criteria are more ambitious. Blue Angel or Nordic Swan Ecolabelled devices are compliant with the comprehensive GPP criteria. The core GPP criteria mainly focus on energy efficiency and duplex printing.

   3.4. Energy efficiency label. Energy Star is the most widely accepted energy label and is also the energy label for imaging equipment in the European Union. More than 1330 imaging devices are currently Energy Star labelled. The latest criteria version is under revision. Energy Star covers all of the different types of imaging equipment thus including scanners, digital duplicators and mailing machines. The product group is divided into different classes according to functionality, performance and technological characteristics. The criteria are then specified per subgroup.

   3.5. EU Ecodesign. The imaging equipment product group is investigated under the EU Ecodesign Directive 2005/32/EC for energy using products. A preparatory study was finalised and a decision on applying Ecodesign implementing measures or accepting the proposed industry voluntary agreement is pending in the Commission. If implementing measures are adopted then the products showing the worst environmental performance will

be restricted from the European market. In the Ecodesign preparatory study valuable information on several aspects is presented: product segments, economic analysis, user behaviour patterns, environmental performance of typical products and best available technologies. Another two Ecodesign studies include one regarding standby losses which has been finalised and implementing measures have been developed; and a second one which is ongoing regarding network standby losses included in its product scope imaging equipment. Thus relevant information on energy efficiency and standby losses of imaging equipment is available there.

3.6. Relevant EU legislation and standards. The most relevant EU legislation applicable to imaging equipment or components of it is the WEEE Directive 2002/96/EC regarding the disposal of the product, the REACH Regulation (EU) 452/2010 and the RoHS Directive 2002/95/EC regarding the use and risk of chemicals, Directive 2006/66/EC regarding batteries and Directive 94/62/EC regarding packaging. In addition there are also several standards for testing and measuring of several technical parameters which are directly or indirectly linked to the product environmental performance of imaging equipment.

The EU Ecolabel criteria developed herein and the criteria regarding EU GPP shall be in line with the aforementioned legislation and will use the international standards appropriate for tests and criteria verification.

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Abbreviations	
CN8	EUROSTAT Combined Nomenclature Codes (CN8) statistics database
DFE	Digital front end
EEE	Electric and electronic equipment
EP	Electro photography
EU	European Union
GPP	Green public procurement
IJ	Inkjet
ILO	International labour organization
ipm	Images per minute
IT	Information technology
LCA	Life cycle assessment
LCD	Liquid crystals diode
LED	Light emitted diode
MEEUP	Methodology for the Ecodesign of Energy-using Products
MFD	Multifunctional device
NACE	NACE is a statistical classification of economic activities in the European Community used by EUROSTAT (Nomenclature statistique des activités économiques dans la Communauté européenne).
OM	Operational mode
PAH	Polycyclic aromatic hydrocarbons
PBB	Polybrominated biphenyls
PBDE	Polybrominated diphenyl ethers
PM	Particulate matter
POP	Persistent organic compounds
PRODCOM	EUROSTAT production and manufacture statistics database
REACH	Registration Evaluation Authorisation and Restriction of Chemicals (Commission Regulation (EU) No 453/2010)
RoHS	Restriction of the use of certain hazardous substances in electrical and electronic equipment (Directive 2002/95/EC)
TEC	Typical electricity consumption
VOC	Volatile organic compounds
WEEE	Waste electrical and electronic equipment (Directive 2002/96/EC)

1. Introduction

Imaging equipment (printers, copiers, scanners, fax machines, etc.) are 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 number of the EU stock of imaging equipment is assessed to be up to 145 million products [1]. The vast development in the IT sector also affects the imaging equipment market. Therefore product lifetime of imaging equipment is considered rather low with an average of 4 – 7 years. Additional functions, higher efficiency and miniaturisation are some of the main trends in this sector.

Moreover, this product group was investigated early and covered by several product policy instruments. The EU Green Public Procurement criteria which would be revised based on the findings of this study included imaging equipment as part of the European IT toolkit [2ref]. The EU Energy label which is in this case in close cooperation with the US Energy Star label also covers imaging equipment [3]. Furthermore, under the framework of the EU Ecodesign Directive 2005/32/EC, an Ecodesign Preparatory study was carried out [1]. The decision for adopting implementing measures is currently pending in the Commission. In addition, at the national level both in Europe and in third countries, there are several Ecolabel schemes for imaging equipment. Notably in Europe are the Ecolabel schemes: Blue Angel from Germany and Nordic Swan from the Nordic countries.

The implementation of the EU Ecolabel EC Regulation 66/2010 [4] for imaging equipment, which refers to the 10 – 20 % best environmental performing products, is expected to result in a significant potential for environmental savings, with presumably limited costs and efforts. In the study of IPTS on the Environmental Impact of Products - Analysis of the life cycle environmental impacts related to the final consumption of the EU-25 (EIPRO project) [5], imaging equipment were ranked within the top 80 product category clusters. It should be emphasised that up to 87 % of total images reproduction (e.g. prints, copies) are made in a professional environment [1] which gives special importance to the development of GPP criteria as public authorities purchase high numbers of imaging devices.

The Ecolabel and Green Public Procurement criteria developed herein take into consideration the net environmental balance between the environmental benefits and burdens and is based on the most significant environmental impacts which are expressed as far as possible via technical key environmental performance indicators.

2. Objective

There are two main objectives of this report. The first one is the application of the Ecolabel regulation on the imaging equipment product group regarding EC Regulation 66/2010, [4] for establishing Ecolabel criteria. The analysis is compliant with EN ISO 14024 Type I [6] existing Ecolabel criteria for the product group of office imaging equipment with a special focus on the Ecolabel criteria of Member States. Moreover, the objective of this report is to establish Green Public Procurement criteria for the imaging equipment product group in line with the European Parliament Communication COM (2008) 400 on 'Public procurement for a better environment' [7] and Regulation (EC) 106/2008 on 'a Community energy-efficiency labelling programme for office equipment' [8].

The Ecolabel regulation should be applied in a way which ensures harmonisation with other European product policy instruments, i.e. with Ecodesign and Green Public Procurement criteria, and should be in line with other relevant environmental legislation for the product group, i.e. WEEE, RoHS, Battery Directive.

3. Product group definition

3.1 The term 'imaging equipment' in European Commission

The term 'imaging equipment' is already in use within the European Commission. DG TREN in the call for tender in the Preparatory Study for Ecodesign Requirements of EuP [9] used this term for defining a product category which consists of printers, copiers, scanners, fax machines and multifunctional devices (MFD).

This specification as analysed in the final report of the Ecodesign preparatory study is *not sufficient to set clear boundaries based on technical or performance criteria for products that fall under the scope of this category* (see p.4 in [1]). Thus, a thorough analysis on the specification of a suitable definition of imaging equipment was carried out. The final conclusion of that report was to propose a definition of the imaging equipment product group by restricting it to the application of products used in an office environment (see p.12 in [1]).

This restriction matches the definition used in the background product report of DG ENV Green Public Procurement (GPP) Training toolkit – Module 3: Purchasing Recommendations for Office IT Equipment [2].

The same definition of the office imaging equipment is also used in the agreement on the coordination of energy efficiency labelling programs for office equipment [10] between the United States of America and the European Community. In all these studies the following definition is used:

A product is included in the (office) imaging equipment product category if it is used in the office (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.

In the scope of this study, imaging equipment covers products which are marketed as printers, copiers, faxes machines, (document) scanners, digital duplicators and multifunctional devices (MFD).

The definition of each product was given in the Preparatory Study for Ecodesign Requirements [11] based on the definition of the energy label Energy Star [12]. These product definitions are as follows:

- A **printer** is a commercially available imaging product that serves as a hard copy output device, and is capable of receiving information from single-user or networked computers, or other input devices (e.g., digital cameras). The unit must be capable of being powered from a wall outlet or from a data or network connection. This definition is intended to cover products that are marketed as printers, including printers that can be upgraded into MFDs in the field.

- A **copier** is a commercially available imaging product whose sole function is the production of hard copy duplicates from graphic hard copy originals. The unit must be capable of being powered from a wall outlet or from a data or network connection. This definition is intended to cover products that are marketed as copiers or upgradeable digital copiers.

- A **fax machine** (or facsimile machine) is a commercially available imaging product whose primary functions are scanning hard copy originals for electronic transmission to remote units and receiving similar electronic transmissions to produce hard copy output. Electronic transmission is primarily over a public telephone system, but also may be via a computer network or the Internet. The product also may be capable of producing hard copy duplicates. The unit must be capable of being powered from a wall outlet or from a data or network connection. This definition is intended to cover products that are marketed as fax machines.

- A **scanner** is a commercially available imaging product that functions as an electro-optical device for converting information into electronic images that can be stored, edited, converted, or transmitted, primarily in a personal computing environment. The unit must be capable of being powered from a wall outlet or

from a data or network connection. This definition is intended to cover products that are marketed as scanners.

- A **digital duplicator** is a commercially available imaging product that is sold in the market as a fully-automated duplicator system through the method of stencil duplicating with digital reproduction functionality. The unit must be capable of being powered from a wall outlet or from a data or network connection. This definition is intended to cover products that are marketed as digital duplicators.

- A **multifunction device (MFD)** is a commercially available imaging product, which is a physically integrated device or a combination of functionally integrated components that performs two or more of the core functions of copying, printing, scanning, or faxing. The copy functionality as addressed in this definition is considered to be distinct from single sheet convenience copying offered by fax machines. The unit must be capable of being powered from a wall outlet or from a data or network connection. This definition is intended to cover products that are marketed as MFDs or multifunction products (MFPs).

It is important to emphasise here that for the Ecolabel and GPP criteria the aforementioned products could be defined either as a whole including their internal consumable product parts or as single units distinguishing between the main product and separate consumable product items. In particular in imaging equipment, the printer or copier is distinguished from its corresponding ink or toner cartridge.

Although the distinction between the main product unit and its internal consumable product parts is clear and respected, some of the Ecolabel criteria regarding the main unit are directly related to its internal consumable parts (i.e. Blue Angel §3.2). Therefore, in particular the ink and toner cartridges are considered environmentally relevant internal consumable parts of imaging equipment products to be initially included in the study scope.

On the contrary, in the use phase of imaging equipment there are also some external consumable parts, for instance the printing paper. These are only considered in the environmental assessment and in the determination of the Ecolabel criteria but are not further included in the scope of this report.

The identified studied product group of office imaging equipment as defined above will be hereinafter simply referred to as imaging equipment.

3.2 Imaging equipment classified in the official European statistics

In the official European statistics, data are collected on manufactured products. These data are available via the database of PRODCOM. The PRODCOM database is based on a product classification. More than 4500 headings relating to manufactured products are available in PRODCOM [13].

Imaging equipment is among those products. PRODCOM uses the statistical classification of economic activities in the European Community of NACE (Nomenclature statistique des activités économiques dans la Communauté européenne).

Products are detailed on an 8-digit level in which the first 4 digits refer to the NACE classification.

In the period prior to 2007 NACE version 1.1 was in use whereas after 2007 the classification is according to NACE version 2.

In addition to PRODCOM, imaging equipment is also classified in the EU-27 trade statistics database by using the Combined Nomenclature Codes, CN8. In the EU-27 trade statistics, the trade of goods inside the EU-27 are documented. This database covers the imports and exports from each Member State whether these are from/to another Member State or from/to a third country.

In Table 1 the codes of the categories of PRODCOM and of EU-27 trade database corresponding to imaging equipment are given. A short description of the products classified in each code is also given. As they will be later analysed in Task 2 each code of these databases is not apparently corresponding to one product (i.e. copier, printer, MFDs, fax machine, scanner or digital duplicator) but could refer to a larger group of products.

This is the case especially for scanners which are classified in larger product groups. In particular, in PRODCOM categories, scanners are subsumed in a larger product group together with keyboards and other input and output devices under the following

PRODCOM codes: 30.02.14.05, 30.02.14.50, 30.02.16.79 and 33.40.32.35. Further analysis on the Eurostat classification is given in Task 2.

Table 1 European classification of imaging equipment in PRODCOM and CN8 categories.

PRODCOM code		**EU 27 Trade code CN8**	
28232100 (NACE 2.0)	Photo-copying apparatus incorporating an optical system or of the contact type and thermo-copying apparatus	90.09.11.00	Electrostatic Photocopying apparatus, operating by reproducing the original image directly onto the copy [direct process]
30012150 (NACE 1.1)	Blueprint and diazocopiers (excl. ordinary photographic printing frames)	90.09.12.00	Electrostatic photocopying apparatus, operating by reproducing the original image via an intermediate onto the copy [indirect process]
30012170 (NACE 1.1)	Electrostatic photocopiers	90.09.21.00	Photocopying apparatus, incorporating an optical system (excl electrostatic)
30012183 (NACE 1.1)	Blueprinters, diazocopiers and other photocopying apparatus of the contact type	90.09.22.10	Photocopying apparatus of the contact type
30012185 (NACE 1.1)	Photocopiers incorporating an optical system, thermocopiers (excluding electrostatic photocopiers and thermo-printers)	90.09.22.00	Blueprinters and diazocopiers
30012190 (NACE 1.1)	Photocopiers incorporating an optical system, thermocopiers and contact type photocopiers (excl. electrostatic photocopiers, blueprinters and diazocopiers)	90.09.22.90	Phootocopying apparatus, of the contact type (excl. Blueprinters and Diazocopiers)
26201640 (NACE 2.0)	Printers, copying machines and facsimile machines, capable of connecting to an automatic data processing machine or to a network (excluding printing machinery used for printing by means of plates, cylinders and other components, and machines performing two or more of the functions of printing, copying or facsimile transmission)	90.09.30.00	Thermo-copying apparatus (excl. thermo-printers)
30021630 (NACE 1.1)	Printers		

30021640 (NACE 1.1)	Printers, copying machines and facsimile machines, capable of connecting to an automatic data processing machine or to a network (excluding printing machinery used for printing by means of plates, cylinders and other components	84.43.32.10	Printers capable of connecting to an automatic data processing machine or to a network
30021402 (NACE 1.1)	Printers and plotters	84.43.39.90	Printers and facsimile machines (excl. those capable of connecting to an automatic data processing machine or to a network)
30021430 (NACE 1.1)	Printers and plotters	84.71.60.20	Printers for digital automatic data-processing machines, whether or not containing storage units in the same housing
26201800 (NACE 2.0)	Machines which perform two or more of the functions of printing, copying or facsimile transmission, capable of connecting to an automatic data processing machine or to a network	84.71.92.20	Printers for digital automatic data processing machines (excl. such machines for use in civilian aircraft of subheading 471.92-10)
29561499 (NACE 1.1)	Other printing apparatus, copying machines and facsimile machines (excluding printing machinery used for printing by means of plates, cylinders and other components, machines capable of connecting to an automatic data processing machine)	84.71.60.40	Printer for digital automatic data processing machines, whether or not containing storage units in the same housing (excl. for use in in civilian aircraft of subheading 8471.60.10)
32202080 (NACE 1.1)	Machines which perform two or more of the functions of printing, copying or facsimile transmission, capable of connecting to an automatic data processing machine or to a network		
32202075 (NACE 1.1)	Facsimile machines	84.43.31.91	Machines which perform at least one of the functions of printing, facsimile transmission in addition to the function of copying by scanning the original and printing the copies by means of electrostatic print engine, capable of connecting to an automatic data processing machine or to a network (excl. those performing the functions of copying and facsimile transmission with a copying speed ≤ 12

			monochrome pages/minute)
30012330 (NACE 1.1)	Hectograph or stencil duplicating machines	84.43.31.10	Machines performing the functions of copying and facsimile transmission whether or not with a printing function, with a copying speed <= 12 monochrome pages/minute capable of connecting to an automatic data processing machine or to a network
		84.43.31.99	Machines which perform two or more of the functions of printing, copying or facsimile transmission capable of connecting to an automatic data processing machine or to a network (excl. those performing the functions of copying and facsimile transmission with a copying speed <= 12 monochrome pages/minute and those performing the function of copying by means of an electrostatic print engine)
		84.43.32.30	Facsimile machines capable of connecting to an automatic data processing machine or to a network
		85.17.82.10	Facsimile machines or line telegraphy
		85.17.21.00	Fax machine for line telephony
		84.72.10.00	Duplicating machines 'hectograph or stencil' (excl. printing machines and photocopying or thermo-copying machines)
Source: EUROSTAT, PRODCOM **http://ec.europa.eu/eurostat/ramon/index.cfm?TargetUrl=DSP_PUB_WELC**			

3.3. Conclusion on imaging equipment definition

In this report imaging equipment is defined with respect to the definition used in the other environmental policy instruments, i.e. Ecodesign, EU Energy label, GPP criteria, ensuring consistency among them. The adopted definition follows.

> A product is included in the 'imaging equipment' product category of 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.

In the scope of this study the imaging equipment covers products which are marketed as printers, copiers, faxs machines, (document) scanners, digital duplicators and multifunctional devices (MFD). The adopted definitions of copiers, printers, MFDs, fax machines, scanners and digital duplicators are the ones determined by Energy Star as given in Section 1.1.

4. Technical aspects of imaging equipment

Imaging equipment could be differentiated using several technical aspects. A way to classify them is by using the criteria of marking technology, of function and of image production performance like speed, color and size.

4.1. Marking technology of imaging equipment

There are several marking technologies. The most common marking technologies dominating in the market are the electro photography and the ink jet technology. The definitions of these technologies that follow are based on the ones used in the Energy Star eligibility criteria report [12]. Other available marking technologies will be thereafter briefly described.

- Electro photography

  A marking technology characterised by illumination of a photoconductor in a pattern representing the desired hard copy image via a light source, development of the image with particles of toner using the latent image on the photoconductor to define the presence or absence of toner at a given location, transfer of the toner to the final hard copy medium, and fusing to cause the desired hard copy to become durable.

In Figure 1 the main steps of electrographic marking technology are presented.

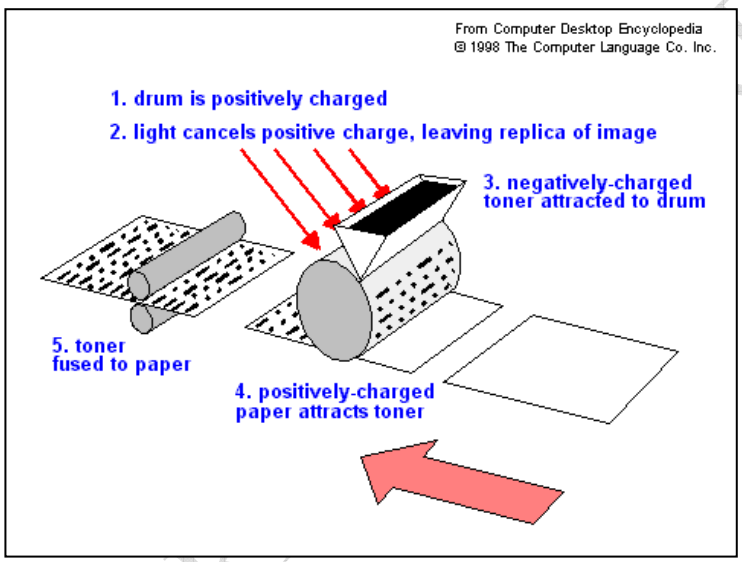

Figure 1. Electro photographic marking process

Electro photography (EP) can be further distinguished in the laser EP, the light emitted diode (LED) EP and the liquid crystals diode (LCD) EP. The above difference relies on the used light source. Laser and LED marking technologies are presented in more detail in Figure 2.

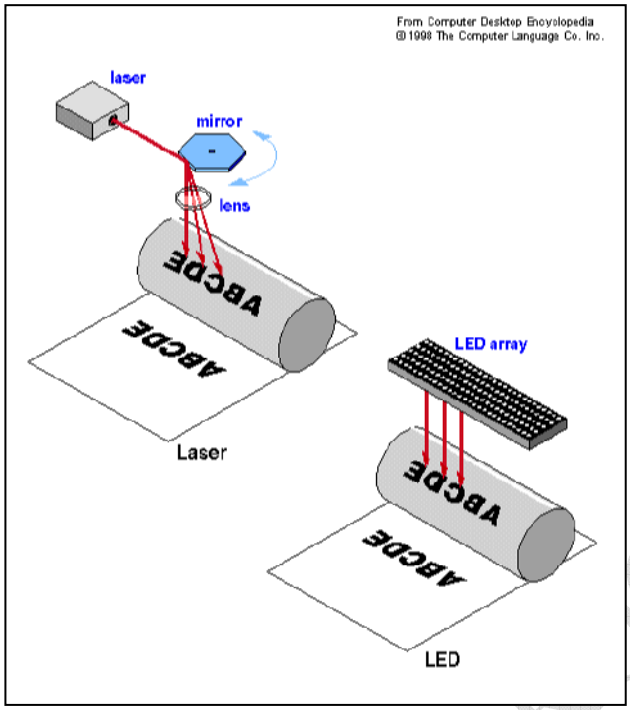

Figure 2. Electro photographic marking using laser and light emitted diode

- Inkjet

  A marking technology where images are formed by depositing colourant in small drops directly to the print media in a matrix manner. Colour IJ is distinguished from monochrome IJ in that more than one colourant is available in a product at any one time.

A typical inkjet printing process is described in Figure 3. In this process droplets of ink are continuously sprayed (continuous inkjet marking). These droplets reach the paper or are winded up in the return gutter. The droplets are synchronised in the nozzle by using a piezoelectric crystal. The charging tunnel selectively charges the droplets. The uncharged droplets reach the paper. The paper is moved appropriately and the next marking cycle starts.

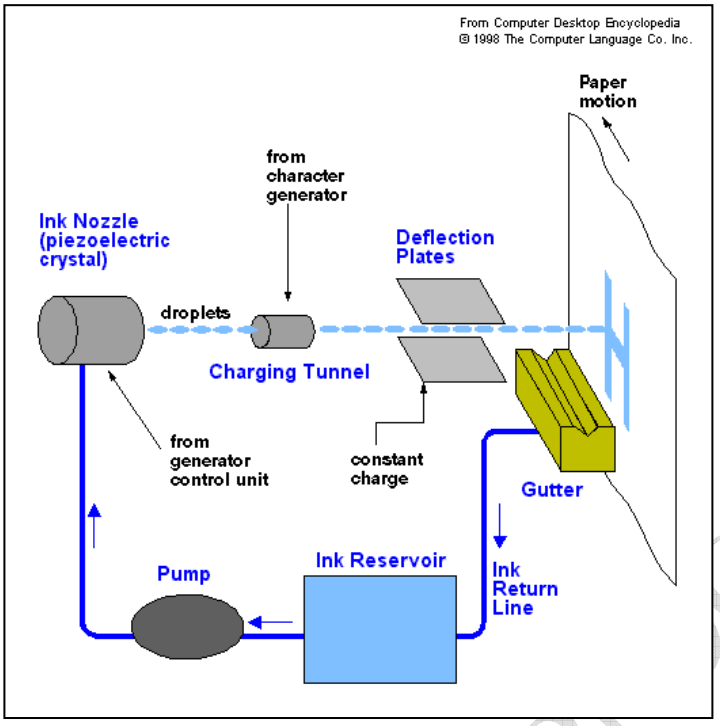

Figure 3. Continuous inkjet marking process
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Alternatively to the continuous inkjet marking there is the drop to demand inkjet marking. The difference between them is due to how the droplets are produced. In the second case the droplets are made through heat (thermal drop on demand) or through charged crystals (piezoelectric drop on demand). The principles of the two options are given below:

- Thermal drop on demand: A heating element inside the nozzle via a pulse of current releases a steam explosion in the chamber which propels a droplet of ink.
- Piezoelectric drop on demand: Piezoelectric crystals are inside the nozzle and change shape/size when the electric current is applied. This change causes the formation of an ink droplet.

The applications of the aforementioned inkjet technologies vary. The continuous inkjet marking is typically used in marking products and codes on packaging. On the contrary, thermal drop on demand marking is mainly used in the consumer inkjet market like the piezoelectric drop on demand alternative. However, the latter is more expensive which is compensated for by its capability to use a larger number of inks. In the case of photo printing the direct competition to the inkjet marking technology includes the dye sublimation and the solid ink technologies, the descriptions of which follow.

- Dye sublimation

The images are formed by depositing (subliming) dye onto the print media based upon the amount of energy delivered by the heating elements. A ribbon or a roll is therefore used.

Important in this technology is that the same amount of ribbon be used no matter how much colour is in the image. Thus, the consumption of ribbon is fixed per print. Consumables for dye sublimation printers generally cost more than for inkjet printers.

- Solid ink

  The ink is solid at room temperature and liquid when heated to the jetting temperature. Transfer to the media can be direct, but is most often made to an intermediate drum or belt and then offset printed to the media.

In this case wax sticks (wax-line ink) are liquefied by heat and then transferred onto the paper. Typically the inks are jetted from the nozzles using the piezoelectric drop on demand method.

- Direct thermal.

  A marking technology that transfers an image by burning dots onto coated media as it passes over a heated print head. Direct thermal products do not use ribbons.

This technology needs coated paper and is often used for printing bar codes or tickets.

- Impact

  A marking technology characterised by the formation of the desired hard copy image by transferring colourant from a ''ribbon'' to the media via an impact process.

- Stencil

  A marking technology that transfers images onto the print media from a stencil that is fitted around an inked drum.

- Thermal transfer

  A marking technology where the desired hard copy image is formed by depositing small drops of solid colourant (usually coloured waxes) in a melted/fluid state directly to the print media in a matrix manner.

The printing mechanism is the same as the one of dye sublimation, but instead of laying down a transparent die, it melts dots of wax-based ink that adhere to almost any kind of stock.

4.2. Functionality of imaging equipment

The product group could be differentiated based on functionality in the single function devices (SFDs) and in the multifunctional devices (MFDs) which perform more than one core function. The core functions are copying, printing, facsimile transmission and scanning.

Based on market data the single function devices show a clear sales decline in recent years and a larger market segments are now covered by multifunctional devices (see in Task, 2 section 2.2.2). The trend towards multifunctional devices is very strong and is expected to increase.

4.3. Image production performance

The image production performance is commonly evaluated by the image speed production, the image quality (i.e. monochrome /colour or photo) and image size.

The image production speed is measured in image-per-minute (ipm). The definition of 1 ipm is: 'one single A4 sheet copied/printed/scanned on one side in one minute'. This aspect becomes important when a copier or printer is used by more than one user, i.e. working environment. The laser electro photographic printers and copiers typically reach a higher number of ipm and therefore are popular in professional environments.

On the contrary, inkjet technology has typically lower printing speed and is the dominating technology for private use. The lower price of colour inkjet printers (or MFDs with printing as the main function) is additionally affecting this. The colour laser printers and copiers are generally more expensive. The size is a performance characteristic which becomes more important in professional use. The standard size in the private use is the A4 though most of the devices also apply on A3 size. In the case of photo print the size is smaller whereas larger formats are used mainly in professional use.

5. Key environmental aspects of imaging equipment

In an integrated system approach, the environmental performance of imaging equipment is addressed under the life cycle perspective. In this approach the product is not assessed as a single object but rather as a means which provides a specific function (see also [14, 15]). Moreover, the environmental performance of the 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. That way 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 is also investigated.

The main advantage of this 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 (e.g. better performance in global warming (reduction of CO_2 emissions) but increase of ecotoxicity and ozone layer depletion equivalents, etc.). However, LCA also has operational drawbacks. These are mainly because of the current lack of knowledge and data especially regarding some environmental impact categories. For instance some kind of improvements in the environmental performance of particular products (like indoor air quality, noise during use phase, etc.) are currently not feasible to be measured in LCA as the latter investigates the major environmental impact categories in a generic way for all the processes involved in the product system life cycle. Therefore, in addition to the system approach of LCA the identification of environmental aspects which can be covered within the framework of Ecolabel criteria needs also to rely on a product oriented environmental performance analysis.

In the case of imaging equipment the function of the product is one or more of the following: printing, copying, scanning and sending/receiving a fax. However, in order to fulfil this function the use of the respective imaging equipment is needed together with other consumables namely paper, electricity, ink or toner. In Figure 4 the two complementary approaches are presented. In one the overall picture of the system approach is emphasised. In the other the focus is on the main product life cycle. In Figure 4 these two approaches are presented for the example of printers.

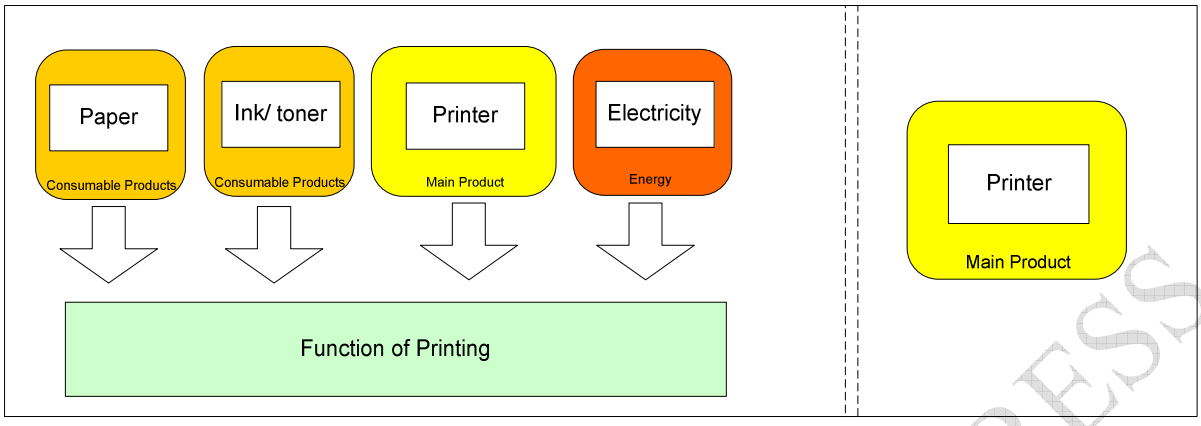

Figure 4. Environmental performance assessment of printers in a) system approach and b) focus on main product

Following the system approach, the environmental performance of imaging equipment investigates the overall performance from cradle to grave (life cycle) of the product system of paper, ink or toner cartridges, imaging equipment and electricity. The proportion of each product system is determined via the specification of the functional unit and its respective quantification with a reference flow, i.e. number of printed pages.

Moreover, when the focus is on the main product (Figure 4b) specific environmental improvement potentials of equipment applying best available technologies (BAT) are investigated in comparison with the performance of average products (comparative assessment). Potential rebound effects of the performance of BAT equipment could be detected applying the investigation on a product life cycle level.

It should be highlighted that the product life cycle systems of the main product and the consumables as illustrated in Figure 4 are in reality interlinked with both mass and energy flows in the pre- and post- consumption phase as for instance electricity is also used in several processes of the product life cycle of paper production as well as in recycling and in the printer production phase. The differentiation between product systems is not based on physical boundaries. It is rather abstract and conceptual mainly due to the assessment needs.

In the system approach the environmental performance could be expressed by allocating respectively the potential environmental impacts to different impact categories. In some

cases overall inventory outcomes are also used (e.g. mass or energy flows). The impact categories which are well standardised and broadly used in LCA cover the following areas: global warming potential, ozone depletion, human toxicity, ecotoxicity, acidification, eutrophication, resource depletion, etc. Commonly used inventory outcomes are the values of cumulative energy demand, electricity, heavy metals, volatile organic compounds, water use, persistent organic compounds, polycyclic aromatic hydrocarbons, particulate matter, etc.

Based on the system approach, the main environmental impacts of imaging equipment are detected on paper consumption. Indicatively we could refer to the findings of the Ecodesign Preparatory study [1]. In this study for the investigated base case of a commonly found laser copier device, the paper consumption during the 6 years use phase was found to contribute to up to 81 % out of the total energy consumption (105 360 MJ out of 129 243 MJ). This immense contribution to the overall energy consumption dominates also the other environmental impact categories as significant environmental impacts are related to the energy production phase.

At this point it is important to emphasise the fact that the consumption of paper is a parameter depending more on user behaviour and less on the design of a printer or a copier. Imaging equipment design could also influence user behaviour (i.e. automated duplex printing and copying, etc.) nevertheless it is eventually up to the user to apply this function or not. The Ecolabel criteria on imaging equipment are considered therefore to achieve only a limited influence in this respect.

Furthermore, another important environmental parameter in the environmental performance of imaging equipment is the electricity consumption during the use phase. 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 is approximately 17 000 MJ out of total 180 500 MJ. However, if we exclude the energy related to the product system of paper, the contribution of electricity to the overall rest energy consumption (20 800 MJ) is significant as it reaches 81 %. An additionally important aspect on this is that the most of this energy consumption is not during image reproduction but during an inactive mode (standby losses). Among the different imaging equipment especially high standby losses are found in fax machines as they reach up to 90 % of the total electricity consumption [16, 17].

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) and together with the energy label criteria is also a key aspect for the Ecolabel criteria.

Furthermore, other environmental aspects on the product life of imaging equipment are related to the use of ink and toner cartridges. Reuse and/or material recycling of ink and toner cartridges is since longer years possible. The reduction of resource depletion based on this practice was considered sufficient to justify the determination of Ecolabel criteria of remanufactured and reprocessed ink and toners on numerous Ecolabel schemes (see also later Section 4). Moreover, in a recent study made on behalf of the Danish Environmental Agency implementing the LCA methodology [18], the product life of ink and toner cartridges were identified as an environmental hot spot for significant environmental savings of the overall environmental life cycle performance of imaging equipment.

As aforementioned, there are some environmental aspects which can not be unveiled under the system perspective but can be determined in a comparative assessment investigating average products and BAT products. Indoor air quality related to substance emissions like ozone and particulate matter as well as noise during the use phase is relevant for the imaging equipment product group. Similar to this the use or better prevention of use of specific substances which are either related directly or indirectly to significant environmental impacts are also considered (e.g. substances which are used as flame retardants are involved in dioxin formation in the case of improper incineration). Investigating these kinds of aspects on a scale of larger product systems often 'dilutes' the importance of the potential environmental savings which can be achieved.

6. Relevant Ecolabels

The EU environmental product policy instruments applicable to the product group are the Ecolabel, the Energy label, the Green Public Procurement and the Ecodesign. The Ecolabel and the Green Public Procurement deal with products which show a higher environmental performance and are not mandatory instruments. A short description of

each environmental policy instrument follows together with a presentation of the applicability in the imaging equipment product group of.

6.1 EU Ecolabel objective and requirements

The EU Ecolabel is covered by the Ecolabel Regulation 66/2010 [4]. The EU Ecolabel scheme is part of the sustainable production and consumption policy of the Community. The objective of this policy is the reduction of negative environmental impacts due to production and consumption including impacts on health, climate and on natural resources.

The EU Ecolabel should promote those products which have a high level of environmental performance. The Ecolabel criteria shall set out the environmental requirements that a product must fulfil in order to bear the EU Ecolabel.

The Ecolabel criteria shall be based on the best products available on the Community market in terms of environmental performance throughout the life cycle. They shall correspond indicatively to the best 10 - 20 % of the products.

Moreover, the criteria shall be determined on a scientific basis considering the whole life cycle of the products and taking into consideration the latest technological developments. Thus, the following shall be considered:

- the most significant environmental impacts, in particular the impact on climate change, the impact on nature and biodiversity, energy and resource consumption, the generation of waste, emissions to all environmental media, pollution through physical effects and 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 it is technically feasible;

- the potential to reduce environmental impacts due to durability and reusability of products;

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

- the criteria shall be based on sound data and information representative as far as possible of the Community market;

- they shall be based on life cycle data and quantitative environmental impacts;

- They shall be in harmonisation with existing legislation applicable to the product group when considering definitions, test methods and technical and administrative documentation.

In order to simplify the EU Ecolabel scheme and to reduce the administrative burden associated with the use of the EU Ecolabel, the assessment and verification procedures should be streamlined where criteria have already been developed under another Ecolabel scheme complying with the requirements of EN ISO 14024 type I environmental labels for a product group for which no EU Ecolabel criteria have been established. In such cases, the shortened criteria development procedure laid down in Ecolabel Regulation 66/2010 Part B of Annex I may apply.

6.2 Existing Ecolabelling schemes (EU and non-EU)

6.2.1. Overview of existing labelling schemes

The currently available Ecolabeling schemes applicable to the product group of imaging equipment were identified and listed as follows.

The European Ecolabel schemes are:

- Blue Angel [19, 20] from Germany
- Nordic Swan [21, 22] from the Nordic countries
- Umweltzeichen from Austria [23, 24]
- TCO '99 [25] from Sweden.

The Ecolabels from non-European countries are:

- EcoMark from Japan [26, 27, 28, 29, 30, 31, 32, 33]
- EcoLogo CM from Canada [34, 35]
- Korea Ecolabel [36, 37]
- Environmental Choice Australia [38]
- Environmental Choice New Zealand [39, 40]
- China Environmental United Certification Center HBC [41]
- Green Mark Taiwan [42]
- Singapore Green Labelling scheme [43]
- Green Label Thailand [44]

In the following section the different Ecolabel schemes will be described one by one.

6.2.1.1. Blue Angel Ecolabel criteria from Germany

Blue Angel is the German environment-related label for products and services. It was the first Ecolabel scheme, created in 1978 by a governmental initiative and its objective is to be a market-conformed instrument of environmental policy designed to distinguish the positive environmental features of products and services on a voluntary basis. Today about 11,500 products and services in around 90 product categories carry the Blue Angel Ecolabel.

The environmental label jury determines the Ecolabel criteria in close co-operation with the German Federal Ministry for Environment, Nature Conservation and Nuclear Safety as well as with the Federal Environmental Agency. The goal of Blue Angel is to make the ecologically most advantageous products the standard. There are four specific thematic areas of protection, namely health, climate, water and resources.

The Blue Angel Ecolabel has the following overall environmental objectives [19]:

- prevention of pollutants, emissions and waste
- the lowest possible energy consumption of electronic devices during use and
- recycling of used products

Pursuance of these environmental aims helps to save resources, prevent the entry of pollutants into the environment and give weight to consumer protection.

Furthermore, the Blue Angel Label shall be awarded to products for which:

- the energy consumption of the devices is comparatively low, especially in ready modes;
- the devices observe the principle of potential system longevity; they are built according to the principles of recyclable design and allow for the reuse and recycling of used products or product components;
- where technically possible, the use of environmentally harmful substances in materials is avoided;
- noise emission during operation is kept as low as possible.

The Blue Angel Ecolabel criteria relevant to imaging equipment are given in the document ''Office Equipment with Printing Function (printers, copiers, multifunction devices)''. The last available Ecolabel criteria were updated in May 2009 and are valid until 31.12.2011 according to the RAL-UZ 122 [19] document. The criteria are presented in Annex 1.

The requirements are set on the following overall aspects:

- energy consumption
- substance emissions
- requirements for toner and inks including material related requirements and restrictions othe use of hazardous substances, heavy metals, azo dyes and biocides
- general Requirements covering recyclable design, double-sided printing and copying, product take back, etc.
- noise emissions.

In particular the following products are covered in the Blue Angel Ecolabel criteria:

- copiers
- printers
- multifunctional devices (MFD) (restricted to the ones which have printing or copying as the primary function).

Fax machines, scanners and digital duplicators are not covered in the criteria of Blue Angel. The difference between fax machines and multifunctional devices (MFD) is explicitly given. Facsimile machines which have, for instance, the function of single sheet ''convenience copying'' are not considered as MFD and hence, are not included. A prerequisite for including fax machines is to have copying or printing as one of their main functions.

The Blue Angel label shows the highest number of applications. There are up to 630 imaging equipments from 18 different companies which bear the label of Blue Angel.

Furthermore, as mentioned before, some of the Blue Angel Ecolabel criteria specify requirements for toner, inks, as well as their modules or containers (see Blue Angel criteria § 3.2.1 & 3.2.2 [19]). These requirements apply only on the unmodified original equipment of the respective product.

In particular, in the case of printed modules which are recycled and refilled with toner Blue Angel specified Ecolabel criteria in the respective report ''Recycled Printing Modules Refilled with Toner, RAL-UZ 55 [20]''. However, Blue Angel Ecolabel criteria on new or recycled printing ink and ink cartridges used in the inkjet printers are not available. Neither are Ecolabel criteria for new toner cartridges. Nevertheless, it should be emphasised that toner cartridges either new or recycled/reused may be considered as one product category. In this product category the recycled/reused toners achieve a

higher environmental benefit throughout their life cycle versus the new toner cartridges which explains the lack of Ecolabel criteria for the latter ones.

In conclusion for the internal consumable parts of imaging equipment products Ecolabel criteria are given for 'Recycled Printing Modules Refilled with Toner, RAL-UZ 55' [20].

6.2.1.2. Nordic Swan Ecolabel

The Nordic Swan is the Ecolabel scheme established for the Nordic countries: Sweden, Denmark, Norway, Iceland and Finland. The product category of Ecolabel Nordic Swan named 'Imaging Equipment' cover the following products:

- copiers
- printers
- multifunctional devices (MFD)
- digital duplicators
- fax machines
- scanners.

The Nordic Ecolabel has been the official Ecolabel for the Nordic countries since 1989. The purpose of Nordic Swan is to help consumers choose among the best products on the market, from an environmental standpoint. Criteria are developed by using a life cycle analysis. Several environmental aspects are taken into account such as: energy and water usage, kinds of chemicals used, recycling and reuse of waste products [45].

The last available Ecolabel criteria on ''Imaging Equipment'' is version 5.1 [21] which is valid until 31.12.2010. An excerpt from the Nordic Swan Ecolabel criteria is provided in Annex 2. These criteria are fully harmonised with the aforementioned Ecolabel criteria of Blue Angel on office imaging equipment [19] (see also §Harmonisation of Ecolabels). It should be highlighted that in Nordic Swan the Ecolabel criteria on imaging equipment cover more products than the ones covered by the Blue Angel Ecolabel scheme. In particular, fax machines, digital duplicators and scanners are additionally covered in Nordic Swan.

The environmentally relevant areas of focus for the Nordic Swan Ecolabel are:

- energy consumption
- design and materials
- plastics in casings and other components

- materials and dangerous substances
- relevant environmental requirements (spare parts supply, double-sided copying)
- performance properties (emissions and noise).

In Nordic Swan there are in total 116 labelled imaging products from 4 companies. Out of them 90 are multifunctional devices, 25 printers and 1 copier. It is important to note that there is no application yet on digital duplicators or scanners.

Furthermore, in the Nordic Swan, similar to Blue Angel, there are also Ecolabel criteria available for remanufactured toner cartridges.

The last available version of these criteria is version 4.1 [22] from March 2006 and is valid until June 2011. Ecolabel criteria from Nordic Swan like in the case of Blue Angel are currently not available for inks or ink cartridges.

6.2.1.3 Austrian Umweltzeichen

The Austrian Ecolabel ''Österreichisches Umweltzeichen'' is supervised by the Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management. Responsible for the criteria determination is the union for consumer information (Der Verein für Konsumenteninformation). The Austrian Ecolabel was founded in 1990 [46].

The Austrian available Ecolabel criteria ''Österreichisches Umweltzeichen'' for imaging equipment are based on a binational cooperation with the German Blue Angel Ecolabel scheme. The relevant Ecolabel criteria are found in the Richtlinie UZ 16, ''Bürogeräte mit Druckfunktion (Drucker, Kopierer, Multifunktionsgeräte)'' [23] and fully adopt the aforementioned Blue Angel criteria on ''Office Equipment with Printing Function (printers, copiers, multifunctional devices)'' [19] Thus, the covered imaging equipment products are as follows:

- copiers
- printers
- multifunctional devices (MFD) (restricted to the ones which have printing or copying as primary function).

Regarding Ecolabel criteria for internal consumable parts of imaging equipment the Austrian Umweltzeichen established Ecolabel criteria on reprocessed toner modules and ink cartridges. The respective document is ''Richtlinie UZ 11 Österreichisches

Umweltzeichen, Wiederaufbereitete Toner-Module und Tintenpatronen'' [24] valid since July 2009.

Similar to the office imaging equipment the respective Austrian document on toner modules is also based on the corresponding document of Blue Angel ''Recycled Printing Modules Refilled with Toner, RAL-UZ 55' [20]'. However, it is important to highlight that in this case the Austrian Umweltzeichen Ecolabel criteria extend the scope and also cover reprocessed ink cartridges. Thus, the Austrian criteria on reprocessed toner modules and ink cartridges are based on (but do not adopt one by one) the respective criteria of Blue Angel. Some additional criteria are also included. In conclusion, in the Austrian Umweltzeichen the following internal consumable imaging equipment products are covered:

- reprocessed toner modules
- reprocessed ink cartridges.

6.2.1.4 TCO from Sweden

The Swedish Confederation of Professional Employees awards the TCO 99 label for printers. The current available version is 2.1 from 2006 [25]. The TCO 99 label focuses primarily on product functionality ergonomics and ease of use but additional ecological criteria are also integrated.

In these criteria, the Blue Angel criteria though are partly used as a reference, though from their older report RAL-UZ 85 [47] on printers as well as the Energy Star [48] program for printers and fax machines in an early report from 1995. Regarding toner or ink cartridges these products are not covered.

These criteria are based on the German Ecolabel scheme and the Energy Star label and are generally considered outdated.

6.2.1.5 EcoMark Ecolabel from Japan

EcoMark which is the Ecolabel of Japan covers several products within the category of imaging equipment. In EcoMark the Ecolabelling criteria are set for each product separately. In particular, the following products with the respective reference documents [26, 27, 28, 29, 30,] are covered:

- copiers
- printers

        - inkjet printers, thermoprinters and wire dot printers
        - electro photographic printers.
- digital duplicators
        - new digital duplicators
        - reused digital duplicators

Under the EcoMark the criteria for the digital duplicators differentiate whether the product is new or reused. This is the first case within the product group of imaging equipment in which an Ecolabel award differentiates between a new and a reused product.

Additionally under the EcoMark criteria, printers are differentiated between electro photographic printers and inkjet, thermo and wire dot printers and are not handled together in one document.

The Japanese EcoMark criteria are harmonised with the respective Ecolabel criteria of Blue Angel and Nordic Swan (see also Section 2.2.2 Harmonization of Ecolabels).

Regarding Ecolabel criteria for internal consumable parts of imaging equipment, under EcoMark Japan, Ecolabel criteria are set for:

- printing inks
- toner cartridges.

These extra equipment and accessories are described separately in an Ecolabel criteria document.

6.2.1.6 EcoLogo CM from Canada

EcoLogo is the national Ecolabel scheme from Canada. Under this scheme imaging equipment is covered under the name of ''Office machines''. The latest document on ''office machines'' is CCD-035 [34] dated March 2009 (the next scheduled review is in 2011) and covers the following products:

- copiers
- printers
- multifunctional devices
- fax machines
- mailing machines.

This document replaces the older separate documents on photocopiers CCD-035, on fax machines CCD-036 and on laser printers CCD-037 which demonstrates the appropriateness of covering all imaging equipment together.

Under the EcoLogo Canada five products are covered. Apart from the most common ones including copiers, printers and MFDs, fax and mailing machines are also included. EcoLogo Canada is the sole Ecolabel scheme which covers mailing machines; nevertheless there is no product labelled.

Regarding energy consumption, the EcoLogo criteria refer to the Energy Star criteria while for the restriction of hazardous substances and their emission during the use phase the given threshold values under the EcoLogo criteria are identical to the ones under the Blue Angel and follow the RoHS Directive [49].

The remanufactured toner cartridges are covered in the EcoLogo Canada document CCD-039 [35] and refer to the Canadian General Standards Board Standard CAN/CGSB-53.148, Rejuvenation of Laser Printer Cartridges but there is currently no product labelled.

6.2.1.7 Ecolabel Korea

In the Korean Ecolabel the following imaging equipment is covered [36]:

- copiers
- printers
- fax machines

Similar to other national Ecolabels, the Korean Ecolabel criteria also refer to the energy consumption requirements set by the Energy Star label.

Regarding ink and toner cartridges, the Korean Eco-Label established criteria for toner cartridges and for printing ink found in the respective documents [37]. It should be emphasised here that these criteria include both new toner cartridges and refilled toner cartridges differently with the European national Ecolabel schemes (Blue Angel and Nordic Swan) which award the Ecolabel solely to remanufactured toner cartridges.

6.2.1.8 Environmental Choice Australia

In the Environmental choice Ecolabel criteria of Australia [38] (latest version February 2008 valid until 2013) the following imaging equipment is covered:

- copiers
- printers
- multifunctional devices
- fax machines
- scanners.

The criteria regarding energy consumption refer to the requirements set by the Energy Star label. It is noteworthy that within the same report in the Australian Ecolabel criteria for imaging equipment toner cartridges, drums and optical photosensitive kits are included as consumable parts of the product group. Another notable point is that in the Australian Environmental Choice Ecolabel criteria, apart from the criteria regarding environmental issues, criteria regarding the company compliance to labour, anti-discrimination and safety regulations are also found. This is also found in the 'Sustainable procurement guidelines for office IT equipment' from the United Nations [50].

6.2.1.9 Environmental Choice New Zealand

Under the Ecolabel scheme of New Zealand, the ''New Zealand Environmental Choice'' in the respective report [39] of May 2009, the following imaging equipment is covered:

- copiers
- printers
- multifunctional devices
- fax machines.

Currently several copiers, printers and MFDs are labelled but there is no application on fax machines.

It is of special importance to highlight that the Ecolabel of New Zealand has its respective core criteria for imaging equipment fully harmonised with the corresponding Ecolabel schemes of Blue Angel, Nordic Swan and EcoMark Japan. Especially regarding energy consumption, the requirements are the same as the ones set by the Energy Star label.

The New Zealand Ecolabel scheme has also established criteria for toner cartridges found in the report 'Toner Cartridges EC-30-05' [40]. Again like the case of Korean Eco-Label scheme, the New Zealand's Ecolabel criteria cover both new and remanufactured toner cartridges unlike to the European national Ecolabel schemes Blue Angel and Nordic

Swan and the Austrian Umweltzeichen which cover only remanufactured toner cartridges.

6.2.1.10 China Environmental United Certification Center HBC

Under the Chinese Label of the China Environmental United Certification Center HBC in the respective Ecolabel criteria report [41] (valid since 2005), the following imaging equipment is covered:

- printers
- fax machines.

The technical requirements of the Chinese Ecolabel criteria refer to the respective older Ecolabel criteria of Blue Angel 'Printers'' (RAL-UZ 85) and ''Fax Machines'' (RAL-UZ 95), of the Nordic Swan for ''Printer & fax combinations'' whereas the energy requirements refer to the Energy Star label.

The Chinese Ecolabel criteria are generally considered outdated.

6.2.1.11 Green Mark Taiwan

In the Taiwan Green Label [42] the following imaging equipment is covered:

- printers
- multifunctional devices
- scanners
- digital duplicators.

The valid version is 1.0.0 which was updated for printers in February 2010 whereas for the other equipment (MFD, scanners and digital duplicators) it was updated in June 2007. Regarding energy consumption, the criteria of Energy Star are referred to. Green Mark Label is one of the few labels which does not cover copiers while digital duplicators and scanners are covered.

Regarding the internal consumable part of imaging equipment under Green Mark new toner cartridges [42] are also covered.

6.2.1.12 Singapore Green Labelling scheme

Under the Singapore Green Labelling [43] scheme the following imaging equipment is covered:

- copiers
- printers
- multifunctional devices
- fax machines.

Regarding energy consumption, again the criteria of Energy Star are referred to. Singapore Green Labelling does not cover toner or ink cartridges.

6.2.1.13 Green Label Thailand

Under the Green Label Thailand [44] the following imaging equipment is covered:

- copiers
- printers
- fax machines

The category of copiers includes multifunctional devices with the primary function being copying. Regarding energy consumption, the requirements are the same ones as under the Energy Star label. Many criteria refer to the standards of Blue Angel and threshold values of emissions or use of chemical substances under to the REACH (Registration, Evaluation, Authorisation and Restriction of Chemicals) regulation.

6.2.2. Conclusion on available Ecolabel schemes

6.2.2.1 Key Ecolabel Schemes

The available Ecolabels as described above could be divided into two larger groups: the European and the non-European Ecolabels. In Europe there are two main schemes, namely the Nordic Swan and the Blue Angel. These two schemes also play a key role on a global level as their criteria are partly or fully adopted by other national Ecolabel authorities.

The Ecolabel criteria of Nordic Swan and Blue Angel are compliant with the standard norm EN ISO 14024 [6] and thus could be used for applying the EU Ecolabel regulation in a shortened procedure regarding EC 66/2010, Annex I.B [4].

6.2.2.2 Product coverage and harmonisation of European Ecolabels

The key Ecolabel schemes in Europe, the Blue Angel and the Nordic Swan are harmonised. The Austrian Umweltzeichen criteria are also identical to the Blue Angel ones. Other European Ecolabel criteria are not available.. Nevertheless, the difference in product coverage is of special importance. The Nordic Swan covers almost all the products within the group of imaging equipment (mailing machines are the only exception) and in addition covers related consumable products, i.e. reprocessed toner cartridges. On the other hand, Blue Angel Ecolabel criteria are restricted to the larger three product groups which are: copiers, printers and multifunctional devices. Between these two schemes the Ecolabel criteria for imaging equipment are harmonised.

Reprocessed toner cartridges are also covered by Blue Angel; nevertheless these criteria are not harmonised with the respective ones of Nordic Swan.

Furthermore, it is of importance to mention that the criteria concerning energy consumption though harmonised are not identical between these two Ecolabel schemes. Blue Angel defines and determines threshold values using in house research whereas Nordic Swan gives two options. In the first one similar to the majority of the other Ecolabel schemes, Nordic Swan refers to compliance to the requirements of the Energy Star label and in the second refers to fulfilment of Blue Angel requirements (due to harmonisation).

6.2.2.3 Other relevant Ecolabels

The Austrian Umweltzeichen which is the third available European Ecolabel scheme has fully adopted the criteria of Blue Angel based on a bilateral agreement with Germany. It is important to note that regarding the criteria for consumable parts, the Austrian Umweltzeichen additionally covers reprocessed ink cartridges.

Moreover, another available European label is ''TCO'99 for printers'' which does not have the main focus on environmental aspects and its latest version is outdated (since 2005). Hence, the TCO'99 label is considered of rather limited importance.

Regarding non-European Ecolabel schemes the quality of the established criteria varies among the different countries. Of relevance for this study is that the criteria of the Japanese EcoMark and the New Zealand's Environmental Choice are harmonised with Nordic Swan and Blue Angel. The EcoLogo of Canada, the EcoLabel of Korea as well as the other Asian Ecolabels (from China, Singapore, Taiwan and Thailand) base many criteria on standards set by Blue Angel, Energy Star and in compliance with to EU regulations, i.e. RoHS. These criteria might be useful for specific issues as they could provide insight into areas which are not covered by the European labels.

6.2.2.4 General overview of product coverage

An overview of the coverage of the products among the different Ecolabelling schemes, the Ecodesign Preparatory study and the Energy label is given in the Table 2.

Table 2. Overview of the products covered in the Ecolabeling schemes, the Ecodesign Preparatory Study and the Energy labels regarding the 'imaging equipment'product group.

Products	Ecodesign	European Ecolabels				Non-European Ecolabels									Energy label
		Nordic swan	Blue Angel Germany	Umwelt-zeichen Austria	TCO Swed.	EcoLogo Canada	Env. Choice Austr.	Env. Choice New Zealand	Eco Mark Japan	Eco-Label Korea	China label	Green Mark Taiwan	Sing. Green Label	Green Label Thail.	Energy Star US
Copiers	X	X	X	X		X	X	X	X	X				X	X
Printers	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Multifun.Dev. (MFD)	X	X	X	X		X	X	X				X	X		X
Digital duplicators	X	X							X			X			X
Fax machines	X	X				X	X	X		X	X	X	X	X	X
Scanners	X	X					X								X
Mailing machines	X					X									X
Reproc essed Toner Cartridges		X	X	X		X		X		X					
Reprocessed Ink Cartridge				X											
Original Toner Cartridges								X		X		X			
Printing Ink									X	X					

Based on table 2 we could conclude on the coverage of the products among the different Ecolabels as follows. Printers are covered in all cases and copiers in almost all the Ecolabels. Multifunctional devices come next with lack of coverage in the Asian Ecolabels. Fax machines show a rather low coverage whereas digital duplicators show even less. The least covered products are scanners and mailing machines with two and one Ecolabel scheme, respectively.

With respect to the consumable parts of imaging equipment these items are less frequently covered than imaging equipment itself. The reprocessed toner cartridges are covered in five Ecolabel schemes whereas original toner cartridges are covered only in three schemes. It is important to emphasise here that the reused cartridges are claimed to be more environmentally friendly compared with new ones thus Ecolabelling both new and reused products could mislead consumers. This explains the lack of new toner cartridges among the European Ecolabels. On the other hand ink cartridges are only included in the Austrian Umweltzeichen while printing ink Ecolabels are covered under the Japan EcoMark and under the Korean Ecolabel.

7. European Green Public Procurement (GPP)

Green public procurement (GPP) is defined as a process whereby public authorities seek to procure goods, services and works with a reduced environmental impact throughout their life cycle when compared to goods, services and works with the same primary function that would otherwise be procured.

Public authorities are major consumers in Europe: they spend approximately Eur 2 trillion annually, equivalent to some 17 % of the EU's gross domestic product. By using their purchasing power to choose goods and services with lower impacts on the environment, they can make an important contribution to sustainable consumption and production. Moreover, green purchasing also influences the market as in numerous cases public authorities have a large and dominant market share. By promoting and using GPP, public authorities can provide industry with real incentives for developing green technologies and products. [51].

The recent Green Public Procurement's legislative document is the Communication on ''Public procurement for a better environment'' COM (2008) 400 [7]. The stated GPP

target in the renewed Sustainable Development Strategy was that by the year 2010, the average level of GPP should have been the same as the 2006 level of the best performing Member States.

Another relevant EU legislation on Green Public Procurement regarding the procurement of imaging equipment is Regulation (EC) 106/2008 on ''a Community energy-efficiency labelling programme for office equipment'' [8]. In this Regulation the purchase of energy efficient imaging equipment is promoted by the public governmental sector. This regulation acts complementary to the GPP criteria of office IT equipment which are presented in Section 7.1.

The established Green Public Procurement criteria are distinguished in two groups: the ''core'' and the ''comprehensive'' criteria. The core criteria are designed to allow easy application of GPP, focusing on the key area(s) of environmental performance of a product and aimed at keeping administrative costs for companies to a minimum. The 'comprehensive' GPP criteria take into account more aspects or higher levels of environmental performance, for use by authorities that want to go further in supporting environmental and innovation goals.

As stated in the Communication of Green Public Procurement 'where, for the same product, European criteria distinguish between various levels of environmental performance, the 'core' and 'comprehensive' GPP criteria are drafted accordingly. If, for instance, a given product is covered by both the Energy Star energy efficiency requirements and by the voluntary European Ecolabel, the 'core' GPP criteria would be set at the level of the energy efficiency requirements of the Energy Star Regulation, whereas the 'comprehensive' criteria would be set on the basis of Ecolabel criteria'. This is the case of imaging equipment where Energy label requirements and Ecolabel criteria (currently on the Member State level) are available.

A first set of common GPP criteria was developed in the framework of the training toolkit on GPP [2]. These have been selected on the basis of the importance of the relevant sector in terms of the scope for environmental improvement, public expenditure, potential impact on the supply side, example setting for private or corporate consumers, political sensitivity, existence of relevant and easy-to-use criteria, market availability and economic efficiency. Following the first set, a second set of criteria was determined and for another 8 product groups GPP criteria are under development. Both sets of criteria are given in Table 3.

Table 3. Priority product groups for Green Public Procurement criteria [51]

1st priority product group for GPP (criteria available)	2nd priority product group for GPP (criteria under development)
Copying and graphic paper	Windows, glazed doors and skylights
Cleaning products and services	Thermal insulation
Office IT equipment	Hard floor-covering
Construction	Wall panels
Transport	Combine heat and power (CHP)
Furniture	Road construction and traffic signs
Electricity	Street lightning and traffic signals
Food and catering services	Mobile phones
Textiles	
Gardening products and services	

7.1 Green Public Procurement criteria for imaging equipment

In this section the currently available EU Green Public Procurement criteria on imaging equipment are described [2]. In this project new GPP criteria are developed which would replace the current available ones. A description of them follows. These GPP criteria are relevant for the development of the Ecolabel ones and the aspects regarding the interface GPP and Ecolabel are therefore emphasised.

In the European Commission Green Public Procurement training toolkit [2, 52] (latest update May 2009), the following imaging equipment is covered:

- copiers
- printers
- multifunctional devices
- fax machines
- scanners.

The specific criteria are given in Annex 3. The requirements for energy consumption refer to the corresponding ones from Energy Star [12] or Blue Angel [19]. The basis of these GPP criteria was the Ecolabel schemes of Nordic Swan and Blue Angel. The criteria are divided into two categories: core which are mandatory and comprehensive which are optional. Products with Ecolabel from the aforementioned schemes fulfil the green public

procurement comprehensive criteria. Fulfilling the energy efficiency requirements as set by the energy label of Energy Star is among the core GPP criteria.

It should be highlighted that in the Green Public Procurement criteria the products should not necessarily bear any Energy label or Ecolabel. However, the GPP criteria refer to the criteria of the Energy label and Ecolabel respectively thus the products bearing these labels do not need any further verification. Concerning the consumable parts of imaging equipment, no specific GPP criteria are available either for new or for reprocessed toner/ink cartridges.

The relevant key environmental impacts identified in the GPP criteria [52] for the imaging equipment product group are:

- energy consumption
- hazardous constituents
- metals contained within batteries
- waste reduction - reuse/recycling and the guarantee of spare parts
- noise emissions
- consumption of paper and toner

These defined Green Public Procurement criteria are in line with the study carried out on behalf of UNEP on sustainable procurement guidelines for office IT equipment [50] which are briefly given in the following Section 7.2.

7.2 Sustainable Public Procurement criteria for imaging equipment

Under the umbrella of the United Nations sustainable procurement guidelines are established and can be found in the background report United Nations Environmental Program, 'Sustainable Procurement guidelines for office IT equipment' [50]. The imaging equipment covered in this report includes:

- copiers
- printers
- multifunctional devices
- fax machines
- scanners.

The definitions of the products were adopted by the Energy Star label [12] definitions which are described in Section 1.1.

The identified key environmental impacts of the product group are the same as the previously described ones of the EU Green Public Procurement guidelines in Section 7.1. However, in these guidelines the recommendation is more general and descriptive compared with the determined core and comprehensive criteria in the GPP and also covers the issue of social considerations. In Table 4 the guidelines concerning the environmental aspects are summarised.

Table 4 Key environmental impacts of imaging equipment and respective guidelines as proposed by UNEP sustainable procurement

Key environmental impacts – Office IT Equipment	
Impact	**Approach**
• Energy consumption and resulting Carbon Dioxide (CO_2) emissions • Air, soil and water pollution, ozone formation (smog), bioaccumulation or food chain exposure and effects on aquatic organisms due to hazardous constituents, e.g. mercury content of LCD displays and flame retardants • Negative impact on the health of employees due to noise, causing stress for those sensitive to such sounds • Use of energy, finite resources and harmful emissions related to the production of IT products • Generation of waste material including packaging and final disposal	• Purchase energy efficient models • Purchase products with a restricted amount of hazardous constituents and promote take back options • Purchase products with a restricted noise level • Design-for-recycling, longer life and promote take back options • Decrease the quantity of packaging used • Ensure the recyclability of the packaging used • Increase the use of recycled

Source: United Nations Environmental Program, (UNEP), Sustainable procurement guidelines for IT equipment. Background report, May 2008 [50]

In the case of more ambitious environmental goals, adoption is recommended of the relevant Ecolabel and Energy label criteria of one of the following schemes: Blue Angel, Nordic Swan and Energy Star. A comparison of the Ecolabel and Energy label schemes is presented but unlike the GPP criteria toolkit, there is no proposed hierarchy of core and comprehensive criteria.

Important social considerations in the procurement of imaging equipment as presented in the sustainable procurement guidelines of UNEP include:

- the International Labour Organization (ILO) conventions
- the Global Compact Framework
- the Electronic Industry Code of Conduct

The core ILO conventions are:

- Freedom of association
    - Freedom of Association and Protection of the Right to Organise (No. 87)
    - Right to Organise and Collective Bargaining (No. 98)

- Forced Labour
    - Forced Labour (No. 29)
    - Abolition of Forced Labour (No. 105)
- Equality
    - Discrimination (Employment and Occupation) (No. 111)
    - Equal Remuneration (No. 100)
- Elimination of child labour
    - Minimum Age (No. 138)
    - Worst Forms of Child Labour (No. 182)

The Global Compact is a voluntary initiative for businesses that are committed to aligning their operations and strategies with the so called ten universally accepted 'Global Compact principles' which are:

- human rights
    - Principle 1: businesses should support and respect the protection of internationally proclaimed human rights;
    - Principle 2: It should be made sure that they are not complicit in human rights abuses.
- labour standards
    - Principle 3: Businesses should uphold the freedom of association and the effective recognition of the right to collective bargaining;
    - Principle 4: the elimination of all forms of forced and compulsory labour;
    - Principle 5: the effective abolition of child labour; and
    - Principle 6: the elimination of discrimination in respect of employment and occupation.
- Environment
    - Principle 7: businesses should support a precautionary approach to environmental challenges;
    - Principle 8: initiatives should be undertaken to promote greater environmental responsibility.
    - Principle 9: the development and diffusion of environmentally friendly technologies should be encouraged.
- Anti-corruption
    - Principle 10: businesses should work against corruption in all its forms, including extortion and bribery.

8. Energy efficiency label

In its Green Paper on the European Energy Strategy, the Commission underlines the need to strengthen its energy efficiency policy. In addition, the target for a 20 % reduction in energy consumption set in this Action Plan is part of the measures requested by the European Council in March 2006 to ensure the environmental feasibility of the European Energy Policy [53].

In line with this, the energy label aims to provide information about the energy consumption of the products in the use phase and to create market transparency and comparability of performance across technologies for consumers. The final goal is to encourage consumers to buy more energy-efficient products.

The imaging equipment product group is covered at the European level by the following legislative initiatives: Regulation (EC) 106/2008 [8] and Agreement between the USA and the EU on the coordination of energy-efficiency labelling programs for office equipment [10]. Another energy label and energy efficient scheme is the top runner program in Japan. A further description of the energy labels and schemes follows.

8.1. European Energy Label and Energy Star Label (US)

The European Commission and the US Environmental Protection Agency have under the EU-US Energy Star Programme [10] agreed (last update in June 2009 [54]) to common energy efficiency standards for office equipment including imaging equipment. In 2008 Regulation (EC) 106/2008 on a Community energy-efficient labelling programme for office equipment was established [55] The European Energy Star Programme is a voluntary energy labelling programme for office equipment. The Energy Star label helps consumers identify office equipment products that save them money and help protect the environment by saving energy. The Energy Star label is the most applicable worldwide label with up to 1339 imaging equipment products labelled. There are 742 multifunctional labeled products. Moreover, there are 836 products which have at least the function of copying, 1049 of printing, 869 of scanning and 345 products with the function of faxing.

The last valid eligibility criteria version is the Energy Star Requirements for Imaging Equipment, version 1.1 [12]. A revision of this version is still ongoing. Based on the

above, DG TREN in regard to the EU Energy label (Framework Directive 2010/30/EU [56] which is the recast of Directive 92/75/EEC [57]) planned to adopt the respective Energy Star criteria for the EU Energy Label. Currently the imaging equipment specifications version 1.1 is pending adoption by the European Community.

The products covered under the Energy Star label for imaging equipment are the following:

- copiers
- printers
- multifunctional devices (MFD)
- digital duplicators
- fax machines
- scanners
- mailing machines.

All the available imaging equipment is covered by Energy Star (see also Table 2: coverage of products). As mentioned before, the Ecolabel criteria for imaging equipment which refer to energy consumption found in the different Ecolabel schemes are harmonised with the requirements set by Energy Star.

In order to enable the determination of energy efficiency criteria for imaging equipment specific definitions of the product group and its technical characteristics are needed. Energy Star has numerous definitions determined. These cover the already mentioned definitions of products (see Section 3.1) and marking technologies (see Section 4.1) but go also further on specifications of operational modes, activities and power states, of product size formats as well as other technical terms like the operational mode, typical electricity consumption, etc.

The focus of Energy Star criteria is on the following aspects: the typical electricity consumption (TEC), the operational mode (OM) and the digital front end (DFE) requirements. The typical energy consumption (TEC) can be measured following the guidelines given in the respective test standard [58]. Regarding the operational mode there is also a respective standard established [59] together with the standard regarding the test conditions [60].

It is important to emphasise at this point that the Energy Star efficiency performance determination is different from the respective one found in the Blue Angel Ecolabel criteria. Blue Angel Ecolabel criteria as presented in Section 4.2.1.1 have developed an in-house method based on a three level limit curve diagram of power consumption versus time (see also Annex 5 in [19]). The advantage of the Blue Angel method is that in order to comply with the criteria it is not decisive that the devise have certain time limits in certain defined energy saving modes (e.g. sleep-modes, standby modes, etc). This gives more freedom to the manufacturers. However, the ambitious level of the set energy efficiency both in the Energy Star and in the Blue Angel criteria depends mainly on the particular set thresholds and less on the methodological approach.

An excerpt of the threshold values for the typical electricity consumption (TEC), the operational mode (OM), and the digital front end (DFE) efficiency of the Energy Star labelled imaging equipment is given in Annex 4.

8.2. Top Runner Japan energy efficiency program

The Top Runner Program is managed by the Energy Conservation Centre Japan. The approach for promoting energy efficiency products is much different. Contrary to the energy label of Energy Star this scheme is not voluntary.

The principle is that based on a market overview the products which show the highest energy efficiency are identified. These products then set the energy consumption base value for the criteria. The base value should become standard at a set fiscal year which is often 5 to 7 years after. The target standard values are often very high. However, the manufacturer, of each product shall ensure that for items to be shipped to the domestic market in the target fiscal year, a numeric value that is to be obtained by taking weighted averages of energy efficiency measured according to a predefined method will not go beyond the target standard value.

In the imaging equipment product group only the electrostatic copying machines are currently covered by the Japanese Top Runner Program [61]. The last report had as the target fiscal year 2006.

9. Ecodesign legislation

Ecodesign is a term that has been used longer in the scientific community meaning the designing of a product in a way which prevents environmental impacts. Ecodesign is defined in the reports of the European Commission as the integration of environmental aspects into product design with the aim of improving the environmental performance of the product throughout its whole life cycle [62].

As an environmental product policy instrument, Ecodesign is used based on the EU Directive 2009/125/EC on 'establishing a framework for the setting of Ecodesign requirements for energy-related products' [62]. This Directive is the recent recast of Directive 2005/32/EC [63] in which the scope of the covered products was extended from energy using to energy related. Nevertheless Directive 2009/125/EC is not applicable to means of transport for persons or goods. Ecodesign policy contributes to sustainable development by increasing energy efficiency and the level of protection of the environment, while at the same time increasing the security of the energy supply.

The Ecodesign scheme is a mandatory programme that sets minimum environmental performance requirements. These requirements should be fulfilled in order for a product to be placed on the market and/or put into service. The ambitious level of the product environmental performance is lower compared to the voluntary schemes of Ecolabel and Energy label. However, the environmental benefit potential of the proposed implementing measures is to a greater extent transformed to environmental savings when the measures are applied. This is different than the voluntary schemes in which the environmental-friendly products are promoted.

Another, important point to highlight is that a product shall be covered with Ecodesign implementing measures when it represents a significant volume of sales and trade, indicatively more than 200 000 units a year within the Community. Moreover, the implementing measures consider the life cycle of the product and all its significant environmental aspects, *inter alia*, energy efficiency. The depth of analysis of the environmental aspects and of the feasibility of their improvement shall be proportionate to their significance [62].

The policy process is as follows. In a first step is the product group preparatory study in which after analysing and assessing the environmental product performance are concluded, ways to improve it are recommended. The preparatory study shall provide the necessary information basis for the impact assessment which lays down essential

figures such as energy saving potential or costs for industry. Afterwards a consultation forum takes place and eventually implementing measures which lay down Ecodesign requirements could be drafted. The application of implementing measures is not inevitable. The industry has the option to propose a voluntary agreement. If this self-regulated voluntary agreement by industry is accepted then; it becomes legally valid and no implementing measures are undertaken.

The preparatory studies follow the methodology of MEEUP. MEEUP stands for Methodology for the Ecodesign of Energy-using Products and is a methodology especially developed for this purpose. The first extension of the product coverage from energy-using to energy-related together with the already gained application experience to several product groups raised discussions for possible extensions and amendments on MEEUP. These are subject of the planned Commission review on the effectiveness of the Ecodesign Directive which should take place before 2012 [64]. In Table 5 the product groups for which preparatory studies are undertaken or are ongoing are given.

Table 5. Product groups for which Ecodesign preparatory studies are undertaken

Product groups with finished Ecodesign preparatory studies			
Domestic washing machines and dishwashers	Boilers and combi-boilers (gas/oil/electric)	Water heaters	Personal computers (desktops and laptops) & computer monitors
Imaging equipment (copiers, faxes, printers, scanners, multifunctional devices)	Televisions	Standby and off-mode losses	Battery chargers and external power supplies
Lighting	Air conditioners and ventilation	Electric motors (1-150 kW), water pumps, circulators in buildings, ventilation fans (non-residential)	Commercial refrigeration (display cabinets and vending machines
Domestic refrigeration	Solid fuel small combustion installation	Laundry dryers	Vacuum cleaners
Complex set top boxes			
Product groups with ongoing Ecodesign preparatory studies			
Local room heating products	Central heating products using hot air to distribute heat (other than CHP)	Professional washing machines, dryers and dishwashers	Networked standby losses of EuPs
Domestic and commercial ovens (electric, gas, microwave), including when incorporated in cookers	Domestic and commercial hobs and grills	Non-tertiary coffee machines	Machine tools
Sound and imaging equipment: DVD/video players and recorders, video projectors, video game consoles.	Distribution and power transformers	Refrigerating and freezing equipment	Industrial and laboratory furnaces and ovens

9.1 Ecodesign on imaging equipment

DG TREN included in the Preparatory Studies for Ecodesign Requirements of EuPs No. TREN/D1/40 Lot 4 -2005 [1] the investigation of imaging equipment. The preparatory study was carried out by Fraunhofer Institute for Reliability and Microintegration, IZM, Berlin and was finalised in May 2008. Ecodesign preparatory studies are extensive and detailed. Thus, this study on imaging equipment is considered of particular importance as it was recently finalised and many features and outcomes of it can be used in the undertaken present report on Ecolabel and GPP criteria specifications.

In the preparatory study of Lot 4 the following imaging equipment is covered:

- copiers
- printers
- multifunctional devices (MFD)
- digital duplicators
- mailing machines
- fax machines
- scanners.

The product list by the Ecodesign preparatory study is longer compared with the one in the Ecolabel schemes of Blue Angel and Nordic Swan. Herein, the mailing machines are additionally included (see also Table 2).

The structure of the study is as follows. After determining the product group and scope of the study an extensive economic and market analysis of imaging equipment in the EU-27 is made. The stock of the products covered is then assessed.

In a following task a technical analysis and a report on user behaviour is elaborated. In this task important features of user behaviour patterns are determined (e.g. images created in personal and working environments) as well as the product lifetime. Based on the available information gained from these tasks, an environmental assessment of representative products (in Ecodesign methodology the term used is 'base case') is implemented. A calculation of the environmental impacts of the current stock of imaging equipment is then determined.

In a further step the best available technologies are determined upon which improvement potentials and environmental savings are explored. Finally,

recommendations for implementing measurements which are in line with the Ecodesign Directive [62] objectives are given.

In the present Preparatory study on imaging equipment six base cases were investigated. The selection of the products was mainly based on information and availability of market data. The products are distinguished based on:

- functionality (SFDs versus MFDs in which the core function is marked)
- user pattern (application in a private or working group environment)
- performance characteristics (the image colour, speed and technology).

The base cases were not real products. However, they are representative for the market and their technical parameters were calculated based on average values of real products. In particular, the investigated base cases were:

1. monochrome electro photographic MFD-copier for use in working environments (medium speed of 26 ipm)
2. colour electro 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).

The environmental assessment of the base cases based on MEEUP methodology investigates under a life cycle perspective several environmental impacts which are:

<u>Environmental Impact Categories</u>

- global warming potential
- acidification potential
- ozone depletion emissions
- eutrophication

<u>Other Environmental Aspects</u>

- 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 (air and water)
- polycyclic aromatic hydrocarbons (PAH)
- particulate matter (PM)

An excerpt from the environmental performance of the investigated MFD-copier as performed in the Ecodesign study using MEEUP is given in the following figure 5. The values of the investigated environmental aspects are given in two forms: the first as modelled taking into account the paper consumption during the product life cycle, and the second by neglecting these impacts.

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 environmental impacts related to the manufacturing phase of imaging equipment also gain importance especially in the category of eutrophication and also concerning the emissions of PAHs, POPs and VOCs. The high importance of paper consumption is related to the larger demands of energy in the paper production phase. As previously mentioned, interpretation of the MEEUP outcomes requires caution as 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 could not be captured like ink production (due to data gaps) or advanced material composition (as the assessment is made on a representative typical product).

Indicatively, only 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 emphasises the need for efficient use of paper towards a final reduction of the total amount of its consumption. Reduction of paper consumption can be achieved when printing and copying is made on both paper sides (duplex image reproduction). This aspect is taken into account in all the aforementioned Ecolabel schemes (Section 6) by setting one Ecolabel criterion regarding the feasibility of duplex printing and/or copying.

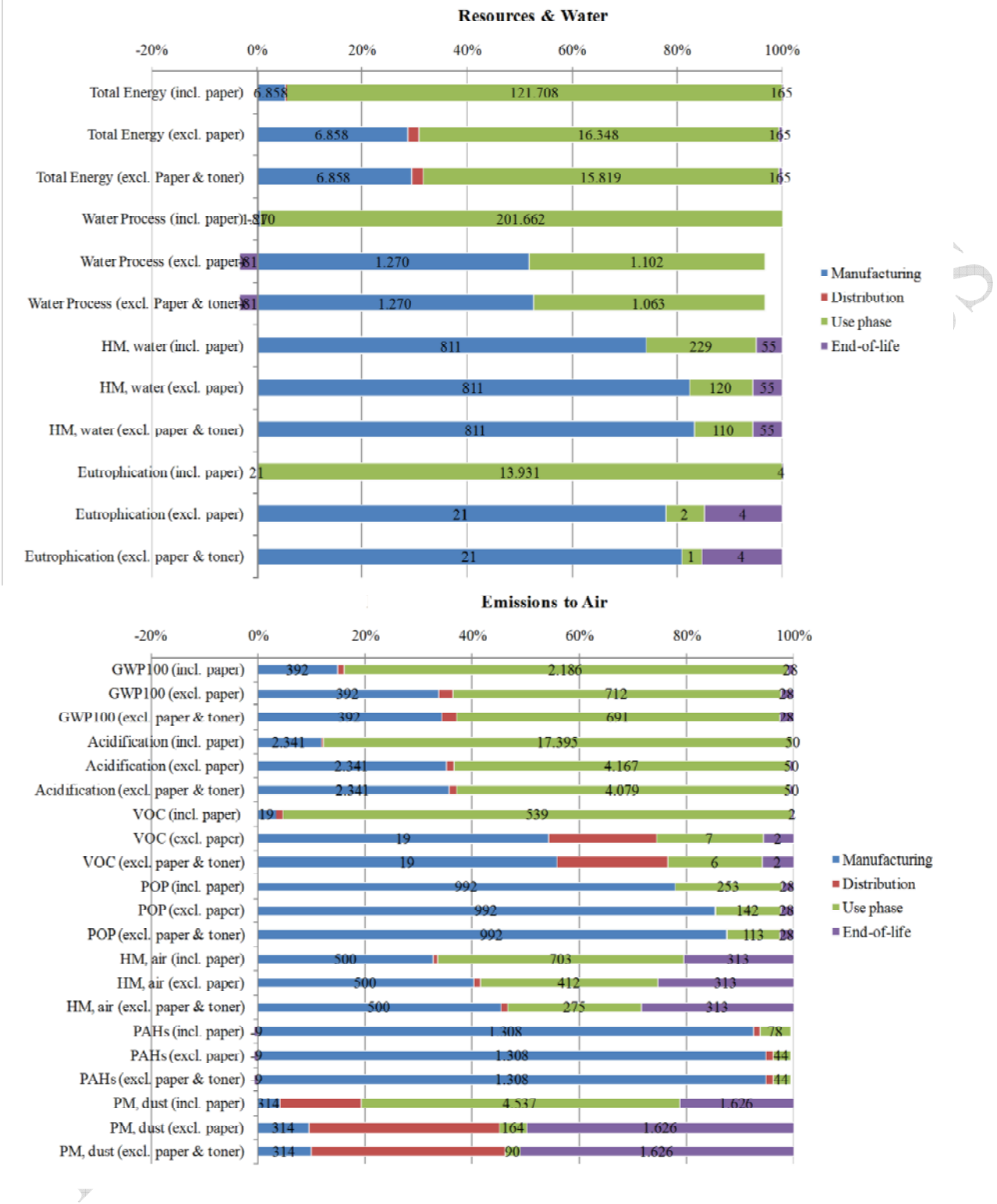

Figure 5 Environmental assessment of MFD-copier life cycle based on MEEUP Ecodesign methodology

Source: Ecodesign Preparatory Study on Imaging Equipment [1]

Another important outcome is that the images created in a working environment are much greater in number than the ones made for private use. Based on the analysis in the Ecodesign study the images in the private environment are for the reference year 2005, estimated up to 119 million units whereas in the working environment 556 million thus a relation of approximately 1:5. This indicates the importance of Green Public Procurement criteria which are applicable for imaging equipment used at work.

The next most important aspect regarding the life cycle environmental performance of imaging equipment as found in the preparatory 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 beneficial also in respect to the other investigated environmental aspects due to the lower pollutant emissions in the energy production phase.

The best available technologies of imaging equipment and the respective derived improvement options which were investigated in the preparatory study can be sorted in the following thematic areas:

- power consumption and energy efficiency
- resource efficiency
- consumables efficiency
- reduced substance emissions.

Out of these areas, energy efficiency became the main focus of the study. Several technological aspects and features were investigated. The challenge to this is that in imaging equipment a diversity of technologies, product designs and user requirements are found which make it complicated to determine general and simple thresholds on power consumption.

The power consumption of imaging equipment differs with respect to mode. Active mode is the most energy-consuming mode. Between two active modes several other modes which consume lower energy are feasible. However, there is no uniform terminology used for these modes. Many users summarise these terms as standby mode but several producers and researchers in order to be more precise refer to terms like 'ready mode', 'sleep mode', 'power save', 'low power', 'standby mode', 'network standby mode' and

others. Overlaps on these terms are found. One widely agreed basis for describing the standby mode is the one used in the Energy Star label.

The Ecodesign Preparatory study proposes implementing measures for short term application regarding the energy consumption based on the Energy Star Tier 1 criteria. A few adaptations and amendments are made in order to overcome drawbacks and to better reflect the objective of the Ecodesign directive. The environmentally ambitious level of the proposed threshold values is lower especially when these are compared with the current Energy Star criteria version 1.1 [12]. However, Ecodesign is a mandatory scheme and its objective is not the promotion of energy efficient (hence also environmental) products.

From a medium term perspective the Ecodesign study proposes two approaches. The first is to determine energy requirements based on a correction factor applied to the updated thresholds of the Energy Star criteria. The other approach is to set threshold values on newly developed and uniformly agreed terms and measurements on standby losses (this is now under development in DG ENER Lot 26 Networked Standby Losses [17] see also Section 9.2).

With regard to the consumable and resource efficiency aspects, the preparatory study bases the proposed implementing measures on the duplex requirements defined by the Energy Star Tier 1. Nevertheless, not all the imaging equipment should comply with these criteria. The product group segment proposed to comply are colour capable reproducing devices with image speed performance of >19 ipm and respectively monochrome ones with performance speed of >24 ipm. Additionally, the study proposes to promote the usage of recycling paper and for the industry to supply information on ink and toner yield cartridge consumption Important to emphasise here is that in general the promotion of use of reused, remanufactured or recycled ink and toner cartridges is left out which is contrary to the promotion made by all the Ecolabel schemes. Moreover, no specific Ecodesign requirements on materials and resource efficiency were considered appropriate due to the plethora of products and technologies available. Finally, regarding the reduction of substance emissions, focus is given to ozone emissions, and micro-dust. The first could be achieved by a restriction on the use of corona wire technology. A general ban on corona wire technology is not however recommended due to its negative impact on the market. On the latter just general recommendations based on the Blue Angel Ecolabel criteria thresholds are given.

After the preparatory study on imaging equipment was finished a voluntary agreement by industry was worked out in line with the Recitals 18-20 and Annex VIII on self-regulation of the ErP Directive 2009/125/EC [62]. The final self-regulated voluntary agreement proposal by industry is Version 2.5 [65] from 19 February 2010. In industry's submitted voluntary agreement, printers, copiers, multifunctional devices and fax machines are covered. The European Commission has not yet concluded on whether to proceed for a directive or for choosing the option of self-regulation.

9.2 Ecodesign preparatory study on standby losses

Relevant and applicable to the product group of imaging equipment is the horizontal Ecodesign EuP Preparatory study of DG TREN Lot 6 'Standby and Off-mode Losses' which was finalised in October 2007 [16]. The study was carried out by Fraunhofer Institute for Reliability and Microintegration, IZM, the same contractors as Lot 4 imaging equipment.

Imaging equipment and in particular fax machines and printers (laser and inkjet) were extensively investigated in Lot 6 together with other office and household appliances like personal computers (with accessories, e.g. monitor, speaker, broadband mode), televisions (with accessories), DVDs and set-top-boxes, audio mini-systems, electric ovens, washing machines, lighting, mobile phone and others.

Imaging equipment stay in networked standby modes in general for longer periods of time. In this study typical fax machines are in a networked standby mode for 23.1 hours per day and only 54 minutes in on-mode. Thus, a consumption of energy of 5.9 Watt takes place during the networked standby mode. In the case of printers these are estimated to be in on-mode from 6 to 24 minutes per day and in networked standby and off-mode for a range of 15 to 20 hours per day. Again the losses of energy during the time the printer is not in on-mode ranges from 9 to 20 Watt. Extrapolating these values for the estimated 4 to 6 years of product lifetime makes the losses more significant.

The investigation of the best available technologies (BAT) in the study of Lot 6 provided results which show that the best printers have 90 % less off-mode losses (the average printer has 3 W versus a BAT printer of 0.3 W) and respectively 50 to 85 % fewer networked standby losses. In the case of fax machines the BAT has 50 % less energy consumption than the average one. It is important to emphasise here that off-mode

losses could be eliminated for printers having a hard off-switch. In this case even more savings can be achieved.

The savings of standby losses as presented in the Preparatory Study of Lot 6 were considered significant. Therefore the European Commission through Regulation (EC) No 1275/2008 on implementing the Ecodesign Directive 2005/32/EC decided to apply implementing measures [66]. In this regulation is stated that in one year's time the relevant products shall have a power consumption in off-mode not exceeding 1 Watt and in 4 years time (thus in 2013) not exceeding 0.5 Watt. The benchmarks set for manufacturers in order to evaluate alternative design solutions (regarding Annex I, Part 3, point 2 of Ecodesign Directive 2005/32/EC) are for off-mode 0 to 0.3 Watt with a hard off-switch while for standby reactivation function and simple displays 0.1 Watt. Revision of this regulation is foreseen to take place no later than 6 years from entering into force.

Currently, the preparatory study of DG ENER Lot 26 Networked standby losses [17] is ongoing. This has many overlaps with the study of Lot 6 and could be considered as a follow up study especially in the case of office equipment. Power consumption of imaging equipment which is connected in a network (this is almost always the case) are included in the scope. Preliminary outcomes can be found in the draft reports of Tasks 1 to 5 available in [17]. The study is planned to finalise in February 2011.

10. Relevant European legislation applicable to imaging equipment

The most relevant EU legislation applicable to imaging equipment either on the products as a whole or on parts of them is:

- Directive 2002/96/EC on waste electrical and electronic equipment (WEEE) [67]
- Directive 2002/95/EC on Restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS) [68]
- Commission Regulation (EU) No 453/2010 on Registration Evaluation Authorisation and Restriction of Chemicals (REACH) [69]
- Commission Directive 2006/66/EC [70] on battery and accumulators and waste batteries and accumulators
- Commission Directive 94/62/EC [71] on packaging and packaging waste

WEEE and RoHS legislation are closely related to each other. In these legislations EU applies the producer responsibility principle based on which producers of electric and electronic equipment (EEE) are responsible for the environmental impact of their products. WEEE promotes the collection and recycling of electric and electronic equipment, including imaging equipment which are listed under information technology (IT) and telecommunication equipment while RoHS restricts the use of hazardous substances in these devices.

The objectives of WEEE are to reduce the overall amount of EEE waste, to encourage separate collection, to encourage treatment, reuse, recovery, recycling, sound disposal and to improve the environmental performance during the product life cycle.

Users of electrical and electronic equipment should have the possibility of returning WEEE at least free of charge. Producers should therefore finance collection from collection facilities, and the treatment, recovery and disposal of WEEE. Each producer should be responsible for financing the management of the waste from his own products. Based on the legislation where appropriate, priority should be given to the reuse of WEEE and its components, subassemblies and consumables. Where reuse is not preferable, all WEEE collected separately should be sent for recovery, in the course of which a high level of recycling and recovery should be achieved. In addition, producers should be encouraged to integrate recycled material into new equipment.

In RoHS the precautionary principle is applied together with the producer responsibility principle. The RoHS legislation aims to minimise the environmental impact of waste of electrical and electronic equipment by reducing the quantities of four heavy metals and two brominated flame retardants which the waste can contain. In particular, RoHS requires lead, mercury, cadmium, hexavalent chromium and flame retardants such as polybrominated biphenyls (PBB) or polybrominated diphenyl ethers (PBDE) which are found in EEE (including imaging equipment) to be substituted by safer alternatives which are more environmental friendly and ensure at least the same level of protection.

Therefore, RoHS requires manufacturers of imaging equipment to ensure that product components and subassemblies do not contain more than the permitted levels of the aforementioned banned substances. They must be able to demonstrate this by submitting technical documents or other information to the enforcement authority when asked.

In the study on the RoHS and WEEE Directives carried out on behalf of DG ENTR [72] it was estimated that in the EU-25 due to RoHS, 6434 tonnes of Pb, 395 tonnes of Cd and 86 ton of Cr (VI) were avoided yearly in printers while in copiers the values are 859 tonnes of Pb, 116 tonnes of Cd and 25 tonnes of Cr (VI). The hazardous substance list of RoHS could be extended in the future based on gained scientific and technical knowledge.

Furthermore, the Regulation on the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) is applicable to chemical substances. The aim of REACH is to improve the protection of human health and the environment through the better and earlier identification of the intrinsic properties of chemical substances. The REACH Regulation gives greater responsibility to industry to manage the risks from chemicals and to provide safety information on the substances. Manufacturers and importers will be required to gather information on the properties of their chemical substances, which will allow for their safe handling, and for registering the information in a central database.

Therefore, a classification and labelling inventory of dangerous substances is made. This classification is continuously updated and gradually more substances are integrated in the database. Based on this classification the different substances are grouped on a common basis with respect to their properties. This proves to be useful in the formulation of Ecolabel and GPP criteria. For instance in the currently available Ecolabel criteria of Blue Angel the use of all substances which are found in toners and are classified with the R-phrases of REACH (R40, R45 and R49) due to their carcinogenic properties are restricted.

Furthermore, Directive 2006/66/EC on batteries and accumulators is applicable to imaging equipment which has these components. Finally, the Packaging Directive which covers all packaging placed on the Community market and all packaging waste thereof is also applicable to the imaging equipment product group.

The Battery Directive aims at minimising the negative impacts of batteries and accumulators on the environment and also harmonising requirements for the smooth functioning of the internal market. To achieve these objectives, Directive 2006/66/EC introduces measures to prohibit the marketing of some batteries containing hazardous substances exceeding thresholds (e.g. mercury and cadmium content). It contains measures for establishing schemes aiming at a high level of collection and recycling of batteries with quantified collection and recycling targets. Therefore Directive 2006/66/EC sets out minimum rules for producer responsibility and provisions with

regard to the labelling of batteries and their removability from equipment. Many imaging equipment products do use batteries or accumulators. Available Ecolabels of imaging equipment set criteria regarding batteries based on Directive 2006/66/EC.

Directive 94/62/EC covers all packaging placed on the market in the Community and all packaging waste, whether it is used or released at any level (e.g. industrial, commercial, office, shop, service, household) regardless of the material used. Member States must ensure that packaging placed on the market complies with the essential requirements on the composition and the reusable, recoverable or recyclable nature of packaging (Annex II of the Packaging Directive). Packaging is always present on every marketed good. Compliance with the Packaging Directive as well as restricting the use of specific substances (e.g. halogen-containing polymers in plastics) based on environmental considerations is common practice for several available Ecolabels including criteria for imaging equipment. As the same kind of packaging can be used for different products Ecolabel criteria development on packaging could be considered as a horizontal cross-reference issue.

At this phase it is important to emphasise that the Member State established Ecolabelling criteria on office imaging equipment of Blue Angel and Nordic Swan which are herein considered as the basis for establishing the EU Ecolabel criteria as well the available GPP criteria are in compliance with all of the aforementioned EU legislation.

11. Relevant standards for imaging equipment

Several standards can be considered relevant to Ecolabel and Green Public Procurement criteria for imaging equipment. Apart from the standards regarding the environmental management and product declaration there are numerous standards for the testing and measuring of several technical parameters which are directly or indirectly linked to the product environmental performance.

Herein, are presented the relevant standards divided in the thematic areas of environmental product declaration and labelling and of measurements methods regarding i) indoor air quality, ii) energy efficiency, iii) noise and iv) reusability of components. Finally, at the end of the section other standards are listed which are relevant to imaging equipment.

<u>Environmental product declaration and labelling</u>

- IEEE 1680.2 Standard for Environmental Assessment of Imaging Equipment [73]

- ISO/ IEC 14024:1999: 'Environmental labels and declarations - Type I environmental labelling - Principles and procedures' [74]
- ISO/IEC 14021:1999: 'Environmental labels and declarations – Self-declared environmental claims (Type II environmental labelling) [75].
- ECMA International 370:2009: 'The Eco Declaration' [76].

The IEEE 1680.2 Standard is currently under development. This standard defines environmental performance standards for imaging equipment (as defined by the Energy Star imaging equipment specification) including copiers, printers, MFDs, fax machines, scanners, digital duplicators and mailing machines. The activity of IEEE 16820.2 is undertaken in US and is based on the participation of a high number of stakeholders. The US environmental protection agency (EPA) fosters this activity. This label is based on self-declaration but after the product enters into the market a third party verification system is foreseen. This standard intent to provide a clear and consistent set of performance criteria for the design of imaging equipment, and provide an opportunity to secure market recognition for efforts to reduce the environmental impact of these electronic products.

This Standard is defined with the intention that the criteria are technically feasible to achieve, but that only products demonstrating the leading environmental performance currently available in the marketplace would meet them at the time of their adoption. As the environmental performance of products that are available in the marketplace improves, it is intended that the criteria will be updated and revised to set a higher performance standard for leadership products [73].

This Standard 1680.2 is part of the 1680 family of Standards and will consist of environmental criteria and other materials that relate specifically to imaging equipment.

In ISO 14024 the framework for labelling products by a third party is given. EU Ecolabel as well as the Ecolabels presented in Section 4 are Type I labelling schemes. In this report for shake of simplicity and if not otherwise stated the term Ecolabel is used explicitly for Type I environmental labelling.

On the contrary to ISO 14024, ISO 14021 standard specifies requirements for self-declared environmental claims. Moreover, it describes terms and qualifications of the commonly used environmental claims supported by a general evaluation and verification methodology.

Standard ECMA 370 is a Type II self-declared environmental standard which meets the basic principles of the ISO 14021 framework. ECMA is an industry association dedicated to the standardisation of information and communication technology (ICT) and consumer electronics (CE). It has published up to 390 standards since 1961.

Measuring standards on indoor air quality

Regarding measuring methods associated with the determination of indoor air quality the following standards are applicable:

- ISO/IEC 28360:2007: 'Information technology - Office equipment - Determination of chemical emission rates from electronic equipment [77]
- ECMA International 328:2009: 'Determination of chemical emission rates from electronic equipment'
  [78]
- BAM 'Test method for the determination of emissions from hardcopy devices with respect to awarding the environmental label for office devices with printing function according to RAL-UZ 122', 2006. This standard is included in Annex 2 of the Blue Angel Ecolabel criteria [19].

In the ECMA 328 standard methods to determine the chemical emission volume from products of information communication technology and consumer electronics including imaging equipment are presented. In the latest version in 2009 the aim was to harmonise as much as possible the different proposed measuring methods. In the elaboration of this standard experts from ECMA and from the German Federal Institute for Materials Research and Testing (BAM) were involved. The measurements described in this standard integrate the ones described in the Blue Angel Ecolabel criteria on imaging equipment covering measurements of: volatile organic compounds (VOC), very volatile organic compounds (VVOC), total volatile organic compounds (TVOC), ozone half-time and particulate matter. Additionally, the following standards regarding specific measurements are also a reference point:

- ISO 1600-9: Indoor air -Part 9: Determination of the emission of volatile organic compounds - Emission test chamber method
- ISO 16000-6: Indoor air - Part 6: Determination of VOC in indoor and chamber air by active sampling on TENAX TA sorbent, thermal desorption and gas chromatography using MSD/FID
- ISO 16000-5:2007: Indoor air - Part 5: Sampling strategy for volatile organic compounds (VOCs)
- ISO 554:1976: Standard atmospheres for conditioning and/or testing specifications.

Measuring standards on energy efficiency

- ENERGY STAR Qualified Imaging Equipment Typical Electricity Consumption (TEC) Test Procedure
- ENERGY STAR Qualified Imaging Equipment Operational Mode (OM) Test Procedure
- Test Conditions and Equipment for ENERGY STAR Imaging Equipment Products
- Blue Angel Ecolabel on Office Equipment with Printing Function, Annex 5 (RAL-UZ 122): 'Determination of the idle modes that are to be tested and list of limit values for power consumption'

The aforementioned energy efficiency measuring standards are widely applicable. Energy Star measuring terms and standards are used in the Blue Angel energy efficiency measurements part (e.g. total energy consumption (TEC)).

Measuring standards on noise emissions

- ISO 7779:2010: 'Acoustics - Measurement of airborne noise emitted by information technology and telecommunications equipment' [79]
- ISO 3741:2010: 'Acoustics - Determination of sound power levels and sound energy levels of noise sources using sound pressure - Precision methods for reverberation test rooms' [80]
- ISO 3744 'Acoustics - Determination of sound power levels and sound energy levels of noise sources using sound pressure - Engineering methods for an essentially free field over a reflecting plane' [81]
- ISO 3745:2003: 'Acoustics - Determination of sound power levels of noise sources using sound pressure - Precision methods for anechoic and hemi-anechoic rooms' [82]

ISO 7779 specifies procedures for measuring and reporting the noise emission of information technology and telecommunications equipment. The determination of noise emission levels for a functional unit tested can be specified with the ISO 7779 described methods individually. Equipment which emits broadband noise, narrowband noise and noise which contains discrete-frequency components, or impulsive noise is addressed in ISO 7779. Three basic noise emission standards -ISO 3741, ISO 3744 and ISO 3745- for determination of the sound power levels are specified in ISO 7779. In particular, ISO 3741 specifies comparison measurements in a reverberation test room whereas ISO 3744 and ISO 3745 specify measurements in an essentially free field over a reflecting plane.

Measuring standards regarding reusability of components

- ISO/IEC 24700:2005: 'Quality and performance of office equipment that contains reused components' [83]

ISO/IEC 24700 specifies 'product characteristics for use in an original equipment manufacturer's or authorised third party's declaration of conformity to demonstrate that a marketed product that contains reused components performs equivalent to new, meets equivalent to new component specifications and performance criteria and continues to meet all the safety and environmental criteria required by responsibly built products. It is relevant to marketed products whose manufacturing and recovery processes result in the reuse of components' [83].

Other standards relevant to imaging equipment

- ISO 10779:2008 Office equipment accessibility guidelines for elderly persons and persons with disabilities.

ISO 10779 specifies accessibility guidelines to be considered when planning, developing and designing electro photographic copying machines, printers and multi-function devices. These guidelines are intended to improve accessibility required when primarily older persons, persons with disabilities and persons with temporary disabilities use office equipment.

Standards on measuring technical performance parameters are listed here:

- ISO/IEC 19799:2007: 'Method of measuring gloss uniformity on printed pages'
- ISO/IEC 24712:2007: 'Colour test pages for measurement of office equipment consumable yield'
- ISO/IEC 24711:2007: 'Method for the determination of ink cartridge yield for colour ink jet printers and multi-function devices that contain printer components'
- ISO/IEC 19798:2007: 'Method for the determination of toner cartridge yield for colour electro photographic printers and multi-function devices that contain printer components'
- ISO/IEC 18050:2006: 'Print Quality Attributes for Machine Readable Digital Postage Marks'
- ISO/IEC 21117:2005: 'Copying machines and multi-function devices Information to be included in specification sheets and related test methods'
- ISO/IEC 24700:2005: 'Quality and performance of office equipment that contains reused components'
- ISO/IEC TR24705:2005: 'Machines for colour image reproduction - method of specifying image reproduction of colour devices by digital and analog test charts'

- ISO/IEC 21118:2005: 'Information to be included in specification sheets - data projectors'
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- ISO/IEC TR19797:2004: 'Device output of 16 colour scales, output linearisation method (LM) and specification of the reproduction properties'
- ISO/IEC 19752:2004: 'Method for the determination of toner cartridge yield for monochromatic electro photographic printers and multi-function devices that contain printer components'
- ISO/IEC 13660:2001: 'Measurement of image quality attributes for hardcopy output – binary monochrome text and graphic images'
- ISO/IEC 15404: 2000: 'Minimum information to be included in specification sheets – facsimile equipment'
- ISO/IEC 14473: 1999: 'Minimum information to be specified for image scanners'
- ISO/IEC 10561: 1999: 'Printing devices - Method for measuring throughput - Class 1 and Class 2 printers'
- ISO/IEC 14545: 1998: 'Method for measuring copying machine productivity'
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- ISO/TR 14062:2002: 'Environmental management - integrating environmental aspects into product design and development'
- ECMA International 341: 'Environmental Design Considerations for ICT & CE Products'.

12. Overall conclusions on product definition and scope

12.1. Definition and scope

The term 'imaging equipment' defines the equipment used in the private or professional office, having as their main function either:

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

or

2) to produce a digital image from a hard copy through a scanning/copying process.

Consequently, imaging equipment includes the products marketed as printers, copiers, fax machines, scanners, multifunctional devices, digital duplicators and mailing machines. The aforementioned definition of imaging equipment is identical to the one used in the available Green Public Procurement Guidelines [2], in the Energy Star label [12] as well as in the relevant Ecodesign Preparatory Study [1]. Thus, the term 'imaging equipment' is used in the same way among the different product policy instruments.

The scope of the study has not yet been strictly determined. Potential products covered are the following: printers, copiers, multifunctional devices, fax machines, scanners, digital duplicators, mailing machines and their consumables (ink and toner cartridges). Due to their wide diffusion the first three (printers, copiers and multifunctional devices) are within the project's scope. However, this has not yet been decided for the other products. Important information for the determination of the final product coverage would be provided from the next Task 2 'Economic and Market Analysis'.

In the case of mailing machines there exists no Ecolabel scheme on European level while at the same time on the global level the applications are limited to very few models. Rather similar is the case of digital duplicators. For digital duplicators despite the fact that the Ecolabel of Nordic Swan covers them there are only a few licences awarded yet. Furthermore, fax machines and scanners when marketed as single functional products are expected to be substituted by multifunctional devices. Respecting the market trends is considered important for a successful marketing of the Ecolabel. Moreover, using multifunctional devices instead of two or more single functional products is considered environmentally beneficial due to resource conservation. In the case of fax machines it should be noted that the function of faxing documents is also more and more substituted by the use of e-mail.

In addition, the inclusion of the imaging equipment's consumable ink or toner cartridges into the project scope is still open. Ecolabels on toner and ink cartridges especially when these products are remanufactured are commonly found (please see Table 2). Nevertheless, ink and toner cartridges are sold as separate products thus they could be considered outside the product category. This is contrary to the fact that under a system approach the environmental performance of the life cycle of imaging equipment (please see also Figure 4) is also dependent on the respective performance of the consumables. The ink and toner cartridges could influence strongly the overall system performance.

Therefore a holistic system approach could possibly justify broadening the product group boundaries despite the different market classification. Hence, the scope of the study could include the consumables ink and toner cartridges.

12.2. Key environmental aspects

Key environmental aspects in the environmental performance of imaging equipment as described in Section 5 are: paper consumption, energy consumption, use of hazardous substances, indoor air emissions, noise pollution and product reuse or recyclability. Based on the initial available information the environmental impact associated with the paper consumption is of higher importance but is indirectly influenced by the product design. This aspect is mainly user behaviour dependent. Ecolabel and GPP criteria regarding product design should promote duplex image reproduction. On the contrary, energy efficiency is a product design aspect hence it is one of the core issues addressed later in the developed Ecolabel and GPP criteria for imaging equipment.

Moreover, in the current available Ecolabels the use of specific substances (many of them hazardous) is restricted. These substances are directly or indirectly associated with significant environmental impacts and avoiding use of them has proved feasible. Another significant aspect is the pollution which occurs during operation. Imaging equipment releases emissions and produces noise during operation. Limit levels on the emitted substances (e.g. VOCs, ozone) as well as limits on noise levels can be determined ensuring the indoor air quality and avoiding user disturbance.

Another aspect regarding the overall environmental performance of imaging equipment is the reusability and recyclability of the product or of parts of it. Significant environmental savings mainly due to resource conservation are considered feasible when reuse and recycle steps are intervened between the consumption and disposal life cycle phase. Hence the developed Ecolabel and GPP criteria would include this and promote reusability and recyclability of whole or components of imaging devices.

12.3. Ecolabel and GPP criteria on imaging equipment

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. It was found that in many Ecolabel schemes criteria originating from these two schemes are used (by cross-referencing) (see also Section 6). It is important that the Ecolabel criteria of Blue Angel and Nordic Swan be harmonised. The most important difference is in the energy efficiency determination. In Nordic Swan, the Energy Star

standards are used while in Blue Angel a different determination which has been developed on national level is applied.

The Blue Angel label shows a higher number of applications. There are up to 630 imaging equipment products from 18 different companies which bear the label of Blue Angel whereas in Nordic Swan there are in total 116 labelled imaging equipment products from 4 companies. The majority of the applications are for multifunctional devices. Between the two schemes differences in product coverage are found. Nordic Swan additionally covers fax machines, digital duplicators and scanners. However, no licence has yet been awarded for scanners and digital duplicators.

The available GPP criteria are found in the European Commission Green Public Procurement training toolkit [2]. These criteria will be later replaced from the new EU GPP criteria developed by this project. The GPP criteria are divided into core and comprehensive ones. The core criteria set minimum energy efficiency, duplex printing requirements and the availability of spare parts. These criteria are the same as the ones found under Blue Angel and Nordic Swan. In the case of energy efficiency, compliance to the limits set by either Energy Star or Blue Angel is required. In the comprehensive GPP criteria further requirements are listed. These are designed so that both the Nordic Swan and Blue Angel Ecolabels may be used to prove compliance. Similarly to the European GPP criteria the 'sustainable public procurement (SPP)' criteria are available on the UN level developed by UNEP. These are similar to the respective GPP ones. However, in the UNEP proposed SPP criteria some basic social considerations are also included (e.g. respect to conventions of the international labour organisation).

12.4. Energy label and Ecodesign on imaging equipment

Energy Star is the widely accepted energy label regarding imaging equipment with worldwide up to 1339 imaging equipment products labelled. Energy Star is the EU energy efficiency label for imaging equipment based on the EU-US Energy Star programme agreement [10]. The latest valid eligibility criteria version is the Energy Star requirements for imaging equipment, version 1.1 [12]. A revision of this version is still ongoing. Under Energy Star the different imaging equipment is labelled, thus including printers, copiers, multifunctional devices, scanners, digital duplicators, fax and mailing machines.

Under the criteria of Energy Star, the product group is classified with respect to functionality, performance and technology characteristics. Based on this classification different performance limits are determined. Energy Star criteria focus on requirements

regarding the typical electricity consumption (TEC), the operational mode (OM) and the digital front end (DFE). Energy Star criteria are for the majority of the Ecolabel schemes the reference in the specification of energy efficiency performance. A notable exception to this is the case of Blue Angel. Blue Angel has developed an in-house energy efficiency method based on a three level limit curve diagram of power consumption versus time.

Imaging equipment is one of the product groups investigated in the EU Ecodesign policy instrument. A Preparatory Study for Ecodesign Requirements on imaging equipment in the framework of the Ecodesign Directive [62] was recently undertaken and finalised [1]. This study is extensive and detailed. Many outcomes of this study are applicable in this report on Ecolabel and GPP criteria determination. In the Ecodesign preparatory study an environmental performance investigation is carried out on average imaging devices which are representative of the community market. Based on this the main environmental aspects under a product life cycle perspective were identified. Moreover, in this report the best available technology products are investigated and environmental improvement potentials are proposed. Energy efficiency was the focus of the Ecodesign study. After the preparatory study was finalised a voluntary agreement by industry was proposed [65]. The European Commission has not yet concluded on whether to proceed for a directive or to choose the option of self-regulation.

There are two other Ecodesign studies which are applicable to several energy-using products, among them imaging equipment. One regards standby and off-mode losses [16] which was finalised and implementing measures were decided [66]. The other one is still ongoing and investigates networked standby losses [17]. The outcomes of these Ecodesign studies represent valuable input for the current project. Ensuring harmonisation of the different policy instruments -Ecolabel, Green Public Procurement, Energy label and Ecodesign- is among the objectives of this study.

12.5. Relevant European legislation and standards

The most relevant EU legislation applicable to imaging equipment either on the products as a whole or on parts of them includes the WEEE Directive [67], the REACH Regulation [69], the RoHS Directive [68], the Battery Directive [70] and the Packaging Directive [71]. The EU Ecolabel criteria and Green Public Procurement criteria developed in this project will take into account and will be in compliance with this legislation.

Imaging equipment is a product group for which several standards have been developed and are applicable. Very important for this study are the standards on testing and measuring of technical parameters. Prior to the determination of Ecolabel and GPP

criteria, it should be ensured that test methods for the assessment of these criteria are available at a reasonable cost (see also Ecolabel Regulation [4]).

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ANNEX 1

Herein, is presented an excerpt of the Blue Angel Ecolabel criteria on office imaging equipment. Administrative criteria were left out.

3 Requirements and Compliance Verifications

3.1 General Requirements

3.1.1 Recyclable Design

Office equipment bearing the Blue Angel must be easily recyclable. The Checklist „Recyclable Design of Equipment" (Annex 1 to the Basic Award Criteria) identifies characteristics that are prerequisites for good recyclability.
These characteristics include among others:

Structure and Joining Technique

- Avoidance of non-separable connections (e.g. glued, welded) between different materials, unless they are technically required;
- easily separable mechanical connections;
- easy detachability of equipment by only one person;

Material Selection

- To reduce the multitude of materials, plastic casing parts that weigh more than 25 grams must consist of a single polymer or polymer blend. Plastic casings may consist of up to four separable polymers or polymer blends at the most.
- Large-size casing parts must be so designed as to ensure that the plastics used can be recycled on the basis of existing recycling technologies for the manufacture of high-quality long-life products. Such casing parts may not have a metallic coating.
- The coating of special parts should be kept to a minimum and reasons for coating shall be given.
- Galvanic coatings of plastic parts shall, however, not be permitted.
- The use of recyclate plastics that meet the material requirements under para. 3.1.2 is permissible and desirable.
- Reusable parts that meet all relevant requirements shall be used with preference.

Recycling of Equipment after Use

- Components and materials according to Annex III to the Electrical and Electronic Equipment Act (ElektroG), must be easily identifiable and removable (e.g. toner

modules, mercury-containing lamps for the lightning of liquid crystal displays as well as the liquid crystal displays themselves).

- The applicant shall provide information on the disassembly of equipment at recycling or treatment plants with regard to the individual components and materials.
- The applicant shall inform RAL about envisaged ways and methods of recycling of components and disposal (recycling and disposal) of devices according to the Electrical and Electronic Equipment Act (ElektroG).

Compliance Verification:

The applicant shall complete the Checklist „Recyclable Design" (Annex 1 to the Basic Award Criteria). The requirements shall be met if all Category M questions have been answered "Yes".

The applicant shall name the casing plastics used for parts > 25 grams and submit a list of plastics (according to Appendix 4) attached to the application according to RAL-UZ 122). This shall include information on the range of recyclate in plastics as permitted by the applicant.

The applicant shall indicate the envisaged measures for reuse and recycling of equipment in Appendix 11 to the Application.

The applicant shall declare in Appendix 1 to the Application that the contracted recycling company will be provided with information as required for an effective disassembly, modules as well as on the substances and components requiring selective treatment.

3.1.2 Material Requirements

3.1.2.1 Material Requirements for Plastics of Casings, Casing Parts

Halogenated polymers and additions of organic halogenated compounds as flame retardants shall not be permissible.

Exempted from this rule are:

- Fluoroorganic additives (as, for example, anti-dripping agents) used to improve the physical properties of plastics, provided that they do not exceed 0.5 weight percent.
- Fluoroplastics as, for example, PTFE.

- Plastic parts weighing less than 25 grams. However, they may not contain PBBs (polybrominated biphenyls), PBDEs (polybrominated diphenyl ethers) or chlorinated paraffins. (This exemption does not apply to keyboard keys.)
- Special plastic parts located close to heating and fuser elements. They may not, however, contain PBBs, PBDEs or chlorinated paraffins.
- Large-sized plastic parts which are reused as can be proved and which are marked according to para. 3.1.3. They may not, however, contain PBBs, PBDEs or chlorinated paraffins.

Flame retardants used in plastic parts with a mass greater than 25 grams shall be named to RAL and identified by their CAS Number.

Other substance bans according to Section 5, Electrical and Electronic Equipment Act (ElektroG) shall be respected.

In addition, no substances may be added to the plastics which are classified according to Directive 67/548/EEC as

- carcinogenic according to Category Carc.Cat.1, Carc.Cat.2 or Carc.Cat.3,
- mutagenic according to Category Mut.Cat.1, Mut.Cat.2 or Mut.Cat.3;
- reprotoxic according to Category Repr.Cat.1, Repr.Cat.2, Repr. Cat.3

or which are classified in TRGS 905 accordingly.

Both regulations have been considered in the overall list of all substances classified as carcinogenic, mutagenic or reprotoxic[5].

Exempted are process-related technologically unavoidable impurities.

Compliance Verification:

The applicant shall declare compliance with the requirements in Appendix 1 to the Application. With regard to flame retardants the applicant shall prompt the plastic suppliers to send a written statement to RAL stating that the banned substances have not been added to the casing plastics (Appendix 5). This also applies to the recyclate plastics used. At the same time, the applicant undertakes to prompt the casing plastics suppliers to confidentially report the chemical designation of the flame retardants used (CAS-Nr.) to RAL (Appendix 5 as well).

[5] www.baua.de

3.1.2.2 Material Requirements for the Plastics used in Printed Circuit Boards

The base material of printed circuit boards may not contain PBBs (polybrominated biphenyls), PBDEs (polybrominated diphenyl ethers) or chlorinated paraffins.

Compliance Verification:

The applicant shall declare compliance with the requirement in Appendix 1 to the Application or submit declarations from the suppliers of printed circuit boards stating that the banned substances are not contained in the boards.

3.1.3 Marking of Plastics

Plastic parts with a weight greater than 25 grams and a plane surface of at least 200 square millimeters, must be permanently marked according to ISO 11469:2000, taking ISO 1043, Parts 1 - 4, into consideration.
Exempted are plastic parts contained in reused complex modules.

Compliance Verification:

The applicant shall declare compliance with the requirement in Appendix 1 to the Application and indicate the marking in the list of plastics according to para. 3.1.1 in Appendix 4.

3.1.4 Batteries

Batteries and accumulators may not contain the heavy metals lead, cadmium or mercury. Exempted are technically unavoidable impurities. They may not exceed the limits given in Directive 91/157/EEC on Batteries and Accumulators, as amended (adapted to technical progress by Directive 98/101/EC)[6].
The applicant undertakes to accept the free return of the original user-exchangeable batteries/accumulators. A third party may be subcontracted for this task.
Under the Batterieverordnung [Battery Ordinance], as amended, the product documents need to include the necessary relevant information as well as details regarding take-back options and user's obligation to dispose of batteries and accumulators at a return facility and under no circumstances via the household waste system.

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[6] The EU Battery Directive is currently being revised. The revised version must be complied with from the time of its coming into force.

Batteries and accumulators which are not designed for exchange by the user must be replaceable at the end of their useful life without needing to exchange the entire printed circuit board or similar parts holding such batteries or accumulators.

Compliance Verification:

The applicant shall declare compliance with the requirements in Appendix 1 to the Application and, if the occasion arises, submit a declaration from the battery manufacturer. In addition, the applicant shall name the types of batteries/accumulators in the user documents (Appendix 12) and inform about the take-back system.

3.1.5 Printing Paper

The devices must be capable of processing recycled paper made of 100 % post consumer paper that meets the requirements of EN 12281:2002. The applicant shall be free to recommend certain types of recycled paper.

The user information shall include the following note: „This device is suited for processing recycled paper." A reference to EN 12281:2002 may be included.

Compliance Verification:

The applicant shall submit the corresponding user information (Appendix 12; see also paragraph 4)

3.1.6 Double-Sided Printing and Copying

Devices with a maximum operating speed of ≥ 45 A4 sized pages (or comparable format) per minute must, as a matter of principle, be equipped with a unit for automatic double-sided printing/copying (so-called duplex unit).

All other devices with a lower maximum operating speed must at least offer a manual option (copiers) or an extra software-based option (printers, multifunction devices) for double-sided printing on A4 size paper.

Electrophotographic devices with a maximum operating speed of 21 to 44 pages per minute must additionally be capable of being equipped - at least optionally - with a duplex unit.

The user documents to be provided by applicant shall include information on options for double-sided printing, the existence of a duplex unit or its availability as an upgrade.

Compliance Verification:

The applicant shall declare compliance with the requirement in Appendix 1 to the Application and submit the relevant user information (Appendix 12; see also paragraph 4).

3.1.7 Potoconductor Drums

Photoconductor drums may not contain selenium, lead, mercury or cadmium or any of their compounds as constituents.

Spent photoconductor drums shall be taken back by applicant (free of charge at a return facility) and either be recovered for reuse or subjected to material recycling.

The user information shall include details regarding take-back and return facility. Such facility shall be in located Germany or, respectively, in the country where the product is offered with reference to the Blue Angel.

Compliance Verification:

The applicant shall declare In Appendix 1 to the Application that the aforementioned substances are not contained in the photoconductor drums and that exchanged drums will be taken back and recycled. The applicant shall indicate the recycling method (Appendix 11 or 12) and refer to the take-back option in the user documents (Appendix 12; see also paragraph 4).

Material Safety Data Sheets shall be submitted to RAL upon request.

3.1.8 Guarantee of Repairs

The applicant undertakes to see to it that spare parts supply and necessary infrastructure for equipment repair is secured for a period of at least 5 years after the end of production and that users are informed about the guaranteed availability of spare parts.

Spare parts - or parts to be replaced - are those parts which typically have the potential to fail during the normal use of the product. In contrast, those parts whose life cycle usually exceeds the usual life of the product need not be provisioned as spare parts.

Compliance Verification:

The manufacturer shall demonstrate compliance with the requirement by presenting the user documents (Appendix 12; see also paragraph 4).

3.1.9 Maintenance of Equipment

Maintenance has great influence on the environmental features of a device. That is why maintenance should only be performed by qualified service persons. The user documents shall include instructions for equipment cleaning and maintenance, provided that such measures are necessary. Users shall be informed about a possibly required replacement of the ozone or dust filter.

Compliance Verification:

The manufacturer shall inform in the user documents about type and extent of maintenance work needed and its performance by qualified persons (Appendix 12; see also paragraph 4).

3.1.10 Product Take-Back

The applicant undertakes to take back own manufactured products bearing the Blue Angel eco-label after use in order to channel them with preference to reuse or to material recycling in terms of the Electrical and Electronic Equipment Act (ElektroG). Non-recyclable device parts shall be disposed of in an environmentally sound manner. Waste equipment from private households[7] may always be given to municipal collection facilities free of charge. Waste equipment from the business sector shall be returned to the applicant or to a return facility to be named by applicant. This presupposes that such Blue Angel labelled devices are returned in a condition consistent with its intended use.

The return facilities named by applicant must be located in Germany or in the country where the product is offered with reference to the Blue Angel. It must be possible to return the device either personally or by shipping services. The product documents shall include details on the equipment return options.

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[7] According to the Electrical and Electronic Equipment Act (ElektroG), equipment from small-scale businesses shall be treated in the same way because it may be passed over to the private final consumer.

Compliance Verification:

The applicant shall declare compliance with the requirement in Appendix 1 to the Application and demonstrate compliance by submitting the user information (Appendix 12; see also paragraph 4).

3.1.11 Packaging

Plastics used for product packaging may not contain halogen-containing polymers. The plastics used must be marked in accordance with the German Verpackungsordnung (Packaging Ordinance), as amended.

Compliance Verification:

The applicant shall declare compliance with the requirement and include information on the marking of packaging plastics used in Appendix 1 to the Application.

3.2 Requirements for Toners and Inks as well as for Modules and Containers for Toner and Ink

3.2.1 Modules and Containers for Toner and Ink

3.2.1.1 Recyclable Design and Reuse

Toner modules and containers as well as ink modules and containers supplied by the applicant along with the original equipment, as well as those recommended in the product documents for use in the respective device, must be so designed as to ensure their channeling to reuse or material recycling. They shall meet the relevant requirements as specified the Checklist "Recyclable Design" (Annex 1 to the Basic Award Criteria). Reuse shall always be given preference over recycling. That is why no parts designed to prevent the reuse of toner or ink modules may be attached to the modules.

If devices are originally equipped with toner or ink modules whose toner or ink content is atypically low users have to be explicitly informed about it.

Compliance Verification:

The applicant shall declare compliance with the requirement by completing the relevant sections of the Check List „Recyclable Design" (Annex 1 to the Basic Award Criteria) and answers „YES" to all the "M" requirements.

The applicant shall inform RAL by Annex 11 to the Contract about projected reuse or recovery methods.

If applicable, the applicant shall additionally give details in the user information on an atypically low capacity of toner or ink modules supplied along with the equipment (Appendix 12; see also paragraph 4).

3.2.1.2 Take-Back

The applicant undertakes to accept the return of toner/ink modules and toner/ink containers supplied or recommended by applicant for use in the product documents in order to channel such modules and container to reuse or material recycling with preference given to reuse. This also applies to residual toner containers. A third party (dealers and service agencies or companies engaged in the module recycling business) may be subcontracted to perform this task. The formers shall be provided with instructions for proper handling of residual toner.

Non-recyclable product parts shall be properly disposed of.

Modules and containers shall be taken back free of charge by the return facility named by the applicant to which products may be returned personally or by shipment. (Return facilities abroad shall only be permissible if the products can be sent there free of charge.) The product documents shall include detailed information on the return system.

Compliance Verification:

The applicant shall demonstrate compliance with the requirement in the user information (Appendix 12; see also paragraph 4).

The applicant shall declare compliance in Appendix 1 to the Application and document the instructions for the recycling contractor for dealing with residual toner (e.g. by means of the EC Material Safety Data Sheet) and by means of the note: „Prevent toner dust from being released into the air") (Appendix 6b).

3.2.1.3 Specific Instructions for Handling Toner Modules

Toner modules and containers must be sealed so as to prevent toner dust from escaping during storage and transport. The user information shall include explicit instructions for proper handling of toner modules. In addition, the user information shall include a note warning the user that toner modules may not be forced open and that in case toner dust has escaped as a result of improper handling inhaling the dust and skin contact should be avoided as precaution. The user information shall additionally include instructions on what to do in case of skin contact.

In addition, it needs to be stressed that toner modules must be kept away from children.

Compliance Verification:

The applicant shall submit the user information (Appendix 12; see also para. 4).

3.2.2 Material-Related Requirements for Toners for Use in Electrophotographic Devices and Inks for Use in Ink jet Devices

3.2.2.1 Hazardous Substances

Toners and inks may not contain substances as constituents which are classified according to Gefahrstoffverordnung (Ordinance on Hazardous Substances)[8] pursuant to Annex I to Directive 67/548/EEC (Publication of the List of Hazardous Substances and Preparations including all adaptation directives) and which require labelling according to Annex VI of said directive with the following R Phrases[9]:

R 40 (Limited evidence of a carcinogenic effect)

R 45 (May cause cancer)

R 46 (May cause heritable genetic damage)

R 49 (May cause cancer by inhalation)

R 60 (May impair fertility)

R 61 (May cause harm to the unborn child)

R 62 (Possible risk of impaired fertility)

R 63 (Possible risk of harm to the unborn child)

R 68 (Possible risk of irreversible effects)

or are classified as carcinogenic, mutagenic or reprotoxic substances according to TRGS 905[10] (as amended). (Both regulations have been taken into consideration in the overall list of substances classified as carcinogenic, mutagenic or reprotoxic,

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[8] GefStoffV (Ordinance on Hazardous Substances) of 23 December 2004, BGBl (Federal Law Gazette) I, page 3758; see also http://www.baua.de

[9] *Explanation:*
The EU System for CMR properties uses the following markings:

R 45, R 49	*carcinogenic Category 1-2*
R 40	*carcinogenic Category 3*
R 46	*mutagenic Category 1-2*
R 68	*mutagenic Category 3*
R 60, R 61	*reprotoxic Category 1-2*
R 62, R 63	*reprotoxic Category 3*

so-called CMR substances[11]),
or which according to Section 5, Ordinance on Hazardous Substances, must be classified according to Annex VI to Directive 67/548/EEC by manufacturers or importers themselves.

Substances that require labelling of the entire product with the R43 Phrase (May cause sensitization by skin contact) may not be included either.
It is assumed that substances that would require labelling as „toxic" or „very toxic" will not be used as a matter of principle.

Compliance Verification:
The applicant shall demonstrate compliance with requirements by submitting a test report or a declaration signed by an authorized representative of the company (Appendix 6a). Material Safety Data Sheets for all toners and inks shall be submitted upon filing of the application (Appendix 6b). Provided that the Material Safety Data Sheets do not show a negative AMES Test the test result of such test shall be given separately (Appendix 6c).

3.2.2.2 Heavy Metals

No substances may be added to toners and inks which contain mercury, cadmium, lead, nickel or chromium-VI-compounds as constituents. Exempted are high molecular weight complex nickel compounds as colorants.
Production-related contamination by heavy metals, such as cobalt and nickel oxides shall be kept as low as technically possible and economically reasonable (ALRA principle - as low as reasonably achievable).

Compliance Verification:
The applicant shall demonstrate compliance with the requirement by submission of the a declaration from the ink or toner manufacturer (Appendix 6a).

3.2.2.3 Azo Dyes

Azo dyes (dyestuffs or pigments) that might release carcinogenic aromatic amines appearing on the list of aromatic amines in Directive 2002/61/EC (see also TRGS 614) may not be used in toners and inks.

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[10] http://www.baua.de/

Compliance Verification:

The applicant shall demonstrate compliance with the requirement by presenting a declaration from the ink or toner manufacturer (Appendix 6a).

3.2.2.4 Biocides in Inks

Only those substances may be added as active biocides to inks which are listed as so-called existing substances in Annex II to Commission Regulation EC 2032/2003 amended by Regulation EC 1048/2005[12]. The use of new (non-listed) active substances would require approval according to the Biozidgesetz (Biocidal Products Act)[13].

Compliance Verification:

The applicant shall demonstrate compliance with the requirement by submitting a declaration from the ink manufacturer (Appendix 6a).

3.3 Substance Emissions

3.3.1 Comment

Also, electronic devices emit volatile organic substances into the indoor air, with the amount of these substances being time-dependent. Heating and printing processes intensify the release (emission) of such substances. Depending on the technology used ozone can additionally be generated during the operation of printing devices. Additionally, there are dust emissions which mainly consist of paper and toner dust (in electrophotographic devices). These emissions should be kept as low as possible in order to maintain good indoor air quality. This is supported by both the limita-

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[11] www.baua.de/prax/ags/cmr_liste.htm

[12] Commission Regulation (EC) No. 2032/2003 of 4 November 2003 on the second phase of the 10-year work programme referred to in Article 16, (2) of Directive 98/8/EC of the European Parliament and of the Council concerning the placing of biocidal products on the market and on the amendment of Regulation (EC) No. 1896/2000, Official Journal of the European Union L 307/1 of 24 November 2003, amended by the Commission Regulation (EC) No. 1048/2005 of 13 June 2005, Official Journal of the European Union L 178/1 of 9 July 2005.

[13] The Biocidal Products Directive 98/8/EC governs the marketing of biocidal active substances and biocidal products. As from the 1st of September 2006 only the existing biocidal agents may be used which appear on the "final list of existing biocidal active substances" in Annex II to Commission Regulation (EC) No. 2032/2003 amended by Commission Regulation (EC) 1048/2005 The 10-year review programme is expected to run until 13 May 2010. Thereafter, the respective biocidal products will require approval according to the German Biocidal Products Act.

tion of emissions within the scope of the requirements for the Blue Angel eco-label and an appropriate user behaviour.

Emission rates determined under defined conditions are used to characterize emissions.

In doing so, the volatile organic compounds are determined as summary parameters TVOC (total volatile organic compounds). In addition, benzene and styrene are determined as single substances. The same applies to ozone and dust.

Determination of emission rates according to Annex 2 to the Basic Award Criteria is done in ready mode[14] of the equipment as well as during continuous printing. Determination of the maximum permissible emission rates starts out from a use factor of monochrome printing equipment in print mode of 0.1, i.e. printing is actually done during 10% of the time theoretically available for uninterrupted printing. (This corresponds to a print volume of about 1000 pages per working day for a device that prints about17 pages/minute.)

A use factor of 0.05, i.e. half of the above value, is assumed, for the time being, for colour printing equipment.

The use factor for the ready phase is 1. The equipment-related emission of newly produced devices will, however, decrease with the passing of time. It is lower for desktop products – primarily because of the lower material and component volume.

The maximum permissible emission rates for ready and print phase in Table 1 consider, from a precautionary perspective, the influence of ready and printing phase on indoor air quality on a proportionate basis.

3.3.2 Electrophotographic Devices

Electrophotographic devices are tested for emissions of volatile organic substances in a ready phase prior to print start. During the printing process they are tested for release of TVOC, styrene and benzene as well as for that of dust and ozone. The emission rates in ready and in printing phase shall be determined and recorded according to the test method described in Annex 2 to the RAL-UZ 122 Basic Award Criteria. They may not exceed the values shown in Table 1:

[14] This ready phase comprises the pre-set time profile of equipment power consumption for one hour.

Table 1

Permissible Maximum Emission Rates Determined According to Annex 2

Substance	Emission rate Print phase (mg/h)		Emission rate Ready phase (mg/h).	
	Colour Printing Total in ready + print phase	Monochrome printing Total in ready + print phase	Desktop products	Floor-mounted equipment (Volume >250 litres)
TVOC	**18**	10	1	2
Benzene	< 0.05	< 0.05		
Styrene	1.8	1.0		
Ozone	3.0	1.5		
Dust	4.0	4.0		

Provided that the emission rate determined also meets the limit values for monochrome printing when printing the colour test page no additional testing of colour equipment will be required for monochrome printing.

The test report shall list the types of toner used in the product for testing. Any change of type of toner shall be notified to RAL and will require a resubmission of a test report for the print phase.

The test report shall always contain month and year of product manufacture[15].

Compliance Verification:

The applicant shall submit a form completed by the testing laboratory (Appendix 7a) confirming compliance with the requirements of the Basic Award Criteria regarding the substance emissions for monochrome printing on monochrome devices as well as for colour printing and, if the occasion arises, for monochrome printing on colour equipment.

[15] The gap between testing and filing of the application should be less than 10 months.

A copy of the complete test report according to the test guideline (Annex 2) shall be enclosed (Appendix 7b).

3.3.3 Ink Jet Devices

TVOC shall be determined for ink jet devices on the basis of the work instructions in Annex 2 when printing the colour test page. Testing shall be performed at the print speed referred to by the manufacturer as normal or standard mode and which is normally factory preset.

When printing the colour test page a TVOC emission rate of 18 mg/hour may not be exceeded.

Provided that the emission rate determined also meets the limit values for monochrome printing when printing the colour test page no additional testing of colour equipment will be required for monochrome printing.

The test report shall list the type of ink used for testing. Any change of the type of ink shall be notified to RAL and will require a resubmission of a test report for the print phase.

Compliance Verification:

The applicant shall submit a form completed by the testing laboratory (Appendix 7a) confirming compliance with the requirements of the RAL-UZ 122 Basic Award Criteria regarding the substance emissions. A copy of the complete test report according to the test guideline (Annex 2) must be enclosed as well (Appendix 7b).

The qualification of the testing laboratory for the emission measurements under paras. 3.3.2 and 3.3.3 shall, for the time being, be established to the satisfaction of Bundesanstalt für Materialforschung und –prüfung (Federal Institute for Materials Research and Testing) Working Group IV.2 „Emission from Materials" and documented in an Annex to the Test Report.

3.3.4 User Information on Substance Emissions

The user information shall include a statement confirming that the requirements for award of the Blue Angel eco-label have been checked and met with the consumables (type of toner or ink) supplied and recommended by the manufacturer.

The applicant shall further state that new electronic devices generally emit volatile substances into the indoor air and that, therefore, the user should ensure more fre-

quent air exchange in rooms where new equipment is set up or directly at the workplace, especially during the first days of use.

Compliance Verification:

The applicant shall submit the user documents (Appendix 12; see also para. 4).

3.3.5 Products of Identical Design

If two devices of identical design differ in their maximum print speed the product printing at higher speed shall be tested.

The result is considered as transferable to those products of identical design whose print speed falls short of the maximum print speed by not more than 20 percent.

When filing application for three or more devices of identical design printing at different speeds the product printing at highest speed and another one featuring a lower print speed shall be tested.

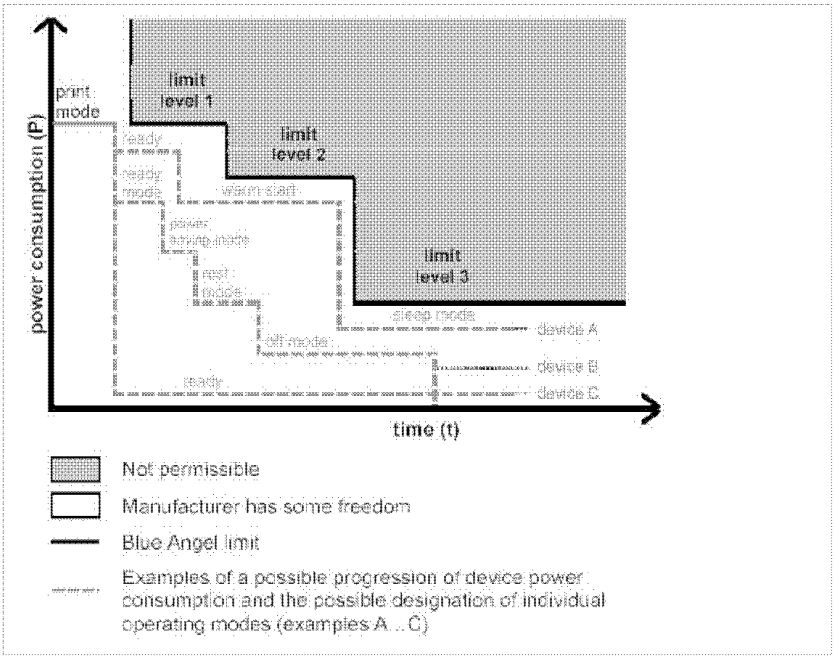
Further comments on devices of identical design can be found in Annex 4 to the Basic Award Criteria.

3.4 Energy

Note: An arrow (↑) preceding a term indicates that this term is defined in paragraph 2 or 3.4.1.

The Blue Angel sets a limit for the power consumption of the device for the time after ↑ the end of the printing process – be it for ↑ printing or for ↑ copying as well as for the time after the end of other ↑ primary functions. The size of this limit decreases in so-called limit levels with the time that elapses after the end of the printing process. The power consumption of the equipment shall not exceed this limit. For compliance with this requirement it is not decisive that the device has certain ↑ sleep modes, i.e. any kind of stand-by or ↑ energy-saving modes. What is decisive is the fact that the equipment does not exceed the limit curve. That means it is up to the manufacturer to lower the size of power consumption in one or more steps, as shown in **Fig. 1** by means of three examples.

Fig. 1: Blue Angel Limit Curve for Equipment Power Consumption during the Time that elapses after the end of the Printing Process



As **Fig. 1** shows, one limit curve is not necessarily assigned to one single sleep mode. One limit curve can also limit the power consumption of several sleep modes.

Example: In Fig. 1, the limit curve 1 of device B (middle line) refers to the modes „ready", „power-saving" and „sleep".

Likewise, various limit values can apply to a single sleep mode.

Example: In Fig. 1, the „warm start" mode of device A (upper line) may exceed neither limit level 1 nor limit level 2.

That is why paragraph 3.4.4 (power consumption) and para. 3.4.5 (times) give values which only describe the shape of the Blue Angel limit curve. They do not indicate limit values for individual sleep modes. A comparison between the shape of the power consumption curve of the device in this mode with the shape of the Blue

Angel limit curve give the limits set by the Blue Angel for a single operating mode of a single device.
After end of the printing process the devices usually switch into ↑ ready mode from which they can immediately start to print, if required.

Example: In Fig. 1 these are the modes „ready" and „low-power mode".

Afterwards, they usually go to a reduced power-consumption mode, a so-called ↑ energy-saving mode. Example in **Fig. 1**: the modes „warm start", „energy-saving mode" and so own. The power consumption in such energy-saving modes can be measured at a laboratory (unit: watts). To what extent these modes will contribute to a reduction in energy consumption in everyday office life (unit: kilowatt-hours) depends on whether they actually occur and, if so, for how long (unit: hours; hence: watts × hours = kilowatt-hours). On many devices the user can change the ↑ activation times of the energy-saving modes – that means they also can chose a very high value – or even deactivate the modes. If, however, a device needs a long ↑ return time, i.e. a time to return to ready mode so long that the user might regard it as burdensome and might try to chose as high a value as possible for the activation time of the energy-saving mode to prevent this mode from occurring very quickly and, thus, so very frequently. Or the user will even deactivate this mode. As a result, the device will remain in a higher power-consumption mode. To avoid this, it is necessary to make the user accept energy-saving modes and their consequences in everyday office life. That is why the Blue Angel sets a low limit for the return time (see para. 3.4.3). Apart from this, the user information shall include corresponding comments.
Measurements of power consumption and those of activation and return times shall be conducted in accordance with Annex 6 taking the comments in Annex 5 into account.

3.4.1 Definitions

To the extent possible, the following definitions are based on the definitions of Energy Star 10'2005[16]. In some cases, however, Energy Star does not offer an adequate definition so that either existing definitions had to be adapted or additional ones had to be created.

Blue Angel Limit Curve

3.4.1.1 Limit level (G_1, G_2 and G_3): section of the limit curve determined by the amount of power consumption P_i[17]. This section starts when after the last print the time t_{iA} has elapsed and ends when the next limit level begins, i.e. at the time $t_{(i+1)A}$. A limit level can also end when the user switches the device to the ↑ Plug-in Off mode or when the device goes to the ↑ standard operation mode.

Device Versions and Components

3.4.1.2 Base Unit: See definition in paragraph 2.

3.4.1.3 Upgrade: Term stands for all changes that lead to an increase in the number of ↑ primary functions of the ↑ base unit performed by device.

This primarily includes changes in the device technology and its control; be it by changing the existing technology/control or by installing new technology/control; be it inside or outside the device. Examples: exchange of existing components of the device; connection of a controller to the device; enabling certain functions by installing certain components (including chips) or installation of appropriate control software.

3.4.1.4 Upgrade level: level of equipment of a ↑ base unit with the extensions described under ↑ upgrade.

3.4.1.5 Accessory (according to the definition of Energy Star 10'2005 for „accessory"[16]): An optional piece of peripheral equipment that is not necessary for the operation of the ↑ base unit, but that may be added before or after shipment in order to add new functionality. An accessory may be sold separately under its own model number, or sold with a base unit as part of a multifunction device package or configuration.

Supplement: Controllers are not considered as accessories.

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[16] „Energy Star Qualified Imaging Equipment – Revised Terminology and Definitions", 28 October 2005

Note: a) Examples of accessories include sorters, high-capacity paper feeders, paper-finishing equipments, large paper supply devices, output paper organizers as well as chips and counters. b) The power consumption of accessories is not included in the power consumption of the device with which the device must meet the limit curve.

3.4.1.6 Delivery status: The condition in which the manufacturer ships the device and in which the manufacturer has set the † activating times of individual operating modes.

3.4.1.7 Printing Unit: Unit of the device used to print on paper and similar data carriers – be it in the primary function † copying, † printing or printing of faxes.

3.4.1.8 Scanning Unit: Unit of the device used to optically scan paper documents or similar data carriers in order to convert them into electronic information that can be stored, edited, converted or transferred – primarily with the aim of using them for data processing in a device (copier) or in a computer. (mainly corresponds to the Energy Star 10'2005 definition of the function of „scanners" [16]).

3.4.1.9 Telephone modem: Unit of the device used to convert data received or sent via telephone line.

3.4.1.10 LAN[18] interface: Unit of the device used to transmit data between the device and a data network (LAN).

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[17] Here and hereinafter the letter „i" stands for index.

[18] LAN = local area network

Operating Modes

Survey of the Operating Modes:

Standard Operation Mode:	Sleep Modes:		
Print mode, Copy mode etc.	Ready Mode	Energy-saving Mode(s)	Plug-in Off

3.4.1.11 Standard Operation Mode (corresponding to the Energy Star 10'2005 definition of „active" mode[16]): In standard operation mode the product is connected to the mains and actively performs a ↑ primary function.

Note: An example of standard operation mode is the ↑ print mode.

3.4.1.12 Print Mode: In print mode the device puts out data by printing on paper and similar materials – be it in the primary function ↑ copying, ↑ printing or when faxing.

3.4.1.13 End of the printing process: point in time when during a print job the last printed page (or similar material) of the print job has left the ↑ print unit of the device so that it is available to the user. This is the case, for example, when the sheet of paper has reached the output tray. If there are different points in time possible for a device – for example, if the device has multiple output trays – the earliest of these points in time shall be considered as the end of the printing process in terms of these Basic Award Criteria.

3.4.1.14 Sleep Mode (Z_a, Z_b, etc.): The power state that the product enters after the ↑ end of the printing process - directly or upon expiry of an ↑ activation time (t_{aA}, t_{bA}, …). The sleep modes also include the ↑ Plug-in Off mode which is either user-activated by a switch or self-initiated by the device. In a sleep mode, the ↑ power consumption (P_a, P_b, …P_S) of the device is usually lower than in the print mode. Sleep modes are stand-by modes in which the device is more or less ready for operation i.e. it can more or less fast return to print mode.↑ Ready mode and energy-saving modes are examples of sleep modes. With respect to the Blue Angel requirements the sleep modes are to be categorized according to Appendix 5, i.e. they shall be delimited from each other.

Note: The sleep modes include, for example, the modes „sleep" and „stand-by", as described by Energy Star 10'2005[16].

3.4.1.15 Ready Mode (corresponding to Energy Star 10'2005 definition of „Ready" mode [16], here, however, limited to ↑ print mode): The sleep mode Z_a in which the product is not producing output, has reached operating conditions, has not yet entered an ↑ energy-saving mode and is ready to return to print mode with minimum delay. All device functions can be activated in this mode and the device must be capable of returning to print mode by responding to the use of input options of the device. Input option include external electrical signals (as, for example, data network signals, fax input or remote control) and direct technical user interventions (such as activation of a switch or button).

Note: "Ready" is the power state that the device enters immediately after the ↑ end of the printing process.

3.4.1.16 Energy-Saving Mode: Sleep mode (Z_b, Z_c, …) where the device goes to after expiry of an ↑ activation time (t_{bA}, t_{cA}, …) and where its ↑ power consumption (P_b, P_c, …) is usually lower than in ready mode.

Note: At the end of the printing process devices usually switch to "ready" mode first and later to an energy-saving mode. Some devices have just one energy-saving mode while others have multiple energy-saving modes of different power consumption levels. And again others have no energy-saving mode at all. These devices stay in „ready" mode where power consumption is mostly very low so that the ready mode fulfils the function of the energy-saving mode.

3.4.1.17 Plug-in Off Mode (corresponding to Energy Star 10'2005 definition of the „off" mode[16]): The power state that the product enters when is has been manually or automatically switched off but is still plugged into and connected to the mains. This mode is ended by an input, for example via a switch or a timer which brings the unit into ↑ ready mode. If this state is manually activated by the user, it is often referred to as "Manual Off", and if it is activated by an automatic or predetermined signal (e.g. activation time or clock), it is often referred to as "Auto Off".

Device Functions and Properties

3.4.1.18 Primary Functions: Primary functions include † printing, † copying, † digitizing and transmitting of data as well as † sending and receiving of electronic messages and faxes.

3.4.1.19 Printing: see definition in paragraph 2.

3.4.1.20 Copying: see definition in paragraph 2.

3.4.1.21 Digitizing and transmission of data: see definition in paragraph 2.

3.4.1.22 Sending and receiving of electronic messages and faxes, see definition in paragraph 2.

3.4.1.23 Multifunctionality: The capability of a device to perform at least two † primary functions at least one of which must be † copying or † printing.

3.4.1.24 Output Speed S_{SW}: Output speed S_{SW} gives the number of A-4 size pages a device can print per minute in black and white according to manufacturer's information if data output is performed on paper or similar materials. If the device offers the primary function "printing" the output speed for this function shall be used. If not, the output speed in the primary function "copying" shall be used. For ink jet devices, the standard mode (usually preset) >>shall be chosen.

3.4.1.25 Output Speed S_F: Output speed S_F gives, analogously to output speed S_{SW} , the number of A-4 size pages a device can print in colour according to manufacturer's information if data output is performed on paper or similar materials. For ink jet devices the standard mode (usually preset) >>shall be chosen.

3.4.1.26 Electrophotographic colour devices of Group A: Devices whose output speed in colour print mode (S_F) is far lower than in monochrome print mode (S_{SW}). The following formula shall apply:

$$\mathbf{S_F < 0.9 \times S_{SW}}$$

3.4.1.27 Electrophotographic colour devices of Group B:

Devices whose output speed in colour print mode (S_F) is almost or exactly the same as in monochrome print mode (S_{SW}). The following formula shall apply:

$$\mathbf{S_F \geq 0.9 \times S_{SW}}$$

3.4.1.28 Power consumption of the device in the ↑ sleep modes, i.e. ready mode (P_a), in the energy-saving modes (P_b, P_c and so on) as well in ↑ Plug-in Off mode (P_S): The basis for evaluating a device is its total power consumption, i.e. the effective power consumption measured at the power supply of the device. The power consumption of the device that must meet the limit curve shall not include the power consumption of ↑ accessories but it shall include the power consumption of controllers. Please see the information contained in Appendix 6.

3.4.1.29 Activation time (t_{aA}, t_{bA} etc.): The time that elapses after the end of the ↑ printing process until the device enters a ↑ sleep mode. (Note: With respect to the ↑ delivery status this corresponds to the Energy Star 10'2005 definition of „default delay time" [16].

3.4.1.30 Return time (t_{iR}): The amount of time it takes to return from an ↑ energy-saving mode to ↑ ready mode. The return time is to be determined as difference between

a) time required to complete a certain print job from energy-saving mode Z_i and

b) time it takes to complete the same job from "Ready" mode Z_a .

(by analogy with Energy Star 3'2005 definition of „recovery time from sleep" [19])

Note: The return time differs from the recovery time as specified in RAL-UZ 114 Basic Award Criteria.

3.4.2 Summary of Requirements

3.4.2.1 The ↑ return time, the time it takes to return from a low-power consumption mode to "Ready" mode, is limited; see para. 3.4.3.

3.4.2.2 The ↑ power consumption curve of the device for the time elapsing after the end of the printing process, i.e. in the sleep modes, may not exceed a specified limit curve. This limit curve is determined by the power consumption values (see para. 3.4.4) and for times (see para. 3.4.5). Appendix 5 shall be taken into account when grading the ↑ sleep modes.

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[19] „Energy Star Qualified Imaging Equipment – Revised Terminology and Definitions", 16 March 2005

- The device must meet the limit curve in any case, i.e. as soon as it has completed any † primary function – not only † copying or † printing – and does not perform any other primary function.
- This shall also apply if the device is connected to a data network. Signals received via the data network which do not serve the performance of a † primary function [20], may neither „weak up" the device, i.e. allow the device to enter a higher power consumption mode nor keep it from switching according to the † activation times set.

3.4.2.3 The device must have a switch mounted in an easily accessible position in a usual setup position which can at least switch the device to † Plug-in Off mode. Easy accessibility must also be ensured if the device is upgraded – for example, with accessories. The device's power consumption may not exceed 2 watts in "Plug-in Off" mode. It must be so designed as to ensure that it may be switched to this mode at least twice a day over the normal life cycle without suffering damage.

3.4.2.4 Standard IEEE 1621 [21] should be complied with when designing switches and buttons. It is highly recommended to follow this standard already now. Future updates of these Basic Award Criteria will require compliance with the standard (update is expected to be released on 1 January 2009).

3.4.2.5 Product specific external power supplies must meet the requirements of EU Commission Guideline on External Power Supplies with regard to the efficiency level (see [22]). Their power consumption in sleep mode (see the above-named European Commission Guideline) shall not exceed the following limit value:

Limit value in watts = Power output in watts × 0.004 + 0.4 watts

3.4.2.6 † Accessories shall not affect energy-saving functions.

3.4.2.7 In † delivery status the device must be set in way that it meets all requirements described in para. 3.4.

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[20] For example: server status inquiries.

[21] http://eetd.lbl.gov/Controls/1621

[22] Code of Conduct on Efficiency of External Power Supplies - Version 2; 24. 1. 2004; http://energyefficiency.jrc.cec.eu.int/html/standby_initiative.htm; see table 3

3.4.2.8 Measurements shall be taken in accordance with the requirements as specified in Appendix 6. Said Annex lists – to the extent appropriate - the Energy Star Test Methods as measuring methods.

3.4.3 Limit Values of Return Times t_{2R} and t_{3R}

If a device is capable of performing the primary function copying the limit value of the ↑ return time refers to the return to ↑ ready mode of the primary function copying. If not, it refers to the return to ready mode of the primary function printing. Return time values shall be determined in accordance with Appendix 6.

The return time limit t_{2R} (see Table 3-1) refers to ↑ sleep mode Z_i where the device runs immediately after expiry of the time given in Table 3-3 for t_{2A} , i.e. at the beginning of limit level 2.

Example: In Fig. 2, this would be "Warm start" mode for device A (upper dotted line).

If right at that moment the device switches between two sleep modes it must meet the return time limit from that sleep mode to which the device switches.

Example: In Fig. 2, this would be the „Off" mode for device B (middle dotted line).

However, if at that moment the device runs in „Ready" mode Z_a, the following should be considered: According to para. 3.4.1.30 return time is the time the device needs to return form one energy-saving mode to „Ready" mode. As the device, in the case described, runs already in „Ready" mode the requirement for the return time is dropped.

Example: In Fig. 2 this would apply to the „Ready" mode for device C (lower dotted line).

This correspondingly applies to the return time limit t_{3R} ; The reference value is t_{3A}.

Examples: With respect to examples A to C shown in Fig. 2 this means: The requirement for return time t_{3R} is to be met from the following sleep modes: Example A (upper line): „energy-saving mode" and example B (middle

line): „Off' mode. Here too, the requirement is dropped for „ready" mode in example C (lower line).

Fig. 2: Return Time Limits

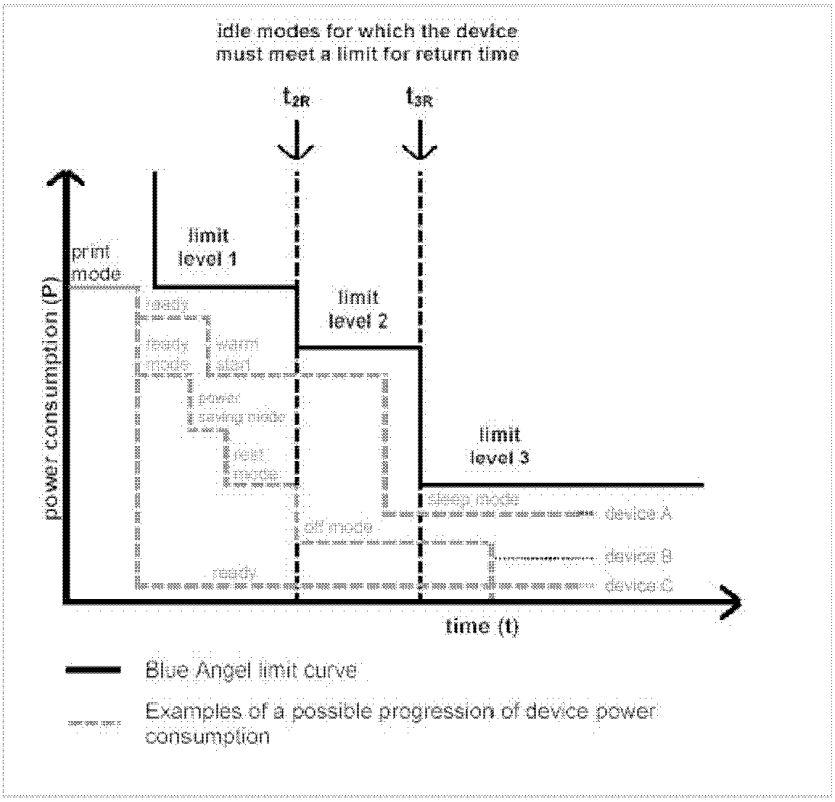
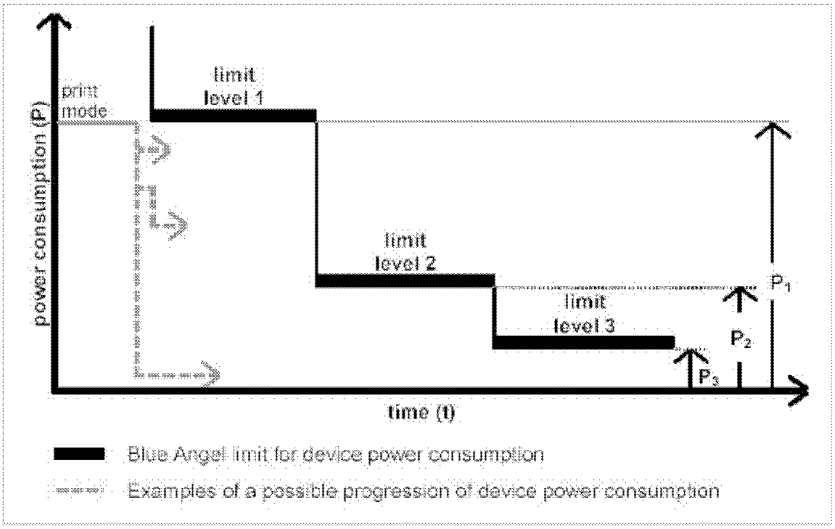


Table 3-1 Return Time Limits

	Values in Seconds	
	Limit level 2 t_{2R}	Limit level 3 t_{3R}
Electrophotographic devices	$0.4 \times S_{SW} + 10$ (maximum 35 sec.)	$0.5 \times S_{SW} + 30$ (maximum 60 sec.)
Ink jet devices	5	5

3.4.4 Power Consumption Limits P_1, P_2 and P_3

Fig. 3: Shape of Power Consumption Limit



The power consumption limits apply to copy mode as well as to print mode. Power consumption values shall be determined in accordance with Appendix 6.

Office equipment with print functions are available in numerous versions and specifications – depending on which of the following „modules“ are used:

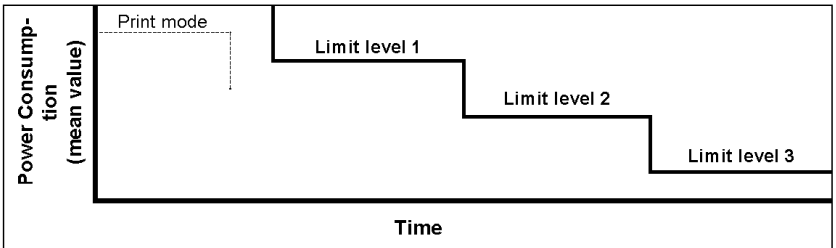
- printing technology: electrophotographic or ink,
- print colours: only black and white or black-and-white and colour as well as
- function: copying, printing, digitizing and transmitting of data as well as sending and receiving of electronic messages and faxes.

That is why the power consumption limits P_i, i.e. P_1, P_2 and P_3, have not been individually determined for all specifications possible. It is rather so that the limits too are composed of „modules“. They are listed in Table 3-2.

The power consumption limits P_i for any device (i.e. P_1, P_2 and P_3) may be determined from the values listed in Table 3-2. In dependence of the output speed S_{SW} a limit P_i is calculated using the formula $P_i = m \times S_{sw} + b$. A basic value for all devices exists for each *m* and *b* (line 1: $P_i = 0.3 \times S_{sw} + 2$). Depending on printing technology and function/functional units of the device values are added for *m* and/or *b* which each make a sum and thereby determine the limit value:

$$\mathbf{P_i = \Sigma m \times S_{sw} + \Sigma b}$$

Table 3-2 Power Consumption Limit



Limits P_i are functions of output speed S_{SW} according to the formula

$$\mathbf{P_i = m \times S_{sw} + b}.$$

Factors *m* and *b* are first replaced by the basic values given in line 1. If the device possesses functional units and/or printing technologies or functionalities in its delivery status that are listed in lines 2 to 7 the values given there for *m* and *b* are added.

Limit value	P_i Values in Watts					
	Limit level 1		Limit level 2		Limit level 3	
	$P_1 = \Sigma m \times S_{sw} + \Sigma b$		$P_2 = \Sigma m \times S_{sw} + \Sigma b$		$P_3 = \Sigma m \times S_{sw} + \Sigma b$	
	m	b	m	b	m	b
1. Devices with print unit (i.e. all devices)	**0.3**	**2**	**0.3**	**2**	**0.3**	**2**
Bonus for individual functional units						
2. ↑ Scan unit	—	**5**	—	**5**	—	—

Limit value	P_i Values in Watts					
	Limit level 1		Limit level 2		Limit level 3	
	$P_1 = \Sigma m \times S_{sw} + \Sigma b$		$P_2 = \Sigma m \times S_{sw} + \Sigma b$		$P_3 = \Sigma m \times S_{sw} + \Sigma b$	
	m	b	m	b	m	b
3. † Telephone modem and/or † LAN interface	**—**	**15**	**—**	**15**	**—**	**10**
Bonus for individual functions						
4. † Multifunctionality of electrophotographic devices	**2.2**	**5**	**2.2**	**5**	**—**	**—**
Bonus for individual printing technologies						
5. Electrophotography, monochrome printing only	**2.5**	**20**	**1.5**	**—**	**0.1**	**—**
6. Electrophotography, monochrome and colour printing, † group A	**2.5**	**70**	**2.5**	**—**	**0.1**	**—**
7. Electrophotography, Monochrome and colour printing, † Group B	**3.0**	**100**	**3.0**	**50**	**0.1**	**10**
Example: For a multifunction device, electrophotographic, colour printing, Group B and the functions printing, copying as well as sending an receiving of faxes (via telephone modem) the limits P_i are calculated as follows:						
1. Devices with print unit	0.3	2	0.3	2	0.3	2
2. Scan unit	—	5	—	5	—	---
3. Telephone modem and/or LAN interface	—	15	—	15	—	10
4. Multifunctionality	2.2	5	2.2	5	—	—
7. Electrophotography, monochrome as well as colour printing, Group B	3.0	100	3.0	50	0.1	10
Total:	5.5	127	5.5	77	0.4	22
Limit values:	**$P_1 = 5.5 \times S_{sw} + 127$**		**$P_2 = 5.5 \times S_{sw} + 78$**		**$P_3 = 0.4 \times S_{sw} + 22$**	

Appendix 5 lists the limits for a great number of possible device specifications.


RAL
gGmbH

3.4.5 Time Limits t_{1A}, t_{2A} and t_{3A} as well as Activation Times t_{aA}, t_{bA} etc.

In the ↑ delivery status the ↑ activation times shall be set in a way that the device does not exceed the limit curve. The latter results from the power consumption limits given in paragraph 3.4.4 as well as the times listed in Table 3-3.

If user can change the activation time of individual sleep modes a fixed upper limit value not exceeding 240 minutes shall be chosen for this setting range. It is strongly recommended to chose those values from among the values listed in Table 3-4 which are to become binding when these Basic Award Criteria will be updated (update is expected to be released on 1 January 2009).

Activation time values shall be determined in accordance with Appendix 6.

Fig 4: Shape of Limit Level and Activation Time Curves

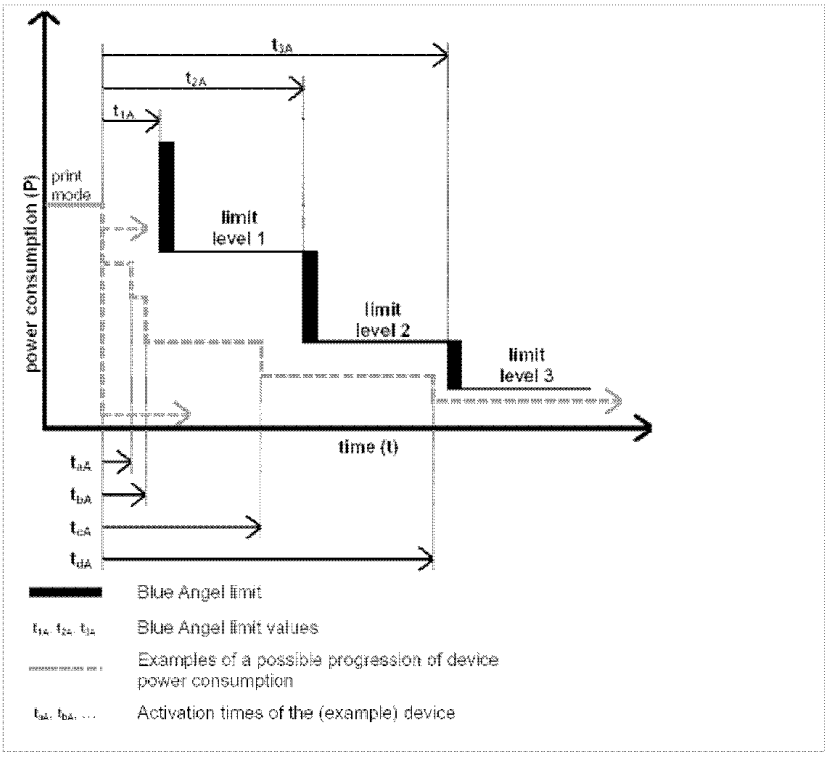


Table 3-3 Limit Curve: Time Limits

all devices with an output speed S_{SW} of	t_{1A}	t_{2A}	t_{3A}
> 0 ... 5 pages/minute	3	5	10
> 5 ... 10 pages/minute	5	10	15
> 10 ... 20 pages/minute	5	10	20
> 20 ... 30 pages/minute	5	10	30
> 30 ... 40 pages/minute	5	10	45
> 40 pages/minute	10	15	60

Table 3-4 Device: Upper Limit of the User-Settable Activation Times Range t_{iA}

These values apply to sleep mode Z_i where the device runs if time t_{iA} has elapsed after the ↑ end of the printing process.

all devices with an output speed S_{SW} of	value to be met; (recommended value expected to become binding as of 1 January 2009 in brackets)		
	t_{1A}	t_{2A}	t_{3A}
> 0 ... 30 pages/minute	—	240 (60)	240 (120)
> 30 pages/minute		240 (120)	240 (180)

Compliance Verification:

- *By completing the forms in Appendix 1 and Appendix 8a the applicant shall give all equipment data which are crucial for the applicability of requirements. Amongst others whether or not the product offers black-and-white and/or colour printing, what are its primary functions as base unit and, if applicable, after upgrading; apart from that the equipment values for the above-mentioned parameters of power consumption, activation times as well as return times. In addition, the applicant shall state for accessories whether or not they are powered via*

(base) unit or a separate power supply. Apart from that, the applicant shall state in Appendix 8a, that the product has been shipped to the laboratory in a condition corresponding to the normal delivery status, above all, with regard to activation times and other parameters influencing power consumption/energy consumption.

- *With respect to power consumption and return time measurements according to Annex 6 the applicant shall submit the measurement report (Appendix 8b).*
- *With respect to indication of energy consumption as required according to Annex 7 pursuant to Energy Star the applicant shall submit the respective measurement report (Appendix 8c).*
- *If the device bears the Energy Star mark and if the measurement report on energy consumption does not already include the other power consumption measurements, as required by Energy Star, the applicant shall submit the corresponding measurement report for comparison purposes (Appendix 8d).*
- *To the extent that user information, as required by Annex 7, are not contained in the Data and Information Sheet (Appendix 12) the applicant shall (only) submit the respective excerpts from the Product Documentation (Appendix 13).*

3.5 Noise Emissions

The declared A-weighted sound-power level L_{WAd} shall be determined in dB(A) on the basis of EN ISO 7779:2001 (corresponds to ISO 7779:1999) in combination with ISO 9296:1988.

Noise measurements shall be conducted at operating temperature, during maximum noise operation of the base unit (usually at maximum print speed) and without additional accessories (e.g. sorting units).

Devices of identical design which differ in their maximum (attainable) printing speeds shall be tested in all configurations in which they are to be offered with reference to the Blue Angel.

The printed sheet according to image C2 of EN ISO 7779:2001 shall serve as test page for monochrome printing or copying.

Devices capable of multiple colour printing shall additionally be tested in full colour mode in the same way as described for monochrome printing. This shall be done by using the colour test page according to Annex 9 to the Basic Award Criteria (taken from JBMS-74-1).

A-4 size paper having a weight per unit area of 70 to 80 g/m^2 shall be used for printouts.

The limit value $L_{WAd,lim,bw}$ for monochrome printing shall be determined in dependence of the operating speed S_{bw} given to one decimal place according to the following formula:

$$L_{WAd,lim,bw} = (59 + 0.35 * S_{bw})\ \text{dB(A)}$$

$L_{WAd,lim,bw}$ = A-weighted sound-power level in dB(A) for monochrome printing to be complied with, given to one decimal place,

S_{bw} = operating speed for monochrome printing in pages per minute.

Accordingly, the following applies to the limit $L_{WAd,\ lim,co}$ for colour printing on parallel systems

$$L_{WAd,lim,co} = (61 + 0.30 * S_{co})\ \text{dB(A)}$$

$L_{WAd,lim,co}$ = A-weighted sound-power level in dB(A) for colour printing to be complied with, given to one decimal place,
S_{co} = operating speed for colour printing in pages per minute.

For serial electrophotographic colour devices with $S_{co} \leq 0.5\ S_{bw}$ the sound power level shall be determined and indicated. For assessment purposes compliance with $L_{WAd,lim,bw}$ for monochrome printing with printing speed S_{bw} shall be considered exclusively.

On ink jet devices the L_{WAd} for colour test page printing can be determined in standard print mode (usually preset). $L_{WAd,lim,co}$ shall be complied with. However, the device shall be set to maximum print speed when testing during monochrome printing.

The declared A-weighted sound-power level L_{WAd} may not exceed the limit $L_{WAd,lim,bw}$ or $L_{WAd,lim,co}$ in the respective print mode. In addition, for Blue-Angel-marked devices L_{WAd} may generally not exceed 75.0 dB(A) (noise limit for office equipment).

At least three devices have to be tested in order for the sound power level to be considered as declared. If the noise emission measurement can be performed on one device only the following formula may be used by analogy with ISO 9296 as a substitute to determine the declared A-weighted sound-power level L_{WAd}.

$$L_{WAd} = L_{WAE} + 3\ \text{dB(A)}$$

L_{WAE} = sound power level determined by single measurement in dB(A).

The following specific requirements shall be taken into account in the testing process:

Printer:

- The measurement time covers the time from the beginning of printing (including preparation of printing, e.g. paper loading and positioning of the print heads) to the output of the sixth page of the standard document.

- The measured values are averaged over this period.
- The declared A-weighted sound-power level L_{WAd} shall be recorded to one decimal place.
- Measurement of the operating speeds S_{bw} and S_{co} in pages per minute shall be performed and recorded by the testing laboratory in the same operating mode as the noise measurement (maximum print speed). Printout counting shall begin after delivery of the first page and end after one minute. Only complete printouts shall be taken into consideration.

Multifunction Devices and Copiers:

- Notwithstanding DIN EN ISO 7779:2002 measurement and determination of the characteristic L_{WAd} shall be conducted for such devices during the combined scanning and printing process. Following the input of the test page via the flat-bed scanner (if available) the measured value is averaged during scanning and the subsequent printing of 6 copies of the scanned standard document.
- The measurement time covers the period from the beginning of the scanning process to the delivery of the last page. Pauses that influence the noise measurements of more than 3 seconds between the end of the scanning process and the beginning of the printing process shall not be included in the averaging.
- The declared A-weighted sound-power level L_{WAd} shall be recorded to one decimal place.
- Measurement of the operating speed shall be done in the same way as for printers.

For information on noise emission the L_{WAd} value measured and calculated accurate to 0.1 dB(A) (according to EN ISO 7779:2001 and ISO 9296) shall be indicated in the user documents (User Manual/Product Documents) as well as in Appendix 12 under „environment and health-related statements“. The user documents of devices concerned shall additionally include a clear notice stating that devices with L_{WAd} > 63.0 dB(A) should not be placed in an office work area but in a separate room.

Consequently, the user information according to paragraph 4 (Appendix 12) must include the following wording:

„Office equipment with L_{WAd} > 63.0 dB (A) is not suitable for use in rooms where people do primarily intellectual work. Such equipment should be placed in separate rooms because of the noise emission."

The wording shall be binding with respect to $L_{WAd,bw}$.

Compliance Verification:

The applicant shall demonstrate compliance with the criteria by attaching a completed Appendix 9 to the Application. Such Appendix 9 shall be filled in and confirmed by the testing laboratory on the basis of the test report.

The testing laboratory must be accredited according to DIN EN ISO/IEC 17025 as well as according to DIN EN ISO 7779 for acoustic measurements. The test lab shall attach a copy of the valid accreditation certificates (Appendix 10). Evidence the required user information shall additionally be provided in the Information and Data Sheet (Appendix 12) according to paragraph 4.

4 Product Documents and User Information

The printed product documentation supplied along with the equipment (User Manual, Product Documents) shall be printed on chlorine-free bleached paper, preferably made of recycled paper.

As long as a printed summary is included for installation purposes these product papers may also be made available on other media (CD, DVD, internet).

In addition to the technical descriptions, the product documents shall also include essential environmental and health-related user information and must at least be published in German.

The following user information shall additionally be summarized on a separate information and data sheet which should also be printed on chlorine-free bleached paper, preferably made of recycled paper, and must at least be published in German:

Details on

- Battery types and battery take-back system according to 3.1.4,
- Usability of recycled paper according to 3.1.5,

ANNEX 2

Nordic Swan Ecolabel criteria on imaging equipment excerpt. Administrative criteria were left out.

2 Environmental requirements

If the product does not hold a valid Eco Mark or Blue Angel license, the product must fulfil the requirements in sections 2, 3 and 4.

Requirements as to analysis laboratories

The analysis laboratory used must fulfil the general requirements of standard EN ISO 17025 or have official GLP status.

The applicant's analysis laboratory/test procedure may be approved for analysis and testing if:

- sampling and analysis is monitored by the authorities, or
- the manufacturer's quality assurance system covers analyses and sampling and is certified to ISO 9001 or ISO 9002, or
- the manufacturer can demonstrate agreement between a first-time test conducted at the manufacturer's own laboratory and testing carried out in parallel at an independent test institution, and the manufacturer takes samples in accordance with a fixed sampling schedule.

2.1 General description

R3 **Description of the product**

Describe the product and how it fulfils the definition of a product eligible to carry the Nordic Eco label.

✉ Description as specified above.

2.2 Energy consumption

R4 **Energy consumption**

The energy consumption of the product must fulfil the energy requirement in Blue Angel criteria for a corresponding product. Energy consumption must be measured in accordance with the requirements described in the criteria for Blue Angel: (RAL-UZ 122, June 2006).

Or

The energy consumption of the product must fulfil the energy requirement in Energy Star criteria for imaging equipment. Energy consumption must be measured in accordance with the requirements described in the Energy Star criteria for imaging equipment (April 2007).

Further information: www.energystar.gov/index.cfm?c=ofc_equip.pr_office_equipment

EM 4-1-12 & BA 3.4

✉ A test report containing the results of the measurement of energy consumption.

2.3 Design and materials

R5 **Single plastic casing parts**

Single plastic casing parts heavier than 25 g must be made of a homopolymer or copolymer. Polymer blends (polymer alloy) are permitted.

EM 4-1-1 & BA 3.1.1

✉ • A declaration for the applied product showing that the requirement is met (Appendix 5 may be used).

• A list showing the plastic materials used (Appendix 6 may be used). Describe also all plastic part comprising of recyded or reused plastic parts.

R6 **Combined plastic casing parts**

Combined plastic casing parts heavier than 25 g must be made of four or fewer types of mutually separable polymers or polymer blends.

EM 4-1-1 & BA 3.1.1

✉ See R5.

R7 **Polymer blends in plastic components**

The variety of materials used for plastic components of similar functions must be limited to one polymer or polymer blends.

EM 4-1-1 & BA 3.1.1

✉ See R5.

R8 **Reused plastic**

At least one part heavier than 25 gram must contain reused plastic or post-consumer and pre-consumer recyded plastic.

EM 4-1-1

✉ See R5.

R9 **Labelling of plastic parts**

Plastic parts must be marked at least in accordance with DIN/ISO 11469:2000. Exemptions from this requirement are plastic parts lighter than 25 g, parts with a flat area less than 200 mm^2 and any reused parts.

EM 4-1-2 & BA 3.1.3

✉ See R5.

R10 **Subassemblies**

Subassemblies (casing parts whose entire weight exceeds 10 g) made of mutually incompatible materials must be separable or connected by separation aids or all materials used must be easily separable by means of recyding technology.

EM 4-1-1 & BA 3.1.1

✉ A declaration for the applied product showing that the requirement is met. (Appendix 5 may be used).

R11 **Special requirements as to products with combined toner cartridges.**

Products with combined toner cartridge may be accepted if the cartridge is not designed to prevent reuse.

Products must accept remanufactured toner cartridges.

In order to ensure that the toner cartridges are returned for reuse, a return system must be offered for recycling combined toner cartridges and information to user about the return system must be provided.

Combined toner cartridge: Drum, developer and toner in one unit.

EM 4-1-5 & BA 3.2.1.2

✉
- A declaration for the applied product showing that the requirement is met (Appendix 5 may be used).
- The applicant must document the existence of a functional return system and describe the structure of this system.

2.4 Plastics in casings and their components

R12 **Chlorine-based plastics**

Plastic parts over 25 grams must not contain chlorinated polymers.

Exemptions from the requirement are:

Casing parts that are demonstrably reused in accordance with R8.

EM 4-1-2 & BA 3.1.2

✉
- The applicant must submit a list of all plastic materials in plastic parts over 25 grams in casing and their components (Appendix 6 may be used).
- The manufacturer(s) of the individual plastic parts must declare that the requirement has been fulfilled (Appendix 7 may be used).

R13 **Additives**

Additives containing organohalogen compounds are not permitted. This includes flame retardants.

Flame retardants used in plastic components must be declared and characterized by their CAS numbers.

Plastics must not, at the time of application, contain additives which are assigned one or more of the following risk phrases:

- R 40 (possible risk of cancer)
- R45 (may cause cancer)
- R46 (may cause heritable genetic damage)
- R 48 (danger of serious damage to health by prolonged exposure)
- R49 (may cause cancer by inhalation)
- R60 (may impair fertility)
- R61 (may cause harm to unborn child)
- R62 (possible risk of impaired fertility)
- R63 (possible risk of harm to unborn child)

Risk phrases in accordance with EU chemical legislation (Council Directive 67/548/EEC as last amended by Commission Directive 98/98/EEC).

Exemptions from the requirement are:

Plastic parts weighing less than 25g. These parts must not, however, contain any PBB (polybrominated biphenyls), PBDE (polybrominated diphenyl ethers), decaBDE or chlorinated paraffins. This exemption is still valid after EU Directive 2002/95/EC (RoHS) comes into force on July 1st 2006.

Casing parts that are demonstrably reused and marked in accordance with requirement R8. These parts must not, however, contain any PBB (polybrominated biphenyls), PBDE (polybrominated diphenyl ethers), decaBDE or chlorinated paraffins. This exemption is still valid after EU Directive 2002/95/EC (RoHS) comes into force on July 1st 2006.

Special plastic components installed in direct vicinity of heating and fusing units. These parts must not, however, contain any PBB (polybrominated biphenyls), PBDE (polybrominated diphenyl ethers) , decaBDE or chlorinated paraffins. This exemption is still valid after EU Directive 2002/95/EC (RoHS) comes into force on July 1st 2006.

Process-induced technologically unavoidable impurities. The maximum allowable concentrations are 0.1 w-% in homogenous material.

Flouroorganic additives which are used to improve the physical properties of plastic, provided they are not present in concentrations greater then 0.5 weight-%.

Fluorinated plastics like for example PTFE.

EM 4-1-2 & BA 3.1.2.1

✉ The manufacturer of used plastic must declare that the requirement has been fulfilled. The manufacturer of plastic must submit a list of all used flame retardants. The list must contain complete chemical name, CAS number or according to "ISO1043-4:1998 (JIS K6899-4:2000)" and name of supplier (Appendix 7 may be used).

2.5 Materials, other dangerous substances

R14 **Batteries**

Batteries used must not contain cadmium, mercury, lead, and their compounds, except for impurities which cannot be avoided technically. Such impurities must not exceed the limiting values as specified in the EU Directives 91/157/EEC and 98/101/EEC (Battery).

EM 4-1-3 & BA 3.1.4

✉ The applicant or the manufacturer of the battery must declare that the battery fulfils the requirement (Appendix 8 may be used).

R15 **Chemicals used during production**

Chemicals containing the following substances regulated in the Montreal Protocol must not be used in the end production of the machines or in the production of circuit boards: CFCs, HCFCs, 1.1.1 trichloro-ethane or carbon-tetrachloride.

EM 4-1-16

✉ The end-manufacturer and direct suppliers (suppliers during the final stages of the supplier chain) must declare that the requirement has been fulfilled (Appendix 9 may be used).

R16 **Chlorine-based packaging materials**

Plastics used for packaging the equipment (including toner powder containers) must not contain chlorinated polymers.

EM 4-1-11 & BA 3.1.11

✉ The applicant must declare that the requirement has been fulfilled (Appendix 8 may be used).

R17 **Labelling of plastic packaging materials**

Plastics used must be marked in accordance with the currently applicable versions of the EU Directive 97/129/EEC (Packaging) or marked in accordance with ISO-11469.

EM 4-1-11 & BA 3.1.11

✉ The applicant must declare that the requirements of the Packaging Directive have been fulfilled (Appendix 8 may be used).

2.6 Other environmental requirements

R18 **Supply of spare parts**

The availability of spare parts must be guaranteed for at least five years after production of the specified ecolabelled machine comes to an end.

EM 4-1-8 & BA 3.1.8

✉ The applicant must declare that spare part will be available for at least five years after the production date of the specified ecolabelled machine (Appendix 10 may be used).

R19 **Double-sided copying**

Appliances with a maximum operating speed of more than 45 sheets per minute for A4 size paper must be equipped with automatic double-side copying (a duplex-unit). Appliances with operating speeds of 20 to 44 sheets per minute must have a double-side copy unit (duplex) as extra equipment for subsequent upgrading if the user so wishes.

EM 4-1-14

✉ The applicant must declare that the requirement is fulfilled (Appendix 10 may be used).

R20 **Traceability**

The licence holder must have a traceability system for the production of the Nordic Ecolabelled product.

✉ Description of/procedures for the fulfilment of the requirement.

R21 **Legislation and regulations**

The licence holder must guarantee adherence to safety regulations in force, working environment legislation, environmental legislation and conditions/concessions specific to the operations at all sites where the Nordic Ecolabelled product is manufactured.

No documentation is required, but Nordic Ecolabelling may revoke the licence if the requirement is not fulfilled.

3 Performance properties

R22 **Emissions**

The product must fulfil the requirement as stated in Blue Angel (RAL-UZ-122) version June 2006 or EcoMark No. 117 "Copier version 2.2" or EcoMArk No 122 "Printers Version 2.0".

Emission rates must be measured in accordance with the requirements described in Blue Angel: RAL-UZ 122 Version June 2006 or EcoMark No. 117 "Copier version 2.2" or EcoMark No 122 "Printers Version 2.0".

✉ The applicant must submit a report containing the results of the emission test according to the methods specified in RAL-UZ 122 version June 2006 (see Appendix 4) or EcoMark No. 117 "Copier version 2.2" or EcoMark No 122 "Printers Version 2.0".

R23 **Noise**

The declared A-weighted sound level LWAd must not exceed the value determined in accordance with the following formula and additionally remain below a limited value: 7.5 (B).

The formula of the limited value:

Copiers: L_{WAd}: 0.035 x CPM + 5.9 (B)

Printers: L_{WAd}: 0.035 x CPM + 5.9 (B)

Fax and MFD: L_{WAd}: 0.035 x CPM + 5.9 (B)

The noise emissions from the product must be measured in accordance with the method specified in ISO 7779 or RAL-UZ 122 and the A-weighted sound level L_{WAd} must be declared in accordance with ISO 9296 in force at the time of application.

The requirement on noise emission of equipment with a CPM above 71 is exempted from the maximum limit of 7.5B, but the L_{WAd} of these machines should be submitted for reference.

For copiers using larger paper sizes (A2 and larger), the number of sheets copied may be counted on an A4 basis (by Energy Star).

EM 4-1-3 & BA 3.5

✉ The applicant must submit a report containing the results of the noise emission test according to the methods as specified in ISO 7779 or RAL-UZ 122 and declared in accordance with ISO 9296.

2 Environmental requirements

If the product does not hold a valid Eco Mark or Blue Angel license, the product must fulfil the requirements in sections 2, 3 and 4.

Requirements as to analysis laboratories

The analysis laboratory used must fulfil the general requirements of standard EN ISO 17025 or have official GLP status.

The applicant's analysis laboratory/test procedure may be approved for analysis and testing if:

- sampling and analysis is monitored by the authorities, or
- the manufacturer's quality assurance system covers analyses and sampling and is certified to ISO 9001 or ISO 9002, or
- the manufacturer can demonstrate agreement between a first-time test conducted at the manufacturer's own laboratory and testing carried out in parallel at an independent test institution, and the manufacturer takes samples in accordance with a fixed sampling schedule.

2.1 General description

R3 **Description of the product**

Describe the product and how it fulfils the definition of a product eligible to carry the Nordic Eco label.

✉ Description as specified above.

2.2 Energy consumption

R4 **Energy consumption**

The energy consumption of the product must fulfil the energy requirement in Blue Angel criteria for a corresponding product. Energy consumption must be measured in accordance with the requirements described in the criteria for Blue Angel: (RAL-UZ 122, June 2006).

Or

The energy consumption of the product must fulfil the energy requirement in Energy Star criteria for imaging equipment. Energy consumption must be measured in accordance with the requirements described in the Energy Star criteria for imaging equipment (April 2007).

Further information: www.energystar.gov/index.cfm?c=ofc_equip.pr_office_equipment

EM 4-1-12 & BA 3.4

✉ A test report containing the results of the measurement of energy consumption.

2.3 Design and materials

R5 **Single plastic casing parts**

Single plastic casing parts heavier than 25 g must be made of a homopolymer or copolymer. Polymer blends (polymer alloy) are permitted.

EM 4-1-1 & BA 3.1.1

✉ • A declaration for the applied product showing that the requirement is met (Appendix 5 may be used).

• A list showing the plastic materials used (Appendix 6 may be used). Describe also all plastic part comprising of recyded or reused plastic parts.

R6 **Combined plastic casing parts**

Combined plastic casing parts heavier than 25 g must be made of four or fewer types of mutually separable polymers or polymer blends.

EM 4-1-1 & BA 3.1.1

✉ See R5.

R7 **Polymer blends in plastic components**

The variety of materials used for plastic components of similar functions must be limited to one polymer or polymer blends.

EM 4-1-1 & BA 3.1.1

✉ See R5.

R8 **Reused plastic**

At least one part heavier than 25 gram must contain reused plastic or post-consumer and pre-consumer recyded plastic.

EM 4-1-1

✉ See R5.

R9 **Labelling of plastic parts**

Plastic parts must be marked at least in accordance with DIN/ISO 11469:2000. Exemptions from this requirement are plastic parts lighter than 25 g, parts with a flat area less than 200 mm^2 and any reused parts.

EM 4-1-2 & BA 3.1.3

✉ See R5.

R10 **Subassemblies**

Subassemblies (casing parts whose entire weight exceeds 10 g) made of mutually incompatible materials must be separable or connected by separation aids or all materials used must be easily separable by means of recyding technology.

EM 4-1-1 & BA 3.1.1

✉ A declaration for the applied product showing that the requirement is met. (Appendix 5 may be used).

R11 **Special requirements as to products with combined toner cartridges.**

Products with combined toner cartridge may be accepted if the cartridge is not designed to prevent reuse.

Products must accept remanufactured toner cartridges.

In order to ensure that the toner cartridges are returned for reuse, a return system must be offered for recycling combined toner cartridges and information to user about the return system must be provided.

Combined toner cartridge: Drum, developer and toner in one unit.

EM 4-1-5 & BA 3.2.1.2

✉
- A declaration for the applied product showing that the requirement is met (Appendix 5 may be used).
- The applicant must document the existence of a functional return system and describe the structure of this system.

2.4 Plastics in casings and their components

R12 **Chlorine-based plastics**

Plastic parts over 25 grams must not contain chlorinated polymers.

Exemptions from the requirement are:

Casing parts that are demonstrably reused in accordance with R8.

EM 4-1-2 & BA 3.1.2

✉
- The applicant must submit a list of all plastic materials in plastic parts over 25 grams in casing and their components (Appendix 6 may be used).
- The manufacturer(s) of the individual plastic parts must declare that the requirement has been fulfilled (Appendix 7 may be used).

R13 **Additives**

Additives containing organohalogen compounds are not permitted. This includes flame retardants.

Flame retardants used in plastic components must be declared and characterized by their CAS numbers.

Plastics must not, at the time of application, contain additives which are assigned one or more of the following risk phrases:

- R 40 (possible risk of cancer)
- R45 (may cause cancer)
- R46 (may cause heritable genetic damage)
- R 48 (danger of serious damage to health by prolonged exposure)
- R49 (may cause cancer by inhalation)
- R60 (may impair fertility)
- R61 (may cause harm to unborn child)
- R62 (possible risk of impaired fertility)
- R63 (possible risk of harm to unborn child)

Risk phrases in accordance with EU chemical legislation (Council Directive 67/548/EEC as last amended by Commission Directive 98/98/EEC).

Exemptions from the requirement are:

Plastic parts weighing less than 25g. These parts must not, however, contain any PBB (polybrominated biphenyls), PBDE (polybrominated diphenyl ethers), decaBDE or chlorinated paraffins. This exemption is still valid after EU Directive 2002/95/EC (RoHS) comes into force on July 1st 2006.

Casing parts that are demonstrably reused and marked in accordance with requirement R8. These parts must not, however, contain any PBB (polybrominated biphenyls), PBDE (polybrominated diphenyl ethers), decaBDE or chlorinated paraffins. This exemption is still valid after EU Directive 2002/95/EC (RoHS) comes into force on July 1st 2006.

Special plastic components installed in direct vicinity of heating and fusing units. These parts must not, however, contain any PBB (polybrominated biphenyls), PBDE (polybrominated diphenyl ethers) , decaBDE or chlorinated paraffins. This exemption is still valid after EU Directive 2002/95/EC (RoHS) comes into force on July 1st 2006.

Process-induced technologically unavoidable impurities. The maximum allowable concentrations are 0.1 w-% in homogenous material.

Flouroorganic additives which are used to improve the physical properties of plastic, provided they are not present in concentrations greater then 0.5 weight-%.

Fluorinated plastics like for example PTFE.

EM 4-1-2 & BA 3.1.2.1

✉ The manufacturer of used plastic must declare that the requirement has been fulfilled. The manufacturer of plastic must submit a list of all used flame retardants. The list must contain complete chemical name, CAS number or according to "ISO1043-4:1998 (JIS K6899-4:2000)" and name of supplier (Appendix 7 may be used).

2.5 Materials, other dangerous substances

R14 **Batteries**

Batteries used must not contain cadmium, mercury, lead, and their compounds, except for impurities which cannot be avoided technically. Such impurities must not exceed the limiting values as specified in the EU Directives 91/157/EEC and 98/101/EEC (Battery).

EM 4-1-3 & BA 3.1.4

✉ The applicant or the manufacturer of the battery must declare that the battery fulfils the requirement (Appendix 8 may be used).

R15 **Chemicals used during production**

Chemicals containing the following substances regulated in the Montreal Protocol must not be used in the end production of the machines or in the production of circuit boards: CFCs, HCFCs, 1.1.1 trichloro-ethane or carbon-tetrachloride.

EM 4-1-16

✉ The end-manufacturer and direct suppliers (suppliers during the final stages of the supplier chain) must declare that the requirement has been fulfilled (Appendix 9 may be used).

R16 **Chlorine-based packaging materials**

Plastics used for packaging the equipment (including toner powder containers) must not contain chlorinated polymers.

EM 4-1-11 & BA 3.1.11

✉ The applicant must declare that the requirement has been fulfilled (Appendix 8 may be used).

R17 **Labelling of plastic packaging materials**

Plastics used must be marked in accordance with the currently applicable versions of the EU Directive 97/129/EEC (Packaging) or marked in accordance with ISO-11469.

EM 4-1-11 & BA 3.1.11

✉ The applicant must declare that the requirements of the Packaging Directive have been fulfilled (Appendix 8 may be used).

2.6 Other environmental requirements

R18 **Supply of spare parts**

The availability of spare parts must be guaranteed for at least five years after production of the specified ecolabelled machine comes to an end.

EM 4-1-8 & BA 3.1.8

✉ The applicant must declare that spare part will be available for at least five years after the production date of the specified ecolabelled machine (Appendix 10 may be used).

R19 **Double-sided copying**

Appliances with a maximum operating speed of more than 45 sheets per minute for A4 size paper must be equipped with automatic double-side copying (a duplex-unit). Appliances with operating speeds of 20 to 44 sheets per minute must have a double-side copy unit (duplex) as extra equipment for subsequent upgrading if the user so wishes.

EM 4-1-14

✉ The applicant must declare that the requirement is fulfilled (Appendix 10 may be used).

R20 **Traceability**

The licence holder must have a traceability system for the production of the Nordic Ecolabelled product.

✉ Description of/procedures for the fulfilment of the requirement.

R21 **Legislation and regulations**

The licence holder must guarantee adherence to safety regulations in force, working environment legislation, environmental legislation and conditions/concessions specific to the operations at all sites where the Nordic Ecolabelled product is manufactured.

No documentation is required, but Nordic Ecolabelling may revoke the licence if the requirement is not fulfilled.

3 Performance properties

R22 **Emissions**

The product must fulfil the requirement as stated in Blue Angel (RAL-UZ-122) version June 2006 or EcoMark No. 117 "Copier version 2.2" or EcoMArk No 122 "Printers Version 2.0".

Emission rates must be measured in accordance with the requirements described in Blue Angel: RAL-UZ 122 Version June 2006 or EcoMark No. 117 "Copier version 2.2" or EcoMark No 122 "Printers Version 2.0".

✉ The applicant must submit a report containing the results of the emission test according to the methods specified in RAL-UZ 122 version June 2006 (see Appendix 4) or EcoMark No. 117 "Copier version 2.2" or EcoMark No 122 "Printers Version 2.0".

R23 **Noise**

The declared A-weighted sound level LWAd must not exceed the value determined in accordance with the following formula and additionally remain below a limited value: 7.5 (B).

The formula of the limited value:

Copiers: L_{WAd}: 0.035 x CPM + 5.9 (B)

Printers: L_{WAd}: 0.035 x CPM + 5.9 (B)

Fax and MFD: L_{WAd}: 0.035 x CPM + 5.9 (B)

The noise emissions from the product must be measured in accordance with the method specified in ISO 7779 or RAL-UZ 122 and the A-weighted sound level L_{WAd} must be declared in accordance with ISO 9296 in force at the time of application.

The requirement on noise emission of equipment with a CPM above 71 is exempted from the maximum limit of 7.5B, but the L_{WAd} of these machines should be submitted for reference.

For copiers using larger paper sizes (A2 and larger), the number of sheets copied may be counted on an A4 basis (by Energy Star).

EM 4-1-3 & BA 3.5

✉ The applicant must submit a report containing the results of the noise emission test according to the methods as specified in ISO 7779 or RAL-UZ 122 and declared in accordance with ISO 9296.

ANNEX 3

An excerpt of the 'Green Public Procurement toolkit office IT' [**Error! Bookmark not defined.**] criteria on imaging equipment follows.

4. IMAGING EQUIPMENT

Subject matter	Subject matter
Purchase of energy efficient [printers, copiers, MFDs, scanners].	Purchase of [printers, copiers, MFDs, scanners] with low environmental impacts throughout the lifecycle.
Specifications	**Specifications**
1. Appliances [with a printing function] with a maximum operating speed of more than 45 sheets per minute for A4 size paper must be equipped with automatic double-sided copying (a duplex-unit). All other devices with a lower maximum operating speed must at least offer a manual option (copiers) or an extra software-based option (printers, multifunction devices) for double-sided printing on A4 size paper.	1. Appliances [with a printing function] with a maximum operating speed of more than 45 sheets per minute for A4 size paper must be equipped with automatic double-sided copying (a duplex-unit). All other devices with a lower maximum operating speed must at least offer a manual option (copiers) or an extra software-based option (printers, multifunction devices) for double-sided printing on A4 size paper.
2. All products must meet either the latest ENERGY STAR (available at www.eu-energystar.org) standards for energy performance. **Verification:** All products carrying the ENERGY STAR will be deemed to comply. Any other appropriate means of proof, such as a technical dossier of the manufacturer or a test report from a recognised body demonstrating that the criteria are met will also be accepted.	2. All products must meet either the latest ENERGY STAR (available at www.eu-energystar.org) standards for energy performance. **Verification:** All products carrying the ENERGY STAR will be deemed to comply. Any other appropriate means of proof, such as a technical dossier of the manufacturer or a test report from a recognised body demonstrating that the criteria are met will also be accepted.
	3. For devices with a printing function the 'Declared A-weighted Sound Level' (LWAd) according to ISO 9296, measured in accordance with ISO 7779, shall not exceed the limits set by the following formula: **LWAd: 0.035 x CPM + 5.9 (B)** Where CPM = Copies per minute. The devices shall additionally not exceed 7.5 (B) LWAd except for devices with a CPM 71. **Verification:** All products carrying any type I ecolabel fulfilling this criterion will be deemed to comply. Other appropriate means of proof will also be accepted.

	Award criteria
	Additional points will be awarded for: 1. Ease of disassembly: • Plastic parts heavier than 25g shall have a permanent marking identifying the material, in conformity with ISO 11469: 2000. • Plastic parts shall be of one polymer or compatible polymers, except for casings. **Verification:** All products carrying any type I ecolabel fulfilling this criterion will be deemed to comply. Alternatively the bidder must provide a written guarantee that this criterion will be met.
	2. Substances in plastic parts hazardous to health: Plastic parts heavier than 25g do not contain flame retardant substances or preparations that are assigned any of the following risk phrases as defined in Council Directive 67/548/EEC: • R45 (may cause cancer). • R46 (may cause heritable genetic damage). • R60 (may impair fertility). • R61 (may cause harm to the unborn child). **Verification:** All products carrying any type I ecolabel fulfilling this criterion will be deemed to comply. Other appropriate means of proof will also be accepted.
Contract performance clauses	**Contract performance clauses**
For notebooks the availability of compatible batteries and power supplies and of the keyboard and its parts shall be guaranteed for at least 3 years from the time that production ceases. **Verification:** All products carrying any type I ecolabel fulfilling this criterion will be deemed to comply. Alternatively the bidder must provide a written guarantee that this criterion will be met.	The bidder must guarantee the availability of spare parts for at least 3 years from the time that production ceases. **Verification:** All products carrying any type I ecolabel fulfilling this criterion will be deemed to comply. Alternatively the bidder must provide a written guarantee that this criterion will be met.

ANNEX 4

An excerpt of the Energy Star program requirements for imaging equipment version 1.1 follows.

Products Designated to Operate with a Type 2 DFE: For an imaging equipment product, sold with a Type 2 DFE, manufactured on or after July 1, 2009 to qualify as ENERGY STAR under the Imaging Equipment Version 1.1 specification, manufacturers should subtract the DFE's energy consumption in Ready mode for TEC products or exclude when measuring Sleep and Standby for OM products. Section 3A provides further detail on adjusting TEC values for DFEs for TEC products and Section 3B provides further detail for excluding DFEs from OM Sleep and Standby levels.

It is EPA's intent that, whenever possible, the power associated with the DFE (Type 1 or Type 2) should be excluded or subtracted from the TEC energy and OM power measurements.

Products Sold with an Additional Cordless Handset: To qualify, fax machines or MFDs with fax capability manufactured on or after July 1, 2009 that are sold with additional cordless handsets must use an ENERGY STAR qualified handset, or one that meets the ENERGY STAR Telephony specification when tested to the ENERGY STAR test method on the date the imaging product is qualified as ENERGY STAR. The ENERGY STAR specification and test method for telephony products may be found at www.energystar.gov/products.

Duplexing: Standard-size copiers, MFDs, and printers that use EP, SI, and High Performance IJ marking technologies addressed by the TEC approach in Section 3.A. must meet the following duplexing requirements, based on monochrome product speed:

Color Copiers, MFDs, and Printers

Monochrome Product Speed	Duplexing Requirement
≤ 19 ipm	N/A
20 – 39 ipm	Automatic duplexing must be offered as a **standard feature** or **optional accessory** at the time of purchase.
≥ 40 ipm	Automatic duplexing is required as a **standard feature** at the time of purchase.

Monochrome Copiers, MFDs, and Printers

Monochrome Product Speed	Duplexing Requirement
≤ 24 ipm	N/A
25 – 44 ipm	Automatic duplexing must be offered as a **standard feature** or **optional accessory** at the time of purchase.
≥ 45 ipm	Automatic duplexing is required as a **standard feature** at the time of purchase.

A. **ENERGY STAR Eligibility Criteria – TEC**. To qualify as ENERGY STAR, the TEC value obtained for imaging equipment outlined in Section 2, Table 1 above must not exceed the corresponding criteria below.

For imaging products with a Type 2 DFE, the energy consumption of the DFE, calculated per the example below, should be excluded when comparing the product's measured TEC value to the criteria listed below. The DFE must not interfere with the ability of the imaging product to enter or exit its lower-power modes. In order to take advantage of this exclusion, the DFE must meet the definition in Section 1.DD. and be a separate processing unit that is capable of initiating activity over the network.

Example: A printer's total TEC result is 24.5 kWh/week and its internal DFE consumes 50W in Ready mode. 50W x 168 hours/week = 8.4 kWh/week, which is then subtracted from the tested TEC value: 24.5 kWh/week – 8.4 kWh/week = 16.1 kWh/week. 16.1 kWh/week is then compared to the following criteria.

Note: In all of the following equations, x = Monochrome Product Speed (ipm).

TEC Table 1

Product(s): Copiers, Digital Duplicators, Fax Machines, Printers	
Size Format(s): Standard-size	
Marking Technologies: DT, Mono DS, Mono EP, Mono Stencil, Mono TT, Mono High Performance IJ	
Monochrome Product Speed (ipm)	Maximum TEC (kWh/week)
≤ 15	***1.0 kWh***
15 < x ≤ 40	***(0.10 kWh/ipm)x – 0.5 kWh***
40 < x ≤ 82	***(0.35 kWh/ipm)x – 10.3 kWh***
> 82	***(0.70 kWh/ipm)x – 39.0 kWh***

TEC Table 2

Product(s): Copiers, Digital Duplicators, Fax Machines, Printers	
Size Format(s): Standard-size	
Marking Technologies: Color DS, Color Stencil, Color TT, Color EP, SI, Color High Performance IJ	
Monochrome Product Speed (ipm)	Maximum TEC (kWh/week)
≤ 32	***(0.10 kWh/ipm)x + 2.8 kWh***
32 < x ≤ 58	***(0.35 kWh/ipm)x – 5.2 kWh***
> 58	***(0.70 kWh/ipm)x – 26.0 kWh***

TEC Table 3

Product(s): MFDs	
Size Format(s): Standard-size	
Marking Technologies: DT, Mono DS, Mono EP, Mono TT, Mono High Performance IJ	
Monochrome Product Speed (ipm)	Maximum TEC (kWh/week)
≤ 10	***1.5 kWh***
10 < x ≤ 26	***(0.10 kWh/ipm)x + 0.5 kWh***
26 < x ≤ 68	***(0.35 kWh/ipm)x – 6.0 kWh***
> 68	***(0.70 kWh/ipm)x – 30.0 kWh***

TEC Table 4

Product(s): MFDs	
Size Format(s): Standard-size	
Marking Technologies: Color DS, Color TT, Color EP, SI, Color High Performance IJ	
Monochrome Product Speed (ipm)	Maximum TEC (kWh/week)
≤ 26	***(0.10 kWh/ipm)x + 3.5 kWh***
26 < x ≤ 62	***(0.35 kWh/ipm)x – 3.0 kWh***
> 62	***(0.70 kWh/ipm)x – 25.0 kWh***

B. **ENERGY STAR Eligibility Criteria – OM.** To qualify as ENERGY STAR, the power consumption values for imaging equipment outlined in Section 2, Table 2 above must not exceed the corresponding criteria below. For products that meet the Sleep-mode power requirement in Ready mode, no further automatic power reductions are required to meet the Sleep criterion. Additionally, for products that meet the Standby-power requirements in Ready or Sleep mode, no further automatic power reductions are required to earn the ENERGY STAR.

For imaging products with a functionally-integrated DFE that relies on the imaging product for its power, the power consumption of the DFE should be excluded when comparing the product's measured Sleep to the combined marking-engine and functional-adder criteria limits below and when comparing to the measured Standby level to the Standby criteria limits below. The DFE must not interfere with the ability of the imaging product to enter or exit its lower-power modes. In order to take advantage of this exclusion, the DFE must meet the definition in Section 1.DD. and be a separate processing unit that is capable of initiating activity over the network.

Default Delay Time Requirements: To qualify for ENERGY STAR, OM products must meet the default-delay time settings provided in Tables A through C below for each product type, enabled upon product shipment. In addition, all OM products must be shipped with a maximum **machine** delay time not in excess of four hours, which is only adjustable by the manufacturer. This maximum machine delay time cannot be influenced by the user and typically cannot be modified without internal, invasive product manipulation. The default-delay-time settings provided in Tables A through C may be user adjustable.

Table A: Maximum Default Delay Times to Sleep for Small-format and Standard-size OM Products, Excluding Mailing Machines, in Minutes

Monochrome Product Speed (ipm)	Fax Machines	MFDs	Printers	Scanners
0 - 10	5	15	5	15
11 - 20	5	30	15	15
21 - 30	5	60	30	15
31 - 50	5	60	60	15
51 +	5	60	60	15

Table B: Maximum Default Delay Times to Sleep for Large-format OM Products, Excluding Mailing Machines, in Minutes

Monochrome Product Speed (ipm)	Copiers	MFDs	Printers	Scanners
0 - 10	30	30	30	15
11 - 20	30	30	30	15
21 - 30	30	30	30	15
31 - 50	60	60	60	15
51 +	60	60	60	15

Table C: Maximum Default Delay Times to Sleep for Mailing Machines in Minutes

Product Speed (mppm)	Mailing Machines
0 – 50	20
51 – 100	30
101 – 150	40
151 +	60

Standby Requirements: To qualify for ENERGY STAR, OM products must meet the Standby power criteria provided in Table D below for each product type.

Table D: Maximum Standby Power Level for OM Products in Watts

Product Type	Standby (W)
All OM Products	1

The eligibility criteria in OM Tables 1 through 8 below address the marking engine of the product. Since products are expected to be shipped with one or more functions beyond a basic marking engine, the corresponding allowances below should be added to the marking engine criteria for Sleep. The total value for the base product with applicable "functional adders" should be used to determine eligibility. Manufacturers may apply no more than **three** Primary functional adders to each product model, but may apply as many Secondary adders as present (with Primary adders in excess of three included as Secondary adders). An example of this approach is provided below:

Example: Consider a Standard-size IJ printer with a USB 2.0 connection and a memory card connection. Assuming the USB connection is the Primary interface used during the test, the printer model would receive a functional-adder allowance of 0.5 W for USB and 0.1 for the memory card reader, for a total of 0.6 W of total functional-adder allowances. Since OM Table 2 provides a Sleep mode marking-engine criterion of 1.4 W, to determine qualification under ENERGY STAR, the manufacturer would sum the Sleep mode marking-engine criterion with the applicable functional-adder allowances to determine the maximum power consumption permitted for qualification of the base product: 1.4 W + 0.6 W. If the power consumption of the printer in Sleep mode measures at or below 2.0 W, then the printer would meet the ENERGY STAR Sleep criterion.

Qualifying Products: Table 3 – OM Functional Adders

Type	Details	Functional Adder Allowances (W)	
		Primary	Secondary
Interfaces	A. Wired < 20 MHz	0.3	0.2
	A physical data- or network-connection port present on the imaging product that is capable of a transfer rate < 20 MHz. Includes USB 1.x, IEEE488, IEEE 1284/Parallel/Centronics, RS232, and/or fax modem.		
	B. Wired ≥ 20 MHz and < 500 MHz	0.5	0.2
	A physical data- or network-connection port present on the imaging product that is capable of a transfer rate ≥ 20 MHz and < 500 MHz. Includes USB 2.x, IEEE 1394/FireWire/i.LINK, and 100Mb Ethernet.		
	C. Wired ≥ 500 MHz	1.5	0.5
	A physical data- or network-connection port present on the imaging product that is capable of a transfer rate ≥ 500 MHz. Includes 1G Ethernet.		
	D. Wireless	3.0	0.7
	A data- or network-connection interface present on the imaging product that is designed to transfer data via radio-frequency wireless means. Includes Bluetooth and 802.11.		
	E. Wired card/camera/storage	0.5	0.1
	A physical data- or network-connection port present on the imaging product that is designed to allow the connection of an external device, such as flash memory-card/smart-card readers and camera interfaces (including PictBridge).		
	G. Infrared	0.2	0.2
	A data- or network-connection interface present on the imaging product that is designed to transfer data via infrared technology. Includes IrDA.		

Type	Details	Functional Adder Allowances (W)	
		Primary	Secondary
Other	Storage	-	0.2
	Internal storage drives present on the imaging product. Includes internal drives only (e.g., disk drives, DVD drives, Zip drives), and applies to each separate drive. This adder does not cover interfaces to external drives (e.g., SCSI) or internal memory.		
	Scanners with CCFL lamps or non-CCFL lamps	-	0.5
	The presence of a scanner that uses Cold Cathode Fluorescent Lamp (CCFL) technology or a technology other than CCFL, such as Light-Emitting Diode (LED), Halogen, Hot-Cathode Fluorescent Tube (HCFT), Xenon, or Tubular Fluorescent (TL) technologies. This adder is applied only once, regardless of the lamp size or the number of lamps/bulbs employed.		
	PC-based system (cannot print/copy/scan without use of significant PC resources)	-	-0.5
	This adder applies to imaging products that rely on an external computer for **significant** resources, such as memory and data processing, to perform basic functions commonly performed by imaging products independently, such as page rendering. This adder does not apply to products that simply use a computer as a source or destination for image data.		
	Cordless handset	-	0.8
	The capability of the imaging product to communicate with a cordless handset. This adder is applied only once, regardless of the number of cordless handsets the product is designed to handle. This adder does not address the power requirements of the cordless handset itself.		
	Memory	-	1.0 W per 1 GB
	The internal capacity available in the imaging product for storing data. This adder applies to all volumes of internal memory and should be scaled accordingly. For example, a unit with 2.5 GB of memory would receive an allowance of 2.5 W while a unit with 0.5 GB would receive an allowance of 0.5 W.		
	Power-supply (PS) size, based on PS output rating (OR) **Note: This adder ONLY applies to products which fall under OM Tables 2 and 6.**	-	For PSOR > 10 W, 0.02 x (PSOR – 10 W)
	This adder applies to only those imaging products which fall under OM Tables 2 and 6. The allowance is calculated from the internal or external power supply's **rated DC output** as specified by the power supply manufacturer. (It is **not** a measured quantity). For example, a unit that is rated to provide up to 3 A at 12 V has a PSOR of 36 W and would receive an allowance of 0.02 x (36-10) = 0.02 x 26 = 0.52 W of power supply allowance. For supplies that provide more than one voltage, the sum of power from all voltages is used unless the specifications note that there is a rated limit lower than this. For example, a supply which can supply 3A of 24 V and 1.5 A of 5 V output has a total PSOR of (3 x 24) + (1.5 x 5) = 79.5 W, and an allowance of 1.39 W.		

For the adder allowances shown in Qualifying Products Table 3 above, distinctions are made for "Primary" and "Secondary" types of adders. These designations refer to the state in which the interface is required to remain while the imaging product is in Sleep. Connections that remain active during the OM test procedure while the imaging product is in Sleep are defined as Primary, while connections that can be inactive while the imaging product is in Sleep are defined as Secondary. Most functional adders typically are Secondary types.

Manufacturers should consider only the adder types that are available on a product in its as-shipped configuration. Options available to the consumer after the product is shipped or interfaces that are present on the product's externally-powered digital front-end (DFE) should not be considered when applying allowances to the imaging product.

For products with multiple interfaces, these interfaces should be considered as unique and separate. However, interfaces that perform multiple functions should only be considered once.

For example, a USB connection that operates as both 1.x and 2.x may be counted only once and given a single allowance. When a particular interface may fall under more than one interface Type according to the table, the manufacturer should choose the function that the interface is primarily designed to perform when determining the appropriate adder allowance. For example, a USB connection on the front of the imaging product that is marketed as a PictBridge or "camera interface" in product literature should be considered a Type E interface rather than a Type B interface. Similarly, a memory-card-reader slot that supports multiple formats may only be counted once. Further, a system that supports more than one type of 802.11 may count as only one wireless interface.

OM Table 1

Product(s): Copiers, MFDs	
Size Format(s): Large Format	
Marking Technologies: Color DS, Color TT, DT, Mono DS, Mono EP, Mono TT, Color EP, SI	
	Sleep (W)
Marking Engine	***30***

OM Table 2

Product(s): Fax Machines, MFDs, Printers	
Size Format(s): Standard-size	
Marking Technologies: Color IJ, Mono IJ	
	Sleep (W)
Marking Engine	***1.4***

OM Table 3

Product(s): MFDs, Printers	
Size Format(s): Large Format	
Marking Technologies: Color IJ, Mono IJ	
	Sleep (W)
Marking Engine	***15***

OM Table 4

Product(s): Mailing Machines	
Size Format(s): N/A	
Marking Technologies: DT, Mono EP, Mono IJ, Mono TT	
	Sleep (W)
Marking Engine	***7***

OM Table 5

Product(s): Printers	
Size Format(s): Small Format	
Marking Technologies: Color DS, DT, Color IJ, Color Impact, Color TT, Mono DS, Mono EP, Mono IJ, Mono Impact, Mono TT, Color EP, SI	
	Sleep (W)
Marking Engine	***9***

OM Table 6

Product(s): Printers	
Size Format(s): Standard-size	
Marking Technologies: Color Impact, Mono Impact	
	Sleep (W)
Marking Engine	***4.6***

OM Table 7

Product(s): Scanners	
Size Format(s): Large Format, Small Format, Standard-size	
Marking Technologies: N/A	
	Sleep (W)
Scanning Engine	***4.3***

OM Table 8

Product(s): Printers	
Size Format(s): Large Format	
Marking Technologies: Color DS, Color Impact, Color TT, DT, Mono DS, Mono EP, Mono Impact, Mono TT, Color EP, SI	
	Sleep (W)
Marking Engine	***14***

C. **DFE Efficiency Requirements.** The following efficiency requirements are for Digital Front End equipment that is defined in Section 1.DD. of this specification.

i. Power Supply Efficiency Requirements

Type 1 DFE Using an Internal Ac-Dc Power Supply: A DFE that gets its dc power from its own internal ac-dc power source must meet the following power supply efficiency requirement: 80% minimum efficiency at 20%, 50%, and 100% of rated output and Power Factor ≥ 0.9 at 100% of rated output.

Type 1 DFE Using an External Power Supply: A DFE that gets its dc power from its own external power supply (as defined by the ENERGY STAR V2.0 Program Requirements for Single Voltage ac-ac and ac-dc External Power Supplies) must be ENERGY STAR qualified or meet the no-load and active mode efficiency levels provided in the ENERGY STAR V2.0 Program Requirements for Single Voltage ac-ac and ac-dc External Power Supplies. The ENERGY STAR specification and qualified product list can

be found at: www.energystar.gov/powersupplies.

ii. Test Procedures

Manufacturers are required to perform tests and self-certify those models that meet the ENERGY STAR guidelines.

- In performing these tests, the partner agrees to use the applicable test procedures provided in Table 4, below.
- The test results for qualifying products must be reported to EPA or the European Commission, as appropriate.

Additional testing and reporting requirements are provided below.

Models Capable of Operating at Multiple Voltage/Frequency Combinations: Manufacturers shall test their products based on the market(s) in which the models will be sold and promoted as ENERGY STAR qualified. EPA and its ENERGY STAR Country Partners have agreed upon a table with three voltage/frequency combinations for testing purposes. Please refer to the **Test Conditions and Equipment for ENERGY STAR Imaging Equipment Products** for details regarding international voltage/frequency combinations for each market.

For products that are sold as ENERGY STAR in multiple international markets and, therefore, rated at multiple input voltages, the manufacturer must test at and report the required power consumption or efficiency values at all relevant voltage/frequency combinations. For example, a manufacturer that is shipping the same model to the United States and Europe must measure, meet the specification, and report test values at both 115 Volts/60 Hz and 230 Volts/50 Hz in order to qualify the model as ENERGY STAR in both markets. If a model qualifies as ENERGY STAR at only one voltage/frequency combination (e.g., 115 Volts/60 Hz), then it may only be qualified and promoted as ENERGY STAR in those regions that support the tested voltage/frequency combination (e.g., North America and Taiwan).

Table 4: Type 1 DFE Test Procedures

Specification Requirement	Test Protocol	Source
Power Supply Efficiency	Internal Power Supply (IPS)	IPS: http://efficientpowersupplies.epri.com/
	External Power Supply (EPS) ENERGY STAR Test	EPS: www.energystar.gov/powersupplies/

4) **Test Procedures**

Product Testing Set-up, Procedures, and Documentation: The specific instructions for testing the energy efficiency of imaging equipment products are outlined in three separate documents entitled:

- "ENERGY STAR Qualified Imaging Equipment Typical Electricity Consumption Test Procedure;"
- "ENERGY STAR Qualified Imaging Equipment Operational Mode Test Procedure;" and
- "Test Conditions and Equipment for ENERGY STAR Imaging Equipment Products."

The test results produced by these procedures shall be used as the primary basis for determining ENERGY STAR qualification.

Manufacturers are required to perform tests and self-certify those product models that meet the ENERGY STAR guidelines. Families of imaging equipment models that are built on the same chassis and are identical in every respect except for housing and color may be qualified through submission of

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