EuP Preparatory Studies "Imaging Equipment" (Lot 4)

Final Report on Task 4 "Technical Analysis"

Compiled by Fraunhofer IZM and PE Europe

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Content

Introduction

This is the **final report** on Task 4 "technical analysis of existing products" for the EuP Preparatory Studies on Imaging Equipment (Lot 4). The findings presented in this report are reflecting the research conducted by the IZM consortium as well as important feedback by industry and other stakeholders. The statements and recommendations presented in the final report however are not to be perceived as the opinion of the European Commission.

We like to acknowledge the fruitful collaboration and trustful working relationship with various industry partners, non-industry stakeholders and the European Commission throughout the study. We like to thank all stakeholders for their contribution and critical reviews of our reports.

12th November 2007

4. Technical Analysis

Selection of representative product segments for the technical analysis

Task 4 is dedicated to the technical analysis of existing products in the European market applying the "MEEuP EcoReport" assessment tool from VHK. In close collaboration with leading imaging equipment manufacturers, bill of materials (BOM) and use phase related data on power consumption and consumables have been compiled for various products. The selection of these product cases was made deliberately in order to provide a reasonable input for the definition of base cases (Task 5) as well as the assessment of total environmental impacts and improvement potentials related to imaging equipment in the European Union (Task 7).

According to the MEEuP methodology the base cases are "a conscious abstraction of reality" and representative for the product stock in the European Union. This indicates that the definition of base cases – and therefore the selection of product cases for the technical analysis – primarily considers economically significant products[1]. It is somewhat unclear however, how comprehensive the base cases have to cover the total imaging equipment market. The MEEuP methodology requires multiplying the results of the base case impact assessments with the total EU-25 product stock in order to assess the overall environmental impact (Task 5 and 7). This requirement leads to the necessity to match the base cases with available market figures. In consequence the definition of base cases is limited to the products (market segments) for which stock data could be compiled. The installed base (stock of products) in the EU has been analyzed in Task 2. Comprehensive stock data are limited to very large market segments. These segments are defined by only few parameters namely marking technology[2], functionality[3], and colour-capability[4]. The following assumptions are summarizing the results of the previous analysis including the main findings of the reports on Tasks 1, 2 and 3. The selection of representative products is reflecting following aspects:

- Economical significance (sales & stock in EU-25)

[1] Please take note, that the term "products" is use throughout the chapter synonymous for groups or categories of products in a sense of market segments. As we have discussed in Task 1 and 2, not a single method exists which defines product segments in the imaging equipment market. Manufacturer, retailer, market survey institution, and statistics offices apply various schemes in order to define market segments. This lack of a single market scheme adds to the difficulty in defining representative base cases.

[2] Although the main marking technologies electro photography (EP) and inkjet (IJ) are reflected in this scheme, a distinction of other technologies e.g. thermal transfer (TT) in the case of facsimile machines is missing.

[3] The term functionality applies only to the aspect of single function or multi function devices. A distinction of functionality related performance such as imaging speed is typical for EP-products. Although such a distinction would add to the accuracy of the assessment results, the framework of this study does not allow such comprehensive segmentation.

[4] According to market forecast, colour capability is a major trend in the EP copier and EP printer market. It is assumed that colour capability will show a certain environmental impact.

- Image creation volume (personal & workgroup environment)
- Functional trend (SFD & MFD / monochrome & colour)
- Performance factor (image speed & quality)

Table 1 and Figure 1 show the available EU-25 stock data for selected imaging equipment according to the reference years 2005 (actual), 2010 and 2020 (forecast).

Table 1: EU-25 stock data for selected imaging equipment in 2005 with forecast 2010, and 2020

Product Segment	EU-25 Stock in 2005 (in 1000 units)	EU-25 Stock in 2010 (in 1000 units)	EU-25 Stock in 2020 (in 1000 units)
EP-Copier mono	5.970	4.122	1.000
EP-Copier color	381	691	5.000
EP-Printer mono	14.735	14.306	10.000
EP-Printer color	1.919	4.198	10.000
IJ-Printer SFD	68.412	31.322	20.000
IJ-Printer MFD	21.760	77.776	100.000
Facsimile SFD	13.241	4.382	1.000
Facsimile MFD	6.890	8.874	8.000
Total:	*133.308*	*145.671*	*155.000*

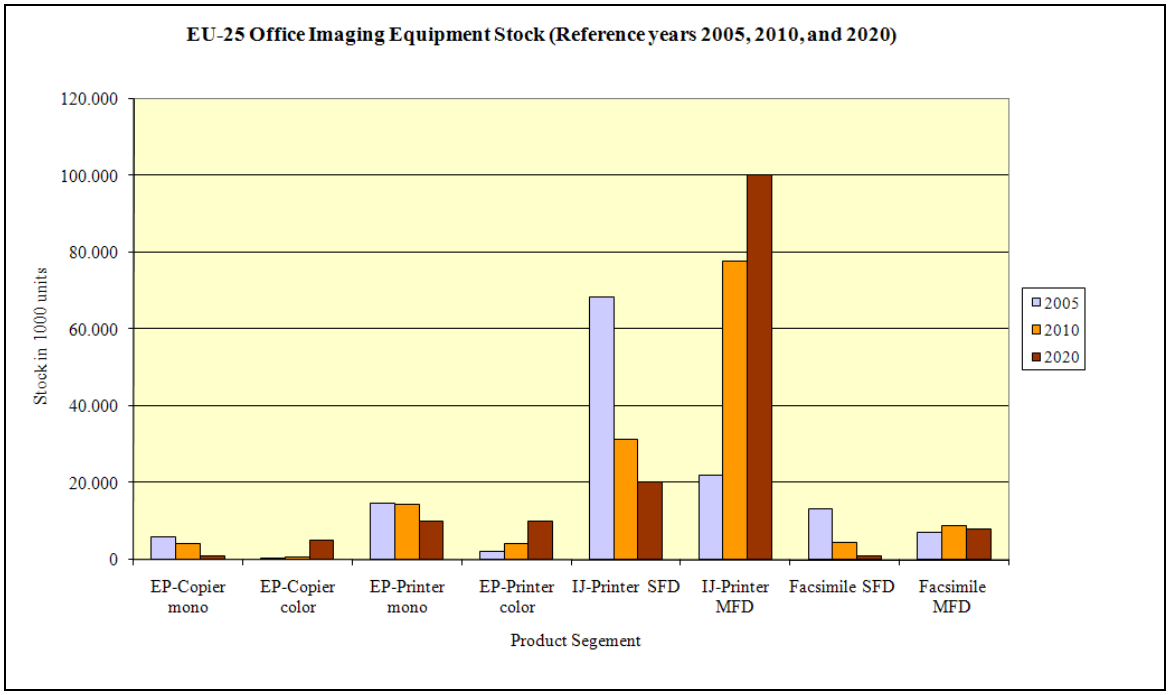

Figure 1: EU-25 stock data for selected imaging equipment in 2005 with forecast 2010, and 2020

According to these stock data IJ-Printers are most representative by the sheer number of products that are in the market. When accumulating single and multi functional IJ devices the installed base in 2005 was approximately 90 million units. This number will even increase while simultaneously an exchange of SFD by MFD will occur in the mid-term. In comparison is the accumulated number

of EP-Copier and EP-Printer with approximately 23 million units in 2005 just one quarter of total IJ-Printers. But this correlation alone is insufficient for determining the "significance" of products. If we compare IJ-Printers with EP-Copier and EP-Printers in terms of their monetary value both product groups appear more equal. Whereas IJ-Printers are selling at low and medium prices, EP-Copier and EP-Printer are more expensive with a higher value-add. A simple calculation shows economical relevance of both the IJ and EP market segments. If we assume average sales prices for IJ-Products (150 €) and EP-Products (600 €), than multiply them with the installed base we come to the following result:

- IJ-Product stock has a monetary volume of 13,5 billion Euro (90 million units á 150 Euro)
- EP-Product stock has a monetary volume of 13,8 billion Euro (23 million units á 600 Euro)

Despite the number of products and their monetary value we have to consider another indicator for the significance of imaging equipment products; the image creation volume (paper output) related to a specific market segment. Figure 2 provides this interesting correlation between the installed base and the annual image creation volume for the reference years 2005 and 2010. The figures are based on data from InfoTrends which have been obtained in Task 2 market analysis (see Table 2).

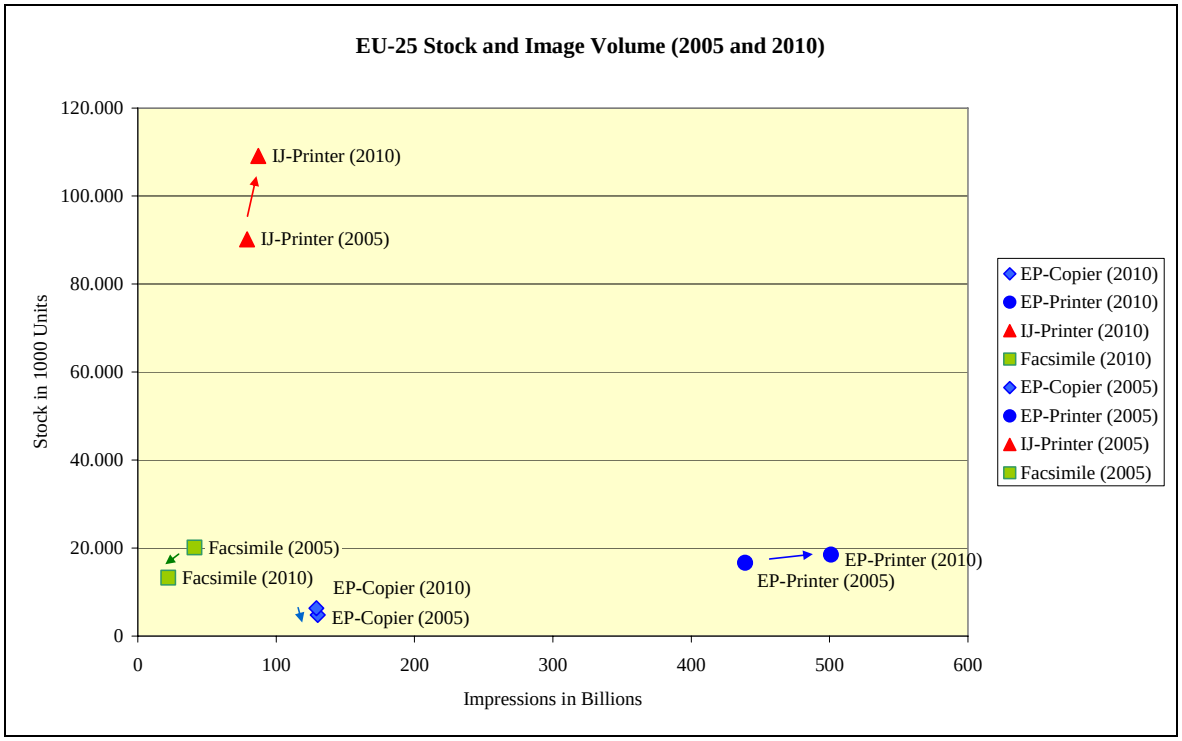

Figure 2: EU-25 stock and annual image volume of imaging equipment in 2005 and 2010

EP-Printers on the one hand clearly dominate the image creation volume. The number of images generated by EP-Printers will increase from 439 billion impressions in 2005 up to 501 billion impressions in 2010. The stock of EP-Printers will also slightly increase from 16.6 million units in

2005 to 18.5 million units in 2010. If we would include EP-Copier/MFD the number of impressions would increase even more. IJ-Printers on the other hand have despite their large number of units in the market a relatively low image creation volume. The paper output related to IJ-Printer is slightly increasing from 79 billion impressions in 2005 to 87 billion impressions in 2010.

Table 2: Impressions according to stock for selected imaging equipment

Product Segment	EU-25 Stock in 2005 (in 1000 units)	Personal Images in 2005 (in 1000 impressions)	Workgroup Images 2005 (in 1000 impressions)	EU-25 Stock in 2010 (in 1000 units)	Personal Images in 2010 (in 1000 impressions)	Workgroup Images 2010 (in 1000 impressions)
EP-Copier mono	5.970			4.122		
EP-Copier color	381			691		
EP-Copier (total)	**6.351**	**13.000.000**	**116.000.000**	**4.813**	**5.000.000**	**125.000.000**
EP-Printer mono	14.735			14.306		
EP-Printer color	1.919			4.198		
EP-Printer (total)	**16.654**	**18.000.000**	**421.000.000**	**18.504**	**1.000.000**	**500.000.000**
IJ-Printer SFD	68.412			31.322		
IJ-Printer MFD	21.760			77.776		
IJ-Printer (total)	**90.172**	**71.000.000**	**8.000.000**	**109.098**	**82.000.000**	**5.000.000**
Facsimile SFD	13.241			4.382		
Facsimile MFD	6.890			8.874		
Facsimile (total)	**20.131**	**17.000.000**	**11.000.000**	**13.256**	**8.000.000**	**7.000.000**

Table 3 provides an overview on the selected product cases (V1 – V8) and the respective selection criteria[5]. This is an interim structure for the definition of base cases.

[5] The "Danish Energy Authority" (DEA) commented, that to their belief "the number of pages for the V1 to V4 cases seems to be on the low side, […] more typical around 40 to 50 ipm".

Table 3: List of selected product cases

No.	Product Case Description	Selection criteria
V1	EP-Copier MFD, monochrome, 26 ipm	• Basic workgroup MFD • High utilization (volume images) • Business model (leasing)
V2	EP-Copier MFD, colour, 26 ipm	• Advanced workgroup MFD (growing segment) • High utilization (volume & value images) • Business model (leasing)
V3	EP-Printer SFD, monochrome, 32 ipm	• Standard Laser Printer (volume segment) • Monochrome SFD prevails in market (low price) • High utilization (volume images) • Business model (selling)
V4	EP-Printer SFD, colour, 32 ipm	• Advanced Laser Printer (growing segment) • Colour capable SFD (growing market) • Moderate utilization (volume & value images) • Business model (selling)
V5	IJ-Printer MFD, personal (low utilization)	• high unit sales and short lifetimes • low utilization (value prints) • assumed standby and off-mode issues
V6	IJ-Printer MFD, workgroup (moderate use)	• increasing unit sales and short lifetimes • higher speed & moderate utilization • market overlap with EP-printer (<25ipm) • always on (fax utilization)
V7	*Facsimile machine*	• Single function phase out due to MFD and email • High performance document fax (niche market) • Less utilization (lower volume images)
V8	*Flatbed scanner*	• Single function phase out due to MFD • High performance document scanner (niche market) • Create no hard-copy image

Compilation of product cases for the technical analysis

Against the background of the eight product segments, representative product cases were selected for the technical analysis. From September to November 2006 various companies were contacted and asked to provide product data based on the VHK EcoReport input categories. A list of favoured products covering the spectrum of the interim base cases were prepared and discussed with individual companies. The focus was placed on products that had been introduced into the market by the year 2004 or 2005. In most cases an agreement was reached on providing data for two particular products (sometimes more). In order to support the industry partners in their work to obtain relevant data and in order to allocate these product data to the VHK EcoReport input categories an interactive PDF-document[6] was prepared and sent on 9 November 2006 to industry partners. Throughout the following month regular contacts were made with these companies in order to check on the status and possible problems in the data allocation. Changes were made by individual companies regarding the chosen products. In two cases our preferred product could not be provided due to the fact that these particular products were only branded by the company but actually manufactured by a different one. In other cases the companies have not been able to provide product data for the desired speed classes and changes had to be accepted. Despite these

[6] Guidance for Product Case Assessment – Guidance on the application of the VHK methodology and additional data requirements per product case (see documentation).

drawbacks, we received from ten industry partners data for 25 imaging equipment products in VHK EcoReport format up to the present day. In most cases the companies followed the guided procedure for distinguishing various modules. Table 4 on the next page shows all available product cases for the technical analysis and their allocation to the proposed interim base cases.

Introduction to technical analysis

The basic concept for the technical analysis was to break down the data input according to main product modules. This allowed us to assess the environmental impact of the sub-assemblies separately and to make a consistency check of the entries. As a result we were able to correlate certain environmental impacts more precisely to a particular functional module of the product. In the following report however only the required aggregated product data will be presented for the:

- Production phase
- Distribution phase
- Use phase
- End-of-life phase

In the production phase the material composition of a product and related manufacturing processes will be analyzed. The focus of this analysis will be put on the determination of the relationship between the amounts of certain materials/components and their technical function. The distribution phase is mainly determined by the dimensions of the product. The use phase assessment is difficult because it requires multiple assumptions particularly on use patterns. The MEEuP EcoReport is a limiting factor as well. Regarding consumables there is no default data set for ink and only one for toner and office paper. As we will see in the assessments, the environmental impact of the assumed paper consumption will dominate the total impact assessment. We therefore show the results always in two forms – with and without paper. The end-of-life phase is similar difficult to assess. From findings in Task 3 we know that components (cartridges) and product parts are to some extent refurbished and reused. The B2B market (medium to high end EP-products) allows manufacturers to develop individual reuse & recycling strategies for their products. This aspect cannot be assessed applying the EcoReport.

Table 4: Available product cases for technical assessment

Product Case	Code	Technology	Function	Image	Speed	Format	Weight	Year	Price
Product V1	**EPCMM-26**	**EP-Copier**	**MFD**	**mono**	**26 ipm**	**A3**	**68 kg**	**2005**	**4.000 €**
V1_a	EPCMM_02	EP-Copier	MFD	mono	35 ipm	A3	74 kg	2004	4.500 €
V1_b	EPCMM_23	EP-Copier	MFD	mono	23 ipm	A3	75 kg	2005	4.000 €
V1_c	EPCMM_26	EP-Copier	MFD	mono	20 ipm	A3	54 kg	2005	3.000 €
Product Case	Code	Technology	Function	Image	Speed	Format	Weight	Year	Price
Product V2	**EPCMC-26**	**EP-Copier**	**MFD**	**color**	**26 ipm**	**A3**	**143 kg**	**2005**	**8.000 €**
V2_a	EPCMC_05	EP-Copier	MFD	color	32 ipm	A3	179 kg	2005	8.000 €
V2_b	EPCMC_28	EP-Copier	MFD	color	25 ipm	A3	118 kg	2005	7.000 €
V2_c	EPCMC_31	EP-Copier	MFD	color	23 ipm	A3	132 kg	2005	9.000 €
Product Case	Code	Technology	Function	Image	Speed	Format	Weight	Year	Price
Product V3	**EPPSM-32**	**EP-Printer**	**SFD**	**mono**	**32 ipm**	**A4**	**23 kg**	**2005**	**900 €**
V3_b	EPPSM_19	EP-Printer	SFD	mono	30 ipm	A4	20 kg	2005	700 €
V3_a	EPPSM_27	EP-Printer	SFD	mono	31 ipm	A4	23 kg	2005	800 €
V3_c	EPPSM_33	EP-Printer	SFD	mono	34 ipm	A4	26 kg	2004	1.000 €
Product Case	Code	Technology	Function	Image	Speed	Format	Weight	Year	Price
Product V4	**EPPSC-32**	**EP-Printer**	**SFD**	**color**	**32 ipm**	**A4**	**43 kg**	**2005**	**1.500 €**
V4_a	EPPSC_11	EP-Printer	SFD	color	40 ipm	A4	51 kg	2005	1.400 €
V4_b	EPPSC_36	EP-Printer	SFD	color	35 ipm	A4	35 kg	2005	1.700 €
V4_c	EPPSC_22	EP-Printer	SFD	color	21 ipm	A4	28 kg	2005	700 €
Product Case	Code	Technology	Function	Image	Speed	Format	Weight	Year	Price
Product V5/6	**IJPM (P/W)**	**IJ-Printer**	**MFD**	**color**	**20 ipm**	**A4**	**9 kg**	**2005**	**200 €**
V5_a	IJPM_34	IJ-Printer	MFD	color	5 ipm	A4	6 kg	2005	100 €
V5_b	IJPM_01	IJ-Printer	MFD	color	19 ipm	A4	10 kg	2005	250 €
V5_c	IJPM_14	IJ-Printer	MFD	color	21 ipm	A4	11 kg	2005	300 €
V5_d	IJPM_21	IJ-Printer	MFD	color	25 ipm	A4	10 kg	2005	170 €
Control Cases							**8kg**		
Product Case	FIJ_06	IJ-Facsimile					3,5 kg		
Product Case	FTT_24	TT-Facsimile					3,0 kg		
Product Case	FBS_12	Flatbed Scanner					2,6 kg		
Product Case	FBS_25	Flatbed Scanner					4,2 kg		
Product Case	CP_08	DS Photo Printer					1,0 kg		
Product Case	CP_13	IJ-Photo Printer					2,7 kg		

Material allocation for missing data sets in the EcoReport

Due to some missing data sets in the VHK EcoReport spread sheet the following table shows allocation we have made in the assessments. All allocations have been done by the Primary Energy consumption of the respective materials.

Table 5: Material allocation for missing data sets in the EcoReports

Material	Allocation for VHK Spreadsheet
POM	PA 6
PET	PP
PBT	PA6
PPE	PS
PPS	PS
SBR	SAN
Polyester	PP
Urethane	PUR
Springs	Stainless coil
Screws	Steel sheet
Motor/ Fan Assemblies	Cu Winding Wire

4.1. Production Phase

4.1.1. EP-Copier/MFD monochrome (V1)

4.1.1.1. Description of Product V1

Table 6 provide the performance data of three EP-copier-based monochrome MFDs. These three products will be averaged and defined as Product V1. In Task 5 the products V1 is the input for the analysis of Base Case 1. The individual product cases were provided by three brand name manufacturers. We like to thank the contributing industry partners for their support.

Table 6: Main technical parameter of product cases V1

Product Case	Code	Technology	Function	Image	Speed	Format	Weight	Year	Price
Product V1	**EPCMM-26**	**EP-Copier**	**MFD**	**mono**	**26 ipm**	**A3**	**68 kg**	**2005**	**4.000 €**
V1_a	EPCMM_02	EP-Copier	MFD	mono	35 ipm	A3	74 kg	2004	4.500 €
V1_b	EPCMM_23	EP-Copier	MFD	mono	23 ipm	A3	75 kg	2005	4.000 €
V1_c	EPCMM_26	EP-Copier	MFD	mono	20 ipm	A3	54 kg	2005	3.000 €

Performance: Product V1 is a basic workgroup Copier/MFD for medium speed (26 ipm), monochrome document handling in standard paper sizes up to A3. The EP-copier-based device has a functional spectrum including: copying, network printing, scanning, and facsimile. It is a duplex capable machine with the option to add accessories such as sorters and extra trays. The three products were introduced into the market in the years 2004 and 2005.

Design: The chassis and trays consist of a metal frames with plastic housing. The marking technology is basic dry-toner electro-photography. The main components for the image creation are the laser beam device, photo conductor drum, toner supply from a cartridge (hopper), blade and charger roller[7], clearer blades, transfer rollers, and a high temperature fixing unit consisting of a hot fuser roller and a pressure roller. Paper transport components include different motors (e.g. stepper motors), belts and rollers of various size, sensors and other driving mechanics. The main components of the scanner unit on top of the machine is the cold cathode florescent lamp (CCFL), mirrors, lenses, scan head, glass plate, driving mechanics, and controller boards and digital interfaces. The functionality and performance of the machine is determined by the integrated electronic hardware including processor, memory, main boards, and digital interfaces with a respective software package. There are multiple boards with different level of system integration

[7] In older models a corona wire was used for charging. But as the source of ozone emission it was replaced primary charge roller that is magnetizing the drum.

designed into the product. The power supply is internal. The user interface is realized both by mechanical (buttons) and optical (LCD) interaction.

4.1.1.2. Comparison of material mass proportions V1

Table 7 and Table 8 below show the main material input categories in weight and percent of total for all three product cases (V1_a/b/c) as well as for the averaged Product V1 in comparison.

Table 7: Comparison of material input categories by weight

		PRODUCTION			
Resources Use and Emissions		Base Case V1 - MFD - Copier mono	Base Case V1_a	Base Case V1_b	Base Case V1_c
Materials	**unit**				
Bulk Plastics	g	**13228**	**14468**	**18681**	**6534**
TecPlastics	g	**5406**	**6448**	**2625**	**7146**
Ferro	g	**39141**	**45776**	**42017**	**29629**
Non-ferro	g	**1834**	**2797**	**1623**	**1083**
Coating	g	**0**	**0**	**0**	**0**
Electronics	g	**2485**	**3194**	**3531**	**730**
Misc.	g	**6048**	**1716**	**6942**	**9485**
Total weight	g	**68141**	**74399**	**75419**	**54606**

Table 8: Comparison of main material input categories in percent

		PRODUCTION			
Resources Use and Emissions		**Base Case V1 - MFD - Copier mono**	**Base Case V1_a**	**Base Case V1_b**	**Base Case V1_c**
Materials	**unit**				
Bulk Plastics	g	19%	19%	25%	12%
TecPlastics	g	8%	9%	3%	13%
Ferro	g	57%	62%	56%	54%
Non-ferro	g	3%	4%	2%	2%
Coating	g	0%	0%	0%	0%
Electronics	g	4%	4%	5%	1%
Misc.	g	9%	2%	9%	17%
Total weight	g	100%	100%	100%	100%

Regarding the mass proportions of the main materials the direct comparison of the individual products shows some differences. These differences are obvious in the case of plastic materials. Depending on functional, aesthetic, and cost requirements each manufacturer makes a different choice. In sum however and in correlation with Ferro metals the proportions are quite similar. Another aspect which generates differences is the allocation of components and materials to a certain input category. In the case of electronics and electro-mechanical components (e.g. motors) we made some corrections after consulting the industry partners. A third aspect is the difference in total weight. The product V1_c has in total 20 kg less weight due to e.g. minimum configuration of paper trays. This results in shift of the mass proportion. Furthermore, according to the data provided by the industry partner for V1_c is the packaging material almost two times heavier than it was reported for V1_b. The product V1_a reported no packaging material at all. This situation is reflected in the input category “Miscellaneous”. We conclude that due to similar mass proportions

of materials in all three products is the compilation of Base Case 1 (V1) feasible by the arithmetic average of V1_a/b/c.

4.1.1.3. Aggregated material input for Base Case 1

The following Table 9 shows the averaged and aggregated material inputs for the Base Case 1.

Table 9: Material Input for the Base Case 1

Version 5 VHK for European Commission 28 Nov. 2005 — Document subject to a legal notice (see below)

ECO-DESIGN OF ENERGY-USING PRODUCTS — EuP EcoReport: INPUTS — Assessment of Environmental Impact

Nr	Product name	Date	Author
	Basce_Case_V1_EP-Copier_MFD-mono		

Pos nr	MATERIALS Extraction & Production Description of component	Weight in g	Category Click &select	Material or Process select Category first !
1		150,4	1-BlkPlastics	**1-LDPE**
2		671,6	1-BlkPlastics	**2-HDPE**
3		249,4	1-BlkPlastics	**4-PP**
4		7614,4	1-BlkPlastics	**5-PS**
5		239,0	1-BlkPlastics	**6-EPS**
6		1727,6	1-BlkPlastics	**7-HI-PS**
7		2575,4	1-BlkPlastics	**10-ABS**
8		396,0	2-TecPlastics	**11-PA 6**
9		4900,9	2-TecPlastics	**12-PC**
10		27,1	2-TecPlastics	**14-Epoxy**
11		81,3	2-TecPlastics	**16-Flex PUR**
12		0,0	2-TecPlastics	
13		1,0	2-TecPlastics	**19-Aramid fibre**
14		35737,5	3-Ferro	**21-St sheet galv.**
15		2549,2	3-Ferro	**22-St tube/profile**
16		11,2	3-Ferro	**24-Ferrite**
17		842,8	3-Ferro	**25-Stainless 18/8 coil**
18		627,0	4-Non-ferro	**26-Al sheet/extrusion**
19		14,3	4-Non-ferro	**28-Cu winding wire**
20		528,6	4-Non-ferro	**29-Cu wire**
21		661,6	4-Non-ferro	**30-Cu tube/sheet**
22		2,7	4-Non-ferro	**31-CuZn38 cast**
23		34,9	6-Electronics	**42-LCD per m2 scrn**
24		556,2	6-Electronics	**44-big caps & coils**
25		91,9	6-Electronics	**45-slots / ext. ports**
26		4,9	6-Electronics	**46-IC's avg., 5% Si, Au**
27		35,6	6-Electronics	**47-IC's avg., 1% Si**
28		142,6	6-Electronics	**48-SMD/ LED's avg.**
29		116,4	6-Electronics	**49-PWB 1/2 lay 3.75kg/m2**
30		299,4	6-Electronics	**50-PWB 6 lay 4.5 kg/m2**
31		62,5	6-Electronics	**52-Solder SnAg4Cu0.5**
32		1793,4	7-Misc.	**54-Glass for lamps**
33		4201,7	7-Misc.	**56-Cardboard**
34		52,5	7-Misc.	**57-Office paper**
35		1140,3	6-Electronics	**98-controller board**
	TOTAL	**68141**		

Interpretation of input data for Base Case 1:

- Ferro Metals used for the chassis and (electro-) mechanical components are dominating with 57% on average the material mass of the product. The metal is mostly galvanized steel sheets and steel profiles.
- Bulk Plastics used for housing and other functional components is with 19% on average the second biggest weight factor followed by Tec Plastics. The mass proportions of both Bulk and Tec Plastics although similar in sum vary considerably in all three products (V1_a/b/c). Depending on functional and e.g. aesthetic design requirements manufactures chose different materials. The most commonly used plastics are PS (HI-PS), ABS and PC. But in general do we find the full spectrum of plastic materials applied in the products.
- A larger difference between the product cases can be noticed in the allocation of the input category "Electronics". V1_c uses about 2,5 kg less electronic components than V1_a and V1_b. The reason seems to be more related to data allocation (e.g. motors, boards, elements of the PSU) than an effect of higher miniaturisation or less electronic components (product have comparable functionality).
- Cardboard used in Case V1_c (8.2 kg) is significantly higher than for V1_b (4.4 kg). For V1_a no data is available. On average we should however assume 6 kg of packaging material.

4.1.2. EP-Copier/MFD colour (V2)

4.1.2.1. Description of Product V2

Table 10 provides the performance data of three EP-copier-based colour MFDs. These three products will be averaged and defined as Product V2. In Task 5 the product V2 is the input for the analysis of Base Case 2. The individual product cases were provided by three brand name manufacturers. We like to thank the contributing industry partners for their support.

Table 10: Main technical parameter of product cases V2

Product Case	Code	Technology	Function	Image	Speed	Format	Weight	Year	Price
Product V2	**EPCMC-26**	**EP-Copier**	**MFD**	**color**	**26 ipm**	**A3**	**143 kg**	**2005**	**8.000 €**
V2_a	EPCMC_05	EP-Copier	MFD	color	32 ipm	A3	179 kg	2005	8.000 €
V2_b	EPCMC_28	EP-Copier	MFD	color	25 ipm	A3	118 kg	2005	7.000 €
V2_c	EPCMC_31	EP-Copier	MFD	color	23 ipm	A3	132 kg	2005	9.000 €

Performance: Product V2 is an advanced workgroup Copier/MFD for medium speed (26 ipm), document handling of monochrome and colour images in standard paper sizes up to A3. The EP-copier-based device has a functional spectrum including: copying, network printing, scanning, and facsimile. The market introduction was in 2005.

Design: The chassis and trays consist of a metal frame with plastic housing. In comparison to the mono copier-based MFD is the colour machine on average by 30% heavier due to the more complex technology for colour image reproduction. The products also feature a larger variety of trays and sorters. The marking technology is an in-line multi-colour (cyan, magenta, yellow, black) dry-toner electro-photography. The main components for the image creation are the laser beam device, photo conductor drum, toner supply from a cartridge (hopper), blade and charger roller[8], clearer blades, transfer rollers, and a high temperature fixing unit consisting of a hot fuser roller and a pressure roller. Paper transport components include different motors (e.g. stepper motors), belts and rollers of various size, sensors and other driving mechanics. The main components of the scanner unit on top of the machine is the cold cathode florescent lamp (CCFL), mirrors, lenses, scan head, glass plate, driving mechanics, and controller boards and digital interfaces. The functionality and performance of the machine is determined by the integrated electronic hardware including processor, memory, main boards, and digital interfaces with a respective software package. There are multiple boards with different level of system integration designed into the product. The power supply is internal. The user interface is realized both by mechanical (buttons) and optical (colour LCD) interaction.

4.1.2.2. Comparison of material mass proportions V2

Table 11 and Table 12 below show the main material input categories in weight and percent of total for all three product cases (V2_a/b/c) as well as for the averaged Product V2 in comparison.

Table 11: Comparison of material input categories by weight

		PRODUCTION			
Resources Use and Emissions		Base Case V2 - MFD - Copier Color	Base Case V2_a	Base Case V2_b	Base Case V2_c
Materials	**unit**				
Bulk Plastics	g	**26262**	**40459**	**13288**	**25038**
TecPlastics	g	**17422**	**13379**	**20739**	**18150**
Ferro	g	**75416**	**108610**	**61744**	**55895**
Non-ferro	g	**7636**	**12160**	**5454**	**5293**
Coating	g	**0**	**0**	**0**	**0**
Electronics	g	**2460**	**2707**	**2371**	**2303**
Misc.	g	**14250**	**2089**	**14788**	**25872**
Total weight	g	**143446**	**179404**	**118383**	**132551**

[8] In older models a corona wire was used for charging. But as the source of ozone emission it was replaced primary charge roller that is magnetizing the drum.

Table 12: Comparison of main material input categories in percent

		PRODUCTION			
Resources Use and Emissions		**Base Case V2 - MFD - Copier Color**	**Base Case V2_a**	**Base Case V2_b**	**Base Case V2_c**
Materials	**unit**				
Bulk Plastics	g	18%	23%	11%	19%
TecPlastics	g	12%	7%	18%	14%
Ferro	g	53%	61%	52%	42%
Non-ferro	g	5%	7%	5%	4%
Coating	g	0%	0%	0%	0%
Electronics	g	2%	2%	2%	2%
Misc.	g	10%	1%	12%	20%
Total weight	g	100%	100%	100%	100%

Regarding the mass proportions of the main materials the direct comparison of the individual products shows again some differences. These differences are obvious in the case of Bulk Plastics and Tec Plastics as well as Ferro metals. But as in the case of the mono Copier/MFD, in sum are the mass proportions quite similar. The differences are mostly related to functional, aesthetic, and cost requirements of the individual manufacturer. In this case we can also detect again the effect of the difference in total weight, which shifts the mass proportion. The product case V2_a features more accessories and is with 179 kg considerably heavier than the other two products. A general problem is also gain the allocation of components and materials to certain input categories. In the case of electronics and motors we have consulted the industry partner in order to streamline the data allocation. The data set of product case V2_a does not contain any data to packaging materials. This explains the lower mass proportion of the input category “Miscellaneous”. In order to represent the packaging materials in the product base case the average of the provided data from product case V2_b and V2_c is used. We conclude that due to similar mass proportions of materials for the three product cases V2_a/b/c the compilation of Base Case 2 (V2) is feasible by the arithmetic average.

4.1.2.3. Aggregated material input for Base Case 2

The following shows the averaged and aggregated material inputs for the Base Case 2.

Table 13: Material Input for the Base Case 2

Version 5 VHK for European Commission 28 Nov. 2005 Document subject to a legal notice (see below)

ECO-DESIGN OF ENERGY-USING PRODUCTS

EuP EcoReport: INPUTS
Assessment of Environmental Impact

Nr	Product name	Date	Author
	Base Case V2 - MFD - Copier Color		

Pos nr	MATERIALS Extraction & Production Description of component	Weight in g	Category Click &select	Material or Process select Category first !
1		298,8	1-BlkPlastics	1-LDPE
2		1980,5	1-BlkPlastics	2-HDPE
3		169,0	1-BlkPlastics	4-PP
4		10214,8	1-BlkPlastics	5-PS
5		6184,7	1-BlkPlastics	6-EPS
6		94,5	1-BlkPlastics	8-PVC
7		7319,3	1-BlkPlastics	10-ABS
8		880,0	2-TecPlastics	11-PA 6
9		14990,3	2-TecPlastics	12-PC
10		89,9	2-TecPlastics	14-Epoxy
11		995,8	2-TecPlastics	15-Rigid PUR
12		466,5	2-TecPlastics	16-Flex PUR
13		72588,4	3-Ferro	21-St sheet galv.
14		6,0	3-Ferro	24-Ferrite
15		2822,1	3-Ferro	25-Stainless 18/8 coil
16		1587,1	4-Non-ferro	26-Al sheet/extrusion
17		179,3	4-Non-ferro	27-Al diecast
18		3910,9	4-Non-ferro	28-Cu winding wire
19		954,6	4-Non-ferro	29-Cu wire
20		1004,0	4-Non-ferro	30-Cu tube/sheet
21		82,3	6-Electronics	42-LCD per m2 scrn
22		0,0	6-Electronics	44-big caps & coils
23		165,9	6-Electronics	45-slots / ext. ports
24		9,7	6-Electronics	46-IC's avg., 5% Si, Au
25		32,0	6-Electronics	47-IC's avg., 1% Si
26		274,3	6-Electronics	48-SMD/ LED's avg.
27		706,5	6-Electronics	49-PWB 1/2 lay 3.75kg/m2
28		280,9	6-Electronics	50-PWB 6 lay 4.5 kg/m2
29		6,1	6-Electronics	51-PWB 6 lay 2 kg/m2
30		1904,5	7-Misc.	54-Glass for lamps
31		12166,7	7-Misc.	56-Cardboard
32		178,4	7-Misc.	57-Office paper
33		902,3	6-Electronics	98-controller board
34				
	TOTAL	143446		

Interpretation of input data for Base Case 2:

- Ferro Metals used for the chassis and (electro-) mechanical components are dominating with 75 kg (53%) on average the material mass of the product. The metal is mostly galvanized steel sheets (72 kg). Non-Ferro-Metal, mainly copper (7 kg), is basically used for winding in motors, roller tubes, and in wires.
- Bulk Plastics used for housing and other functional components is with 18% on average the second biggest weight factor followed by Tec Plastics with 12%. The mass proportions of both Bulk and Tec Plastics although similar in sum vary considerably in all three products

(V2_a/b/c). The single highest amount is PC (15 kg), followed by PS (10 kg), and ABS (7 kg). But in general we find the full spectrum of plastic materials applied in the products.

- A larger difference between the product cases can be noticed in the allocation of the input category "Electronics". The reason again seems to be more related to data allocation (e.g. motors, boards, elements of the PSU) than an effect of higher miniaturisation or less electronic components (products have comparable functionality). Nevertheless, an average of 1 kg electronic boards alone is considerable.
- Packaging material 12 kg (cardboard) and almost 2 kg glass (scanner unit) account for the larges portion of material in the category Miscellaneous.

4.1.3. EP-Printer/SFD mono (V3)

4.1.3.1. Description of Product V3

Table 14 provide the performance data of three EP-Printer/SFD monochrome devices. These three products will be averaged and defined as Product V3. In Task 5 the product V3 is the input for the analysis of Base Case 3. The individual product cases were provided by three brand name manufacturers. We like to thank the contributing industry partners for their support.

Table 14: Main technical parameter of product cases V3

Product Case	Code	Technology	Function	Image	Speed	Format	Weight	Year	Price
Product V3	**EPPSM-32**	**EP-Printer**	**SFD**	**mono**	**32 ipm**	**A4**	**23 kg**	**2005**	**900 €**
V3_b	EPPSM_19	EP-Printer	SFD	mono	30 ipm	A4	20 kg	2005	700 €
V3_a	EPPSM_27	EP-Printer	SFD	mono	31 ipm	A4	23 kg	2005	800 €
V3_c	EPPSM_33	EP-Printer	SFD	mono	34 ipm	A4	26 kg	2004	1.000 €

Performance: Product V3 is a standard single function desktop laser printer (EP-Printer/SFD) for monochrome volume document printing, in standard paper sizes up to A4. The product is a desktop, medium speed (32 ipm), duplex capable machine with one to three paper trays. The market introduction was in the years 2004 and 2005.

Design: The chassis and trays consist of a metal frame with plastic housing. In comparison to the mono copier-based MFD is the EP-Printer a very compact single function machine. The marking technology is standard monochrome dry-toner electro-photography. The main components for the image creation are the laser beam device, photo conductor drum, toner supply from a cartridge (hopper), blade and charger roller[9], clearer blades and transfer rollers in as single housing. The compact high temperature fixing unit consists of a hot fuser roller and pressure roller. Paper

[9] In older models a corona wire was used for charging. But as the source of ozone emission it was replaced primary charge roller that is magnetizing the drum.

transport components include different motors (e.g. stepper motors), and rollers of various size, sensors and other driving mechanics. The functionality and performance of the machine is determined by the integrated electronic hardware including processor, memory, and digital interfaces with a respective software package. There are multiple boards with different levels of system integration designed into the product. The power supply is internal. The printer has a hard-off switch. The user interface is realized both by mechanical (buttons) and an optical (small LCD) interaction.

4.1.3.2. Comparison of material mass proportions V3

Table 15 and Table 16 below show the main material input categories in weight and percent of total for all three product cases (V3_a/b/c) as well as for the averaged Product V3 in comparison.

Table 15: Comparison of material input categories by weight

		PRODUCTION			
Resources Use and Emissions		Base Case_V3_EP-Printer-SFD-mono	Base Case V3_a	Base Case V3_b	Base Case V3_c
Materials	**unit**				
Bulk Plastics	g	**4613**	**4369**	**3233**	**6237**
TecPlastics	g	**5307**	**4494**	**5588**	**5839**
Ferro	g	**7290**	**4564**	**8036**	**9270**
Non-ferro	g	**807**	**1432**	**206**	**784**
Coating	g	**0**	**0**	**0**	**0**
Electronics	g	**823**	**911**	**446**	**1111**
Misc.	g	**4265**	**4303**	**5231**	**3260**
Total weight	g	**23104**	**20073**	**22738**	**26501**

Table 16: Comparison of main material input categories in percent

		PRODUCTION			
Resources Use and Emissions		**Base Case_V3_EP-Printer-SFD-mono**	**Base Case V3_a**	**Base Case V3_b**	**Base Case V3_c**
Materials	**unit**				
Bulk Plastics	g	20%	22%	14%	24%
TecPlastics	g	23%	22%	25%	22%
Ferro	g	32%	23%	35%	35%
Non-ferro	g	3%	7%	1%	3%
Coating	g	0%	0%	0%	0%
Electronics	g	4%	5%	2%	4%
Misc.	g	18%	21%	23%	12%
Total weight	g	100%	100%	100%	100%

Regarding the mass proportions of the main materials the direct comparison of the individual products shows considerable differences. These differences are again obvious in the case of Bulk Plastics and Tec Plastics as well as Ferro metals. The material distribution of V3_c has the most significant difference due to the comparatively low weight of input category Miscellaneous. The V3_b is characterized by a high mass of Ferro metals which seems to substitute bulk plastics. The low amount of non-Ferro metals is related to comparatively less copper wire. The Cu-wire mass of the V3_b is only 1/10 in comparison to the V3_a. We can only speculate what the reason is. It is

also interesting to notice that the Electronics mass volume of V3_b is much lower in comparison to the other two product cases. In general we have to say that the components/material allocation of all three product cases is quite problematic and less specific in comparison to the Copier product cases. Nevertheless, from the weight ratio point of view are the averaged mass proportions a feasible base for further assessment. We conclude that due to similar mass proportions of used materials for the three product cases V3_a/b/c the compilation of Base Case 3 (V3) is feasible by the arithmetic average.

4.1.3.3. Aggregated material input for Base Case 3

The following Table 17 shows the averaged and aggregated material inputs for the Base Case 3.

Table 17: Material Input for the Base Case 3

Version 5 VHK for European Commission 28 Nov. 2005 — Document subject to a legal notice (see below)

ECO-DESIGN OF ENERGY-USING PRODUCTS — **EuP EcoReport: INPUTS** — **Assessment of Environmental Impact**

Nr	Product name	Date	Author
	Base_Case_V3_EP-Printer-SFD-mono		

Pos nr	MATERIALS Extraction & Production Description of component	Weight in g	Category Click &select	Material or Process select Category first !
1		114,9	1-BlkPlastics	1-LDPE
2		366,9	1-BlkPlastics	2-HDPE
3		43,4	1-BlkPlastics	3-LLDPE
4		82,2	1-BlkPlastics	4-PP
5		851,8	1-BlkPlastics	5-PS
6		3,7	1-BlkPlastics	6-EPS
7		191,2	1-BlkPlastics	8-PVC
8		4,1	1-BlkPlastics	9-SAN
9		2954,5	1-BlkPlastics	10-ABS
10		626,4	2-TecPlastics	11-PA 6
11		4219,4	2-TecPlastics	12-PC
12		48,0	2-TecPlastics	13-PMMA
13		38,8	2-TecPlastics	14-Epoxy
14		50,8	2-TecPlastics	15-Rigid PUR
15		139,3	2-TecPlastics	16-Flex PUR
16		184,1	2-TecPlastics	18-E-glass fibre
17		6506,7	3-Ferro	21-St sheet galv.
18		212,5	3-Ferro	22-St tube/profile
19		3,5	3-Ferro	23-Cast iron
20		109,0	3-Ferro	24-Ferrite
21		458,0	3-Ferro	25-Stainless 18/8 coil
22		213,0	4-Non-ferro	26-Al sheet/extrusion
23		388,6	4-Non-ferro	28-Cu winding wire
24		45,6	4-Non-ferro	27-Al diecast
25		96,1	4-Non-ferro	29-Cu wire
26		29,4	4-Non-ferro	30-Cu tube/sheet
27		2,7	4-Non-ferro	31-CuZn38 cast
28		31,9	4-Non-ferro	32-ZnAl4 cast
29		113,7	6-Electronics	44-big caps & coils
30		87,4	6-Electronics	45-slots / ext. ports
31		6,4	6-Electronics	46-IC's avg., 5% Si, Au
32		9,1	6-Electronics	47-IC's avg., 1% Si
33		45,0	6-Electronics	48-SMD/ LED's avg.
34		65,5	6-Electronics	49-PWB 1/2 lay 3.75kg/m2
35		97,3	6-Electronics	50-PWB 6 lay 4.5 kg/m2
36		303,7	6-Electronics	51-PWB 6 lay 2 kg/m2
37		4,6	6-Electronics	52-Solder SnAg4Cu0.5
38		84,6	7-Misc.	54-Glass for lamps
39		4057,0	7-Misc.	56-Cardboard
40		123,1	7-Misc.	57-Office paper
41		89,9	6-Electronics	98-controller board
	TOTAL	23104		

Interpretation of input data for Base Case 3:

- Ferro Metals used for the chassis and (electro-) mechanical components are dominating with 7,3 kg (32%) on average the material mass of the product. The metal is mostly galvanized steel sheets (6.5 kg). Non-Ferro-Metal, mainly copper (4 kg), is basically used

for winding in motors, roller tubes and in wires. In comparison to the Copier/MFD is the ratio of metals to plastics smaller with a higher amount of plastics in the laser printer case.

- Tec Plastics used for housing and other functional components is with 23% on average the second biggest weight factor followed by Bulk Plastics with 20%. The mass proportions of both Bulk and Tec Plastics although similar in sum vary considerably in all three products (V3_a/b/c). The single highest amount is Tec Plastics PC (4.2 kg), followed by Bulk Plastic ABS (3 kg), and PS (0.8 kg). But in general we do find the full spectrum of plastic materials applied in the products.
- A larger difference between the product cases can be noticed in the allocation of the input category "Electronics". The reason again seems to be more related to data allocation (e.g. motors, boards, elements of the PSU) than an effect of higher miniaturisation or less electronic components (products have comparable functionality). Nevertheless, an average of 800 gr electronic boards alone is considerable.
- Packaging material 4 kg (cardboard) accounts for the larges portion of material in the category Miscellaneous.

4.1.4. EP-Printer/SFD colour (V4)

4.1.4.1. Description of Product V4

Table 18 provide the performance data of three EP-Printer/SFD colour devices. These three products will be averaged and defined as Product V4. In Task 5 the product V4 is the input for the analysis of Base Case 4. Complete Bill of Materials (BOM) were provided by industry partners for two products (EPPSC_11 [V4_a] and EPPSC_36 [V4_b]). For the third product (EPPSC_22 [V4_c]) only the aggregated inputs for the main categories are available. We therefore list them separately and only for comparison. This approach seems feasible also due to the lower speed of the third devices. We like to thank the contributing industry partners for their support.

Table 18: Main technical parameter of product cases V4

Product Case	Code	Technology	Function	Image	Speed	Format	Weight	Year	Price
Product V4	**EPPSC-32**	**EP-Printer**	**SFD**	**color**	**32 ipm**	**A4**	**43 kg**	**2005**	**1.500 €**
V4_a	EPPSC_11	EP-Printer	SFD	color	40 ipm	A4	51 kg	2005	1.400 €
V4_b	EPPSC_36	EP-Printer	SFD	color	35 ipm	A4	35 kg	2005	1.700 €
V4_c	EPPSC_22	EP-Printer	SFD	color	21 ipm	A4	28 kg	2005	700 €

Performance: Product V4 is a standard colour laser printer (EP-Printer/SFD) for colour/mono document printing, in standard paper sizes up to A4. The product is a desktop, medium speed (32 ipm), duplex capable machine with one to three paper trays. The market introduction was in 2005.

Design: The component and material composition of the products is basically the same as in the monochrome laser printer case, except that these products feature different colour engines with multi-colour cartridges (cyan, magenta, yellow, black). The chassis and trays consist of a metal frame with plastic housing. The marking technology is standard monochrome dry-toner electro-photography. The main components for the image creation are the laser beam device, photo conductor drum, toner supply from a cartridge (hopper), blade and charger roller[10], clearer blades, and transfer rollers in a single housing. The compact high temperature fixing unit consists of a hot fuser roller and pressure roller. Paper transport components include different motors (e.g. stepper motors), and rollers of various size, sensors and other driving mechanics. The functionality and performance of the machine is determined by the integrated electronic hardware including processor, memory, and digital interfaces with a respective software package. There are multiple boards with different level of system integration designed into the product. The power supply is internal. The printer has a hard-off switch. The user interface is realized both by mechanical (buttons) and an optical (small LCD) interaction.

4.1.4.2. Comparison of material mass proportions V4

Table 19 and Table 20 show the main material input categories in weight and percent of total for the two product cases (V4_a/b) as well as for the averaged Product V4 in comparison. Table 21 shows for comparison the main weight ratio of the main input categories of the third product case.

Table 19: Comparison of material input categories by weight

		PRODUCTION		
Resources Use and Emissions		Base Case_V4_EP-Printer-SFD-color	Base Case V4_a	Base Case V4_b
Materials	**unit**			
Bulk Plastics	g	**14998**	**17130**	**12866**
TecPlastics	g	**2424**	**2958**	**1890**
Ferro	g	**15901**	**20494**	**11309**
Non-ferro	g	**1619**	**1954**	**1284**
Coating	g	**2**	**0**	**4**
Electronics	g	**1533**	**1475**	**1590**
Misc.	g	**6625**	**7309**	**5941**
Total weight	g	**43103**	**51320**	**34885**

[10] In older models a corona wire was used for charging. But as the source of ozone emission it was replaced primary charge roller that is magnetizing the drum.

Table 20: Comparison of main material input categories in percent

		PRODUCTION		
Resources Use and Emissions		**Base Case_V4_EP-Printer-SFD-color**	**Base Case V4_a**	**Base Case V4_b**
Materials	**unit**			
Bulk Plastics	g	35%	33%	37%
TecPlastics	g	6%	6%	5%
Ferro	g	37%	40%	32%
Non-ferro	g	4%	4%	4%
Coating	g	0%	0%	0%
Electronics	g	4%	3%	5%
Misc.	g	15%	14%	17%
Total weight	g	100%	100%	100%

Table 21: Third product case (V4_c) main input categories by weight

Base Case V4_c	**Production**	
Bulk Plastics	g	6609,8
TecPlastics	g	4551,4
Ferro	g	14072,9
Non-ferro	g	540
Coating	g	
Electronics	g	2211,5
Misc.	g	48,8
Total weight	**g**	**28034,4**

Although the total mass differences are significant (V4_a is 51 kg [this includes packaging material], V4_b is 35 kg, and V4_c is 28 kg), the direct comparison regarding the mass proportions of the main material inputs (Table 20) show only the typical differences as in all the previews cases. This is due to individual mix of Bulk and Tec Plastics as well as Ferro and non-Ferro Metals for realizing the frame and housing. The differences in Ferro-Metals and Electronics might be due to different allocation of components. The high mass of electronics in the third product case (V4_c) is related to this aspect. Although the data are not fully transparent we conclude that due to similar mass proportions of the two product cases V4_a/b the compilation of Base Case 4 (V4) is feasible by the arithmetic average.

4.1.4.3. Aggregated material input for Base Case 4

The following Table 22 shows the averaged and aggregated material inputs for the Base Case 4.

Table 22: Material Input for the Base Case 4

Version 5 VHK for European Commission 28 Nov. 2005 Document subject to a legal notice (see below)

ECO-DESIGN OF ENERGY-USING PRODUCTS

EuP EcoReport: INPUTS
Assessment of Environmental Impact

Nr	Product name	Date	Author
	Base_Case_V4_EP-Printer-SFD-color		

Pos nr	MATERIALS Extraction & Production Description of component	Weight in g	Category Click &select	Material or Process select Category first !
1		1182,2	1-BlkPlastics	1-LDPE
2		61,0	1-BlkPlastics	2-HDPE
3		1224,9	1-BlkPlastics	4-PP
4		6575,7	1-BlkPlastics	5-PS
5		200,6	1-BlkPlastics	6-EPS
6		330,1	1-BlkPlastics	7-HI-PS
7		226,2	1-BlkPlastics	8-PVC
8		507,0	1-BlkPlastics	9-SAN
9		4690,6	1-BlkPlastics	10-ABS
10		1258,7	2-TecPlastics	11-PA 6
11		1129,1	2-TecPlastics	12-PC
12		3,0	2-TecPlastics	13-PMMA
13		20,9	2-TecPlastics	15-Rigid PUR
14		12,4	2-TecPlastics	16-Flex PUR
15		14654,8	3-Ferro	21-St sheet galv.
16		25,7	3-Ferro	22-St tube/profile
17		171,9	3-Ferro	23-Cast iron
18		219,0	3-Ferro	24-Ferrite
19		830,0	3-Ferro	25-Stainless 18/8 coil
20		448,4	4-Non-ferro	26-Al sheet/extrusion
21		18,7	4-Non-ferro	27-Al diecast
22		297,6	4-Non-ferro	28-Cu winding wire
23		531,8	4-Non-ferro	29-Cu wire
24		291,2	4-Non-ferro	30-Cu tube/sheet
25		22,8	4-Non-ferro	31-CuZn38 cast
26		8,8	4-Non-ferro	32-ZnAl4 cast
27		2,2	5-Coating	40-Cu/Ni/Cr plating
28		0,0	5-Coating	41-Au/Pt/Pd
29		14,0	6-Electronics	42-LCD per m2 scrn
30		517,6	6-Electronics	44-big caps & coils
31		88,2	6-Electronics	45-slots / ext. ports
32		19,8	6-Electronics	46-IC's avg., 5% Si, Au
33		19,9	6-Electronics	47-IC's avg., 1% Si
34		78,4	6-Electronics	48-SMD/ LED's avg.
35		605,1	6-Electronics	49-PWB 1/2 lay 3.75kg/m4
36		15,9	6-Electronics	52-Solder SnAg4Cu0.5
37		340,0	7-Misc.	54-Glass for lamps
38		3251,1	7-Misc.	56-Cardboard
39		3033,9	7-Misc.	57-Office paper
40		173,6	6-Electronics	98-controller board
41				
	TOTAL	43103		

Interpretation of input data for Base Case 4:

- Ferro-Metals used for the chassis and (electro-) mechanical components are dominating with 15.9 kg (37%) on average the material mass of the product. The metal is mostly galvanized steel sheets (14.6 kg). Non-Ferro-Metal, mainly Copper (1.1 kg), is basically used for winding in motors, roller tubes, and in wires.

- Bulk Plastics used for housing and other functional components have with 35% a very high mass proportion. In contrary to the previews product cases is the amount of Tec Plastics with only 6% considerably low. The full spectrum of Bulk Plastics is used in the product. Bulk Plastic PS (6.6 kg) and ABS (4.7 kg) have the single highest amount followed by Tec Plastic PA 6 (1.3 kg).
- The input category “Electronics” amounts 1.6 kg and is characterized by simple printed wiring boards (49-PWB) and large components (44-big caps and coils).
- Packaging material 3.2 kg (cardboard) accounts for the larges portion of material in the category Miscellaneous.

4.1.5. IJ-Printer/MFD personal (V5) and workgroup (V6)

4.1.5.1. Description of Product V5 and V6

In the case of IJ-Printers the main aspects of product distinction is the spectrum of functionality as well as the use environment. Although a large amount of single function desktop IJ-Printers are in the market, we have chosen more advanced multifunctional devices as a growing segment. These IJ-Printer/MFDs are very compact, so called "all-in-one" products with a functional spectrum of scanning, copying, and (photo quality) printing. Some of the more expensive devices include a fax capability and have been designed for somewhat larger volume output in an office environment. The technical analysis of IJ-Printer/MFDs (V5/V6) is based on four products (see Table 23). From our perspective the use environment is important for the definition of base cases. Because the analyzed products can be applied in a personal (home) and workgroup (office) environment we decided to average the same set of products (all four) for both the definition of Base Case 5 (V5 personal use) and Base Case 6 (V6 workgroup use). Complete Bill of Materials (BOM) were provided by four different brand name manufacturers. We like to thank the contributing industry partners for their support.

Table 23: Main technical parameter of product cases V5 and V6

Product Case	Code	Technology	Function	Image	Speed	Format	Weight	Year	Price
Product V5/6	**IJPM (P/W)**	**IJ-Printer**	**MFD**	**color**	**20 ipm**	**A4**	**9 kg**	**2005**	**200 €**
V5_a	IJPM_34	IJ-Printer	MFD	color	5 ipm	A4	6 kg	2005	100 €
V5_b	IJPM_01	IJ-Printer	MFD	color	19 ipm	A4	10 kg	2005	250 €
V5_c	IJPM_14	IJ-Printer	MFD	color	21 ipm	A4	11 kg	2005	300 €
V5_d	IJPM_21	IJ-Printer	MFD	color	25 ipm	A4	10 kg	2005	170 €

Design: The four products that have been made available for the analysis show differences in their functional spectrum and performance. These differences relate to the applied technologies and components. Regarding the print head technology there are either mechanical, using piezoelectric system, or (more common today) thermal inkjet technologies utilized in the products. Both inkjet technologies have advantages and disadvantages regarding drop precision and speed, but also maintenance and reliability. The cartridge configuration is similar diverse. The analyzed products include devices with single colour cartridges, multi colour cartridges as well as separate photo colour cartridges and black & white cartridges. Paper transport components include motors (e.g. stepper motors) and other mechanics. All four products have integrated flatbed scanner incorporating CCD (Charge Coupled Device) or CIS (Contact Image Sensor) as sensor and with CCFL (Cold Cathode Fluorescent Lamp) and/or LED (Light Emitting Diode) arrays as light source. There are populated electronic boards (e.g. memory, driver circuitry, digital interfaces) with

different levels of system integration designed into the products. The user interface is realized both through mechanical (buttons) and optical (small colour LCD) components. The power supply is internal. The frame and housing consists of steel and plastics.

Comparison of material mass proportions V5 and V6

Table 24 and Table 25 below show the main material input categories in weight and percent of total for the all product cases (V5_a/b/c/d) as well as for the averaged Products V5/V6 in comparison.

Table 24: Comparison of material input categories by weight

		PRODUCTION				
Resources Use and Emissions		Base Case V5_IJ-Printer-MFD-color	Base Case V5_a	Base Case V5_b	Base Case V5_c	Base Case V5_d
Materials	**unit**					
Bulk Plastics	g	**4453**	**3154**	**5233**	**5050**	**4374**
TecPlastics	g	**489**	**274**	**511**	**704**	**467**
Ferro	g	**1929**	**1063**	**2703**	**2392**	**1556**
Non-ferro	g	**293**	**67**	**256**	**297**	**553**
Coating	g	**0,2**	**0,2**	**0,0**	**0,9**	**0,0**
Electronics	g	**478**	**305**	**490**	**455**	**663**
Misc.	g	**1712**	**1229**	**834**	**2607**	**2179**
Total weight	g	**9355**	**6092**	**10027**	**11506**	**9792**

Table 25: Comparison of main material input categories in percent

		PRODUCTION				
Resources Use and Emissions		Base Case V5_IJ-Printer-MFD-color	Base Case V5_a	Base Case V5_b	Base Case V5_c	Base Case V5_d
Materials	**unit**					
Bulk Plastics	g	**48%**	**52%**	**52%**	**44%**	**45%**
TecPlastics	g	**5%**	**4%**	**5%**	**6%**	**5%**
Ferro	g	**21%**	**17%**	**27%**	**21%**	**16%**
Non-ferro	g	**3%**	**1%**	**3%**	**3%**	**6%**
Coating	g	**0%**	**0%**	**0%**	**0%**	**0%**
Electronics	g	**5%**	**5%**	**5%**	**4%**	**7%**
Misc.	g	**18%**	**20%**	**8%**	**23%**	**22%**
Total weight	g	**100%**	**100%**	**100%**	**100%**	**100%**

At first we would like to point out that Product V5_a is a typical “personal” device and is with 6.1 kg roughly one third lighter that the other products. The general material distribution of Bulk and Tec Plastics as well as Ferro and non-Ferro Metals for realizing the frame and housing is in general comparable in all four product cases. The use of particular plastics is defined by the functional and aesthetic preferences of the manufacturer. The low ratio of “Miscellaneous” in Product V5_b is due to missing data on packaging material. We conclude that due to similar mass proportions of the product cases V5_a/b/c/d the compilation of Base Case 5 (V5) and Base Case 6 (V6) is feasible by the arithmetic average.

4.1.5.2. Aggregated material input for Base Case 5 and 6

Table 26 shows the averaged and aggregated material inputs for the Base Case 5 and 6.

Table 26: Material Input for the Base Case 5 and 6

Version 5 VHK for European Commission 28 Nov. 2005 Document subject to a legal notice (see below)

ECO-DESIGN OF ENERGY-USING PRODUCTS

EuP EcoReport: INPUTS
Assessment of Environmental Impact

Nr	Product name	Date	Author
	Base Case V5_IJ-MFD-Personal		

Pos nr	MATERIALS Extraction & Production Description of component	Weight in g	Category Click &select	Material or Process select Category first !
1		97,1	1-BlkPlastics	1-LDPE
2		40,8	1-BlkPlastics	2-HDPE
3		76,2	1-BlkPlastics	4-PP
4		767,6	1-BlkPlastics	5-PS
5		51,0	1-BlkPlastics	6-EPS
6		2334,5	1-BlkPlastics	7-HI-PS
7		41,2	1-BlkPlastics	8-PVC
8		2,7	1-BlkPlastics	9-SAN
9		1041,7	1-BlkPlastics	10-ABS
10		211,8	2-TecPlastics	11-PA 6
11		84,9	2-TecPlastics	12-PC
12		16,6	2-TecPlastics	13-PMMA
13		5,9	2-TecPlastics	14-Epoxy
14		37,8	2-TecPlastics	15-Rigid PUR
15		116,3	2-TecPlastics	16-Flex PUR
16		15,7	2-TecPlastics	18-E-glass fibre
17		0,0	2-TecPlastics	19-Aramid fibre
18		1863,1	3-Ferro	21-St sheet galv.
19		38,1	3-Ferro	24-Ferrite
20		27,4	3-Ferro	25-Stainless 18/8 coil
21		67,2	4-Non-ferro	26-Al sheet/extrusion
22		36,0	4-Non-ferro	28-Cu winding wire
23		145,5	4-Non-ferro	29-Cu wire
24		44,0	4-Non-ferro	30-Cu tube/sheet
25		0,7	4-Non-ferro	31-CuZn38 cast
26		0,0	5-Coating	40-Cu/Ni/Cr plating
27		0,2	5-Coating	41-Au/Pt/Pd
28		74,3	6-Electronics	42-LCD per m2 scrn
29		90,5	6-Electronics	44-big caps & coils
30		28,2	6-Electronics	45-slots / ext. ports
31		2,7	6-Electronics	46-IC's avg., 5% Si, Au
32		4,2	6-Electronics	47-IC's avg., 1% Si
33		13,8	6-Electronics	48-SMD/ LED's avg.
34		107,4	6-Electronics	49-PWB 1/2 lay 3.75kg/m2
35		29,3	6-Electronics	50-PWB 6 lay 4.5 kg/m2
36		7,2	6-Electronics	51-PWB 6 lay 2 kg/m2
37		5,1	6-Electronics	52-Solder SnAg4Cu0.5
38		650,2	7-Misc.	54-Glass for lamps
39		901,0	7-Misc.	56-Cardboard
40		161,1	7-Misc.	57-Office paper
41		115,8	6-Electronics	98-controller board
	TOTAL	9355		

Interpretation of input data for Base Case 5 and 6:

- Bulk Plastics, particularly HI-PS (2.3 kg), ABS (1 kg) and PS (0.8 kg), have with 48% of total a very high mass proportion. These plastics are used for housing and other functional components.
- Tec Plastics, mainly PA 6 (212 gr) and Flex PUR (116 gr), are only amount to 5% of total. This very low utilization of more expensive Tec Plastics is explainable by the price critical design of Product V5.
- Nevertheless, the full spectrum of Bulk and Tec Plastics is used in the products.
- Ferro-Metals used for the chassis and (electro-) mechanical components are with 21% (1.9 kg) of total considerable. Galvanized steel sheets account with 1.8 kg for most metals. Copper wire and aluminium sheets are used in much smaller amounts.
- Gold is used as plating material in the printing unit.
- The input category “Electronics” is with 5% of the total comparable to the previous EP-product cases. The category “Miscellaneous” contains roughly 0.65 kg of glass which is the scanner glass plate.

4.2. Distribution Phase

The distribution phase of a product is considered in the VHK spreadsheet by product type and packaging volume. To select the product type, there is the possibility to select an ICT product with a weight that is less than 15 kg, an installed appliance or none of them. Specific distribution distance is not specified in the VHK spreadsheet. The used materials and masses for the packaging are not mentioned in this table, but is mentioned in "materials extraction & production" table. The packaging volume of the product cases have been calculated by the dimensions (W/H/D). The data input for the MEEuP EcoReport spreadsheet is listed individually below.

4.2.1. EP-Copier/MFD monochrome (V1)

The volume of packaging is 0.338 m³.

Table 27: EcoReport input table for distribution phase of Product V1

Pos nr	DISTRIBUTION (incl. Final Assembly) Description		Answer	Category index (fixed)
208	Is it an ICT or Consumer Electronics product <15 kg ?		NO	59 0
209	Is it an installed appliance (e.g. boiler)?		NO	60 1
				62 1
210	Volume of packaged final product in m^3	in m3	0,338	63 0
				64 1

4.2.2. EP-Copier/MFD colour (V2)

The volume of packaging is 0.616 m³.

Table 28: EcoReport input table for distribution phase of Product V2

Pos nr	DISTRIBUTION (incl. Final Assembly) Description		Answer	Category index (fixed)
208	Is it an ICT or Consumer Electronics product <15 kg ?		NO	59 0
209	Is it an installed appliance (e.g. boiler)?		NO	60 1
				62 1
210	Volume of packaged final product in m^3	in m3	0,616	63 0
				64 1

4.2.3. EP-Printer/SFD monochrome (V3)

The volume of packaging is 0.113 m³.

Table 29: EcoReport input table for distribution phase of Product V3

Pos nr	DISTRIBUTION (incl. Final Assembly) Description		Answer	Category index (fixed)
208	Is it an ICT or Consumer Electronics product <15 kg ?		NO	59 0
209	Is it an installed appliance (e.g. boiler)?		NO	60 1
				62 1
210	Volume of packaged final product in m^3	in m3	0,113	63 0
				64 1

4.2.4. EP-Printer/SFD colour (V4)

The volume of packaging is 0.216 m³.

Table 30: EcoReport input table for distribution phase of Product V4

Pos nr	DISTRIBUTION (incl. Final Assembly) Description		Answer	Category index (fixed)
208	Is it an ICT or Consumer Electronics product <15 kg ?		NO	59 0
209	Is it an installed appliance (e.g. boiler)?		NO	60 1
				62 1
210	Volume of packaged final product in m^3	in m3	0,216	63 0
				64 1

4.2.5. IJ-Printer/MFD personal and workgroup (V5 and V6)

The volume of packaging is 0.029 m³.

Table 31: EcoReport input table for distribution phase of Product V5 and V6

Pos nr	DISTRIBUTION (incl. Final Assembly) Description		Answer	Category index (fixed)
208	Is it an ICT or Consumer Electronics product <15 kg ?		NO	59 0
209	Is it an installed appliance (e.g. boiler)?		NO	60 1
				62 1
210	Volume of packaged final product in m^3	in m3	0,029	63 0
				64 1

4.3. Use Phase (Product)

VHK EcoReport considers the use phase of the products by calculation of total annual power consumption (including off-, standby- and on-mode of the device), the amount of spare parts used for maintenance over the product use phase, the product life in years and the number of km for services.
The amount for spare parts is fixed in the VHK spreadsheet to 1% of the total product materials and manufacturing.

Power consumption data were obtained for all EP-Products (V1 – V4) based on Energy Star TEC methodology in kWh/week and then with 52 weeks in order to calculate an annual power consumption. In the case of the IJ-Products (V5 and V6) power consumption data for individual modes (active, ready, sleep, off) have been obtained. Annual power consumption was that calculated based on the "personal" (V5) and "workgroup" (V6) use patterns as they were introduced in Section 3.1.1.4. In a similar way we calculated the amount of auxiliaries such as paper, toner or ink. The amount of consumables for the EP-Products are again calculated based on the Energy Star TEC method and for the IJ-Products according to the use patterns (discussed in Task 3). The product life time for EP-Products (V1 – V4) is calculated with 6 years and for IJ-Products (V5 and V6) with 4 years.

The Following Table 32 provides a quick overview all relevant input data for the use phase assessment according to the average product cases (V1 – V6).

Table 32: Main use phase data regarding power consumption and consumables

BC	Product	Imaging speed	Image Volume	Weekly Pages	Annual Pages	Annual Paper	Toner/ Ink per page	Annual toner/ink	Weekly power	Annual power
		ipm	page/day	page/week	page/year	kg/year	gr/page	gr/page	kWh/week	kWh/year
V1	EPCMM-26	26	338	1.690	87.880	439	0,02	1.758	4,81	250
V2	EPCMC-26	26	338	1.690	87.880	439	0,03	2.636	7,11	370
V3	EPPSM-32	32	512	2.560	133.120	666	0,02	2.662	5,19	270
V4	EPPSC-32	32	512	2.560	133.120	666	0,03	3.994	6,92	360
V5	IJPM-P	1	4	20	1.040	5	0,07	73	0,35	18
V6	IJPM-W	1	15	75	3.900	20	0,07	273	0,42	22
		Regarding the copied volume per week, we assume that the machine is operated from Monday to Friday without Saturday and Sunday. Therefore, the copied volume per week was calculated as "page/day x 5 days".								
		Regarding the amount of used toner, please calculate the amount of applied toner per page, then multiplied it by the copied volume in a year (the example is given with 0,02 or 0,03 gr per page). Regarding the amount of ink we assume that 1ml equals 1gr of ink. Ink consumption per page varies between 0,04 gr and 0,1gr per page. We assume an average 0,07 gr per page for the								
		In Energy Star criteria, the value per week is calculated, so we considered 1 year as 52 weeks for calculation. (if the number of weeks per year is different between you and us, please correct it and calculate again.)								

4.3.1. EP-Copier/MFD monochrome (V1)

4.3.1.1. Power consumption of Product V1

Industry partners provided total annual power consumption data based on Energy Star TEC methodology values. In the case of Product V1 these power consumption data varied largely between 56 kWh/a, and 401 kWh/a. We contacted the industry partners and discussed the issue. For the purpose of the study we assume following value for total annual power consumption:

Annual Power Consumption of Product V1 250 kWh/a
Assumed lifetime of the Product V1: 6 years

4.3.1.2. Paper consumption of Product V1

Paper consumption is calculated on Energy Star TEC methodology. The reference value for the Product V1 has been calculated based on the following assumption:

1 image	= 1page A4 with paper weight 5gram	
TEC value for 26 ipm	= 338 pages/day	
Annual images	= 338 * 5 (days) * 52 (weeks)	= 87,880 pages/a
Amount of paper	= 87,880 pages * 5 (gram per page)	= 439 kg/a

Annual Paper Consumption of Product V1: 439 kg/a

4.3.1.3. Toner consumption of Product V1

The toner consumption is calculated based on data from industry partners. Industry sources indicated that average toner consumption per page (A4) is between 0.02 grams and 0.04 grams. For the purpose of this study we assume the amount of black toner per page is 0.02 gr and multiplied this figure with the number of images/pages per year:

Annual Toner Consumption of Product V1: 1,758 gram

Table 33: EcoReport input table for use phase of Product V1

Pos nr	USE PHASE Description		unit	Subtotals
211	**Product Life in years**	6	years	
	Electricity			
212	**On-mode: Consumption per hour, cycle, setting, etc.**	250	kWh	**250**
213	**On-mode: No. Of hours, cycles, settings, etc. / year**	1	#	
214	**Standby-mode: Consumption per hour**		kWh	**0**
215	**Standby-mode: No. Of hours / year**		#	
216	**Off-mode: Consumption per hour**		kWh	**0**
217	**Off-mode: No. Of hours / year**		#	
	TOTAL over Product Life	**1,50**	**MWh (=000 kWh)**	**65**
	Heat			
218	**Avg. Heat Power Output**	0	kW	
219	**No. Of hours / year**	0	hrs.	
220	**Type and efficiency (Click & select)**			**85-not applicable**
	TOTAL over Product Life	**0,00**	**GJ**	
	Consumables (excl, spare parts)			**material**
221	**Water**	0	m^3/year	**83-Water per m3**
222	**Auxilliary material 1 (Click & select)**	439	kg/ year	**57-Office paper**
223	**Auxilliary material 2 (Click & select)**	1,758	kg/ year	**79-Toner**
224	**Auxilliary material 3 (Click & select)**	0	kg/ year	**85-None**
	Maintenance, Repairs, Service			
225	**No. of km over Product-Life**	0	km / Product Life	**86**
226	**Spare parts (fixed, 1% of product materials & manuf.)**	681	g	

4.3.2. EP-Copier/MFD colour (V2)

4.3.2.1. Power consumption of Product V2

Industry partners provided total annual power consumption data based on Energy Star TEC methodology values. In the case of Product V2 these power consumption data were very similar in a rage of 367 kWh/a, and 373 kWh/a. For the purpose of the study we assume following value for total annual power consumption:

Annual Power Consumption of Product V2: 370 kWh/a
Assumed lifetime of the Product V1: 6 years

4.3.2.2. Paper consumption of Product V2

Paper consumption is calculated on Energy Star TEC methodology. The reference value for the Product V2 has been calculated based on the following assumption:

1 image	= 1page A4 with paper weight 5 gram	
TEC value for 26 ipm	= 338 pages/day	
Annual images	= 338 * 5 (days) * 52 (weeks)	= 87,880 pages/a
Amount of paper	= 87,880 pages * 5 (gram per page)	= 439 kg/a

Annual Paper Consumption of Product V2: 439 kg/a

4.3.2.3. Toner consumption of Product V2

The toner consumption is calculated based on data from industry partners. Industry sources indicated that average toner consumption per page (A4) is between 0.02 grams and 0.04 grams. For the purpose of this study we assume the amount of color toners per page is (somewhat higher than black) 0.03 gr and multiplied this figure with the number of images/pages per year:

Annual Toner Consumption of Product V2: 2,636 gram

Table 34: EcoReport input table for use phase of Product V2

Pos nr	USE PHASE Description		unit	Subtotals
211	**Product Life in years**	6	years	
	Electricity			
212	**On-mode: Consumption per hour, cycle, setting, etc.**	370	kWh	**370**
213	**On-mode: No. Of hours, cycles, settings, etc. / year**	1	#	
214	**Standby-mode: Consumption per hour**	0	kWh	**0**
215	**Standby-mode: No. Of hours / year**		#	
216	**Off-mode: Consumption per hour**	0	kWh	**0**
217	**Off-mode: No. Of hours / year**		#	
	TOTAL over Product Life	**2,22**	**MWh (=000 kWh)**	**65**
	Heat			
218	**Avg. Heat Power Output**	0	kW	
219	**No. Of hours / year**	0	hrs.	
220	**Type and efficiency (Click & select)**			**85-not applicable**
	TOTAL over Product Life	**0,00**	**GJ**	
	Consumables (excl, spare parts)			**material**
221	**Water**	0	m^3/year	**83-Water per m3**
222	**Auxilliary material 1 (Click & select)**	439	kg/ year	**57-Office paper**
223	**Auxilliary material 2 (Click & select)**	2,636	kg/ year	**79-Toner**
224	**Auxilliary material 3 (Click & select)**	0	kg/ year	**85-None**
	Maintenance, Repairs, Service			
225	**No. of km over Product-Life**	0	km / Product Life	**86**
226	**Spare parts (fixed, 1% of product materials & manuf.)**	1434	g	

4.3.3. EP-Printer/SFD monochrome (V3)

4.3.3.1. Power consumption of Product V3

Industry partners provided total annual power consumption data based on Energy Star TEC methodology values. In the case of Product V3 these power consumption data varied largely between 202 kWh/a, and 338 kWh/a. We contacted the industry partners and discussed the issue. For the purpose of the study we assume following value for total annual power consumption:

Annual Power Consumption of Product V3: 270 kWh/a
Assumed lifetime of the Product V1: 6 years

4.3.3.2. Paper consumption of Product V3

Paper consumption is calculated on Energy Star TEC methodology. The reference value for the Product V3 has been calculated based on the following assumption:

1 image	= 1page A4 with paper weight 5 gram	
TEC value for 32ipm	= 512 pages/day	
Annual images	= 512 * 5 (days) * 52 (weeks)	= 133,120 pages/a
Amount of paper	= 133,120 pages * 5 (gram per page)	= 666 kg/a

Annual Paper Consumption of Product V3: 666 kg/a

4.3.3.3. Toner consumption of Product V3

The toner consumption is calculated based on data from industry partners. Industry sources indicated that average toner consumption per page (A4) is between 0.02 grams and 0.04 grams. For the purpose of this study we assume the amount of black toner per page is 0.02 gr and multiplied this figure with the number of images/pages per year:

Annual Toner Consumption of Product V3 2,662 gram

Table 35: EcoReport input table for use phase of Product V3

Pos nr	USE PHASE Description		unit	Subtotals
211	**Product Life in years**	6	years	
	Electricity			
212	**On-mode: Consumption per hour, cycle, setting, etc.**	270	kWh	**270**
213	**On-mode: No. Of hours, cycles, settings, etc. / year**	1	#	
214	**Standby-mode: Consumption per hour**	0	kWh	**0**
215	**Standby-mode: No. Of hours / year**	0	#	
216	**Off-mode: Consumption per hour**	0	kWh	**0**
217	**Off-mode: No. Of hours / year**	0	#	
	TOTAL over Product Life	**1,62**	**MWh (=000 kWh)**	**65**
	Heat			
218	**Avg. Heat Power Output**	0	kW	
219	**No. Of hours / year**	0	hrs.	
220	**Type and efficiency (Click & select)**			**85-not applicable**
	TOTAL over Product Life	**0,00**	**GJ**	
	Consumables (excl, spare parts)			**material**
221	**Water**	0	m^3/year	**83-Water per m3**
222	**Auxilliary material 1 (Click & select)**	666	kg/ year	**57-Office paper**
223	**Auxilliary material 2 (Click & select)**	2,662	kg/ year	**79-Toner**
224	**Auxilliary material 3 (Click & select)**	0	kg/ year	**85-None**
	Maintenance, Repairs, Service			
225	**No. of km over Product-Life**	0	km / Product Life	**86**
226	**Spare parts (fixed, 1% of product materials & manuf.)**	231	g	

4.3.4. EP-Printer/SFD colour (V4)

4.3.4.1. Power consumption of Product V4

Industry partners provided total annual power consumption data based on Energy Star TEC methodology values. In the case of Product V4 these power consumption data varied largely between 222 kWh/a, and 437 kWh/a. We contacted the industry partners and discussed the issue. For the purpose of the study we assume following value for total annual power consumption:

Annual Power Consumption of Product V4: 360 kWh/a
Assumed lifetime of the Product V1: 6 years

4.3.4.2. Paper consumption of Product V4

Paper consumption is calculated on Energy Star TEC methodology. The reference value for the Product V4 has been calculated based on the following assumption:

1 image	= 1page A4 with paper weight 5 gram	
TEC value for 32 ipm	= 512 pages/day	
Annual images	= 512 * 5 (days) * 52 (weeks)	= 133,120 pages/a
Amount of paper	= 133,120 pages * 5 (gram per page)	= 666 kg/a

Annual Paper Consumption of Product V4: 666 kg/a

4.3.4.3. Toner consumption of Product V4

The toner consumption is calculated based on data from industry partners. Industry sources indicated that average toner consumption per page (A4) is between 0.02 grams and 0.04 grams. For the purpose of this study we assume the amount of color toners per page is (somewhat higher than black) 0.03 gr and multiplied this figure with the number of images/pages per year:

Annual Toner Consumption of Product V4: 3,994 gram

Table 36: EcoReport input table for use phase of Product V4

Pos nr	USE PHASE Description		unit		Subtotals
211	**Product Life in years**	6	years		
	Electricity				
212	**On-mode: Consumption per hour, cycle, setting, etc.**	360	kWh	360	
213	**On-mode: No. Of hours, cycles, settings, etc. / year**	1	#		
214	**Standby-mode: Consumption per hour**	0	kWh	0	
215	**Standby-mode: No. Of hours / year**	0	#		
216	**Off-mode: Consumption per hour**	0	kWh	0	
217	**Off-mode: No. Of hours / year**	0	#		
	TOTAL over Product Life	**2,16**	**MWh (=000 kWh)**		**65**
	Heat				
218	**Avg. Heat Power Output**	0	kW		
219	**No. Of hours / year**	0	hrs.		
220	**Type and efficiency (Click & select)**			**85-not applicable**	
	TOTAL over Product Life	**0,00**	**GJ**		
	Consumables (excl, spare parts)			**material**	
221	**Water**	0	m^3/year	**83-Water per m3**	
222	**Auxilliary material 1 (Click & select)**	666	kg/ year	**57-Office paper**	
223	**Auxilliary material 2 (Click & select)**	3,994	kg/ year	**79-Toner**	
224	**Auxilliary material 3 (Click & select)**	0	kg/ year	**85-None**	
	Maintenance, Repairs, Service				
225	**No. of km over Product-Life**	0	km / Product Life		**86**
226	**Spare parts (fixed, 1% of product materials & manuf.)**	431	g		

4.3.5. IJ-Printer/MFD personal (V5)

4.3.5.1. Power consumption of Product V5

In the case of IJ-Printers the annual power consumption data for Product V5 and V6 is calculated based on the mode-specific power consumption averages and the developed use pattern from Task 3[11]. The applied use pattern for the Product V5 (Personal) is shown in Table 37.

Table 37: Use pattern for Product V5

Modes:	Active	Ready	Sleep	Off-mode	0 (zero) W	Day (total)
	in hours	in hours	in hours	in hours	in hours	in hours
Personal	0,07	0,50	3,43	16,00	4,00	24,00

Annual Power Consumption of Product V5 was calculated based on the averages of the four individual product cases. Whereas power consumption in active and ready mode is comparable in magnitude, we can notice for the sleep and off-mode rather large differences. The First two products show considerable power consumption in these modes, whereas the other two – more expensive – products have considerable low power consumption in sleep and off-mode (see Table 38). The comparison indicates that the more expensive products (IJPMW_01 and IJPMW_14 [for main product parameter see Table 23]) have considerably lower power consumption in sleep mode (≤2 W) and in off-mode (≤0.5 W). The less expensive products feature up to 7.5 W in sleep mode and 6.5 W in off-mode, which is quite high for today's standards. By taking the average of the four product cases we assume to display a fairly realistic situation of the current situation. It is not possible to determine to what extend the distribution of energy efficient and less energy efficient products is in the European market today. For the purpose of this study we have therefore averaged the mode-specific power consumption values and multiplied them with the use pattern (52 weeks). The resulting annual power consumption is **18.28 kWh/a**.

[11] The "Market Transformation Programme" (MTP) proposed a different use pattern (also for Section 4.3.6.1).

Table 38: Power consumption calculation for Product V5

Mode	Active	Ready	Sleep	Off	Personal per week	Personal per year
	in Watt	in Watt	in Watt	in Watt	in kWh/w	in kWh/a
IJPMP_34	11,90	7,70	7,00	5,50	0,58	30,34
IJPMW_21	17,00	7,50	7,50	6,50	0,67	35,01
IJPMW_01	17,20	5,20	1,70	0,50	0,09	4,59
IJPMW_14	19,70	10,30	1,20	0,10	0,06	3,18
Average	16,45	7,68	4,35	3,15	0,35	**18,28**
Max	19,70	10,30	7,50	6,50	0,68	35,43
Min	11,90	5,20	1,20	0,10	0,05	2,38

4.3.5.2. Paper and ink consumption of Product V5

Paper and ink consumption is calculated based on the use pattern defined in Task 3. The product's lifetime is assumed to be 4 years. Regarding the amount of ink we assume that 1 ml equals 1 gr of ink. According to industry sources and own calculations ink consumption per page varies between 0.04 gr and 0.1 gr. We assume an average 0.07 gr per page for the assessment. The reference values for the Product V5 are based on the following assumption:

1 image	= 1page A4 with paper weight 5 gram	
2x2 print jobs	= 4 pages/day	
Annual images	= 4 * 5 (days) * 52 (weeks)	= 1,040 pages/a
Amount of paper	= 1,040 pages * 5 (gram per page)	= **5.2k g/a**
Ink per page / year	= 0.07 ml/gr per page	= **72.8 gr/a**

Table 39 shows the EcoReport input table for the use phase. Please note that the EcoReport does not provide a specific input category for ink. We have used the default category 85-None as input for ink. Environmental data on ink is not available as the detailed composition is confidential and proprietary. In consequence, the ink consumption will only be reflected in the life cycle cost assessment but not in the environmental assessment of the EcoReport.

Table 39: EcoReport input table for use phase of Product V5

Pos nr	USE PHASE Description		unit	Subtotals
211	**Product Life in years**	4	years	
	Electricity			
212	**On-mode: Consumption per hour, cycle, setting, etc.**	18,28	kWh	**18,28**
213	**On-mode: No. Of hours, cycles, settings, etc. / year**	1	#	
214	**Standby-mode: Consumption per hour**	0	kWh	**0**
215	**Standby-mode: No. Of hours / year**	0	#	
216	**Off-mode: Consumption per hour**	0	kWh	**0**
217	**Off-mode: No. Of hours / year**	0	#	
	TOTAL over Product Life	**0,07**	**MWh (=000 kWh)**	**65**
	Heat			
218	**Avg. Heat Power Output**	0	kW	
219	**No. Of hours / year**	0	hrs.	
220	**Type and efficiency (Click & select)**			**85-not applicable**
	TOTAL over Product Life	**0,00**	**GJ**	
	Consumables (excl. spare parts)			**material**
221	**Water**	0	m^3/year	**83-Water per m3**
222	**Auxilliary material 1 (Click & select)**	5,2	kg/ year	**57-Office paper**
223	**Auxilliary material 2 (Click & select)**	0,073	kg/ year	**85-None**
224	**Auxilliary material 3 (Click & select)**	0	kg/ year	**85-None**
	Maintenance, Repairs, Service			
225	**No. of km over Product-Life**	0	km / Product Life	**86**
226	**Spare parts (fixed, 1% of product materials & manuf.)**	94	g	

4.3.6. IJ-Printer/MFD workgroup (V6)

4.3.6.1. Power consumption of Product V6

In the case of IJ-Printers the annual power consumption data for Product V6 is calculated based on the mode-specific power consumption averages and the developed use pattern from Task 3. The applied use pattern for the Product V6 (Workgroup) is shown in Table 40.

Table 40: Use pattern for Product V6

Modes:	Active	Ready	Sleep	Off-mode	0 (zero) W	Day (total)
	in hours	in hours	in hours	in hours	in hours	in hours
Workgroup	0,25	1,25	10,50	8,00	4,00	24,00

The mode-specific power consumption data of the available product cases have been already discussed in chapter 4.3.5.1. For the purpose of this study we have therefore averaged the mode-specific power consumption values and multiplied them with the use pattern (52 weeks). The resulting annual power consumption of Product V6 is **21.99 kWh/a.**

Table 41: Power consumption calculation for Product V6

Mode	Active	Ready	Sleep	Off	Workgroup per week	Workgroup per year
	in Watt	in Watt	in Watt	in Watt	in kWh/w	in kWh/a
IJPMP_34	11,90	7,70	7,00	5,50	0,65	33,83
IJPMW_21	17,00	7,50	7,50	6,50	0,72	37,54
IJPMW_01	17,20	5,20	1,70	0,50	0,16	8,49
IJPMW_14	19,70	10,30	1,20	0,10	0,16	8,11
Average	16,45	7,68	4,35	3,15	0,42	**21,99**
Max	19,70	10,30	7,50	6,50	0,74	38,62
Min	11,90	5,20	1,20	0,10	0,11	5,95

4.3.6.2. Paper and ink consumption of product V6

Paper and ink consumption is calculated based on the use pattern defined in Task 3 (see). The product's lifetime is assumed to be 4 years. The reference values for the product V6 are based on the following assumption:

1 image	= 1page A4 with paper weight 5 gram	
3x5 print jobs	= 15 pages/day	
Annual images	= 15 * 5 (days) * 52 (weeks)	= 3,900 pages/a
Amount of paper	= 3,900 pages * 5 (gram per page)	= **19.5 kg/a**

Ink per page / year = 0.07 ml/gr per page = **273.0 gr/a**

Table 42 shows the EcoReport input table for the use phase. Please note that the EcoReport does not provide a specific input category for ink. We have used the default category 85-None as input for ink. In consequence, the ink consumption will only be reflected in the life cycle cost assessment but not in the environmental assessment of the EcoReport.

Table 42: EcoReport input table for use phase of Product V6

Pos nr	USE PHASE Description		unit	Subtotals
211	**Product Life in years**	4	years	
	Electricity			
212	**On-mode: Consumption per hour, cycle, setting, etc.**	21,99	kWh	**21,99**
213	**On-mode: No. Of hours, cycles, settings, etc. / year**	1	#	
214	**Standby-mode: Consumption per hour**	0	kWh	**0**
215	**Standby-mode: No. Of hours / year**	0	#	
216	**Off-mode: Consumption per hour**	0	kWh	**0**
217	**Off-mode: No. Of hours / year**	0	#	
	TOTAL over Product Life	**0,09**	**MWh (=000 kWh)**	**65**
	Heat			
218	**Avg. Heat Power Output**	0	kW	
219	**No. Of hours / year**	0	hrs.	
220	**Type and efficiency (Click & select)**			**85-not applicable**
	TOTAL over Product Life	**0,00**	**GJ**	
	Consumables (excl, spare parts)			**material**
221	**Water**	0	m^3/year	**83-Water per m3**
222	**Auxilliary material 1 (Click & select)**	19,5	kg/ year	**57-Office paper**
223	**Auxilliary material 2 (Click & select)**	0,273	kg/ year	**85-None**
224	**Auxilliary material 3 (Click & select)**	0	kg/ year	**85-None**
	Maintenance, Repairs, Service			
225	**No. of km over Product-Life**	0	km / Product Life	**86**
226	**Spare parts (fixed, 1% of product materials & manuf.)**	94	g	

4.4. Use Phase (System)

4.4.1. Printer/MFD Networks

4.4.1.1. Power consumption in non-active modes

Office imaging equipment such as printers, printer-based MFDs, and copier-based MFDs which produce a hard-copy image from a digital source are peripheral devices to stationary or mobile computers integrated in a communication network. As a peripheral device to PCs, the printer/MFD has to be in a mode from which it can be (instantly) activated via network communication. From an environmental point of view is the power consumption for providing constant accessibility (e.g. ready mode or network standby) a considerable aspect of system interaction. An effective utilization of the printer/MFD would be ideal. However, in reality printers might not be utilized as frequently and consume certain amounts of power will waiting for a print job. Although the power consumption in “non active modes” should not be considered a waist, it should be reduced to the minimum that is necessary to provide the reactivation functionality. The reactivation time is the critical aspect, which has already been discussed to some extent under the topic of use patterns and user interaction in Task 3. We like to conclude that the inbuilt power management of printers/MFDs should focus on an effective transition into lower power modes in order to increase energy efficiency within the network conditions.

4.4.1.2. Upward/downward compatibility

The dynamic technical development (hardware and software) in the field of personal computing, digital photography, wired and mobile communication provides the problem of upward/downward compatibility of older/new peripheral devices. This aspect gets more and more recognized by electronics manufacturers and has been addressed in product design. Nevertheless, product development is very fast and products might lose compatibility over five to ten years already. We like to conclude that network and software compatibility is essential over a longer period of time in order to avoid, that peripheral devices such as printers get obsolete in short cycles.

4.5. End-of-Life Phase

The end of life phase is defined by the disposal, incineration, re-use (closed loop), material and thermal recycling materials. The MEEuP EcoReport is calculating an eco benefit from reuse and recycling of material. The input data derive from the material values of the manufacturing phase.

In the particular case of office imaging equipment, electronics (electronic boards) is assumed to be disassembled and separately treated. Regarding the reuse, material and thermal recycling of plastics no specific data could be obtained for the individual products on the European basis. Usually, thermal recycling of plastics (90%) and to a small fraction material recycling and reuse (10%) is the most common procedure. Reuse (closed loped recycling) could apply to the toner/ink cartridges. Furthermore, an educated guess is that B2B products (product leasing) such as more expensive Copier/MFD and Printer/MFD might be treated differently in comparison to lower price B2C products such as IJ-Printers. This means that the ratio of material recycling is higher in the case of EP-Copier/MFD (Product V1 and V2) as well as to a lesser extent EP-Printer/SFD (Product V3 and V4). For the purpose of this study we make following pragmatic assumptions:

Product V1 and V2:	2% reuse, 28% material recycling, and 70% thermal recycling[12]
Product V3 and V4:	2% reuse, 18% material recycling, and 80% thermal recycling
Product V5 and V6:	2% reuse, 8% material recycling, and 90% thermal recycling

The end-of-life input data for each product case is presented in the following tables.

[12] i.e. incineration

4.5.1. EP-Copier/MFD monochrome (V1)

Table 43: EcoReport input table for the end-of-life phase of product V1

Pos nr	DISPOSAL & RECYCLING Description		unit	Subtotals
	Substances released during Product Life and Landfill			
227	Refrigerant in the product (Click & select)	0	g	1-none
228	Percentage of fugitive & dumped refrigerant	0%		
229	Mercury (Hg) in the product	0	g Hg	
230	Percentage of fugitive & dumped mercury	0%		
	Disposal: Environmental Costs perkg final product			
231	Landfill (fraction products not recovered) in g en %	6814	10%	88-fixed
232	Incineration (plastics & PWB not re-used/recycled)	13681	g	91-fixed
233	Plastics: Re-use & Recycling ("cost"-side)	5590	g	92-fixed
	Re-use, Recycling Benefit	in g	% of plastics fraction	
234	Plastics: Re-use, Closed Loop Recycling (please edit%)	373	2%	4
235	Plastics: Materials Recycling (please edit% only)	5218	28%	4
236	Plastics: Thermal Recycling (please edit% only)	13044	70%	72
237	Electronics: PWB Easy to Disassemble ? (Click&select)	637	YES	98
238	Metals & TV Glass & Misc. (95% Recycling)	45822		fixed

4.5.2. EP-Copier/MFD colour (V2)

Table 44: EcoReport input table for the end-of-life phase of product V2

Pos nr	DISPOSAL & RECYCLING Description		unit	Subtotals
	Substances released during Product Life and Landfill			
227	Refrigerant in the product (Click & select)	0	g	1-none
228	Percentage of fugitive & dumped refrigerant	0%		
229	Mercury (Hg) in the product	0	g Hg	
230	Percentage of fugitive & dumped mercury	0%		
	Disposal: Environmental Costs perkg final product			
231	Landfill (fraction products not recovered) in g en %	14345	10%	88-fixed
232	Incineration (plastics & PWB not re-used/recycled)	31301	g	91-fixed
233	Plastics: Re-use & Recycling ("cost"-side)	13105	g	92-fixed
	Re-use, Recycling Benefit	in g	% of plastics fraction	
234	Plastics: Re-use, Closed Loop Recycling (please edit%)	874	2%	4
235	Plastics: Materials Recycling (please edit% only)	12232	28%	4
236	Plastics: Thermal Recycling (please edit% only)	30579	70%	72
237	Electronics: PWB Easy to Disassemble ? (Click&select)	722	YES	98
238	Metals & TV Glass & Misc. (95% Recycling)	93403		fixed

4.5.3. EP-Printer/SFD monochrome (V3)

Table 45: EcoReport input table for the end-of-life phase of product V3

Pos nr	DISPOSAL & RECYCLING Description		unit	Subtotals
	Substances released during Product Life and Landfill			
227	Refrigerant in the product (Click & select)	0	g	1-none
228	Percentage of fugitive & dumped refrigerant	0%		
229	Mercury (Hg) in the product	0	g Hg	
230	Percentage of fugitive & dumped mercury	0%		
	Disposal: Environmental Costs perkg final product			
231	Landfill (fraction products not recovered) in g en %	2310	10%	88-fixed
232	Incineration (plastics & PWB not re-used/recycled)	8297	g	91-fixed
233	Plastics: Re-use & Recycling ("cost"-side)	1984	g	92-fixed
	Re-use, Recycling Benefit	in g	% of plastics fraction	
234	Plastics: Re-use, Closed Loop Recycling (please edit%)	198	2%	4
235	Plastics: Materials Recycling (please edit% only)	1786	18%	4
236	Plastics: Thermal Recycling (please edit% only)	7936	80%	72
237	Electronics: PWB Easy to Disassemble ? (Click&select)	362	YES	98
238	Metals & TV Glass & Misc. (95% Recycling)	11838		fixed

4.5.4. EP-Printer/SFD colour (V4)

Table 46: EcoReport input table for the end-of-life phase of product V4

Pos nr	DISPOSAL & RECYCLING Description		unit	Subtotals
	Substances released during Product Life and Landfill			
227	Refrigerant in the product (Click & select)	0	g	1-none
228	Percentage of fugitive & dumped refrigerant	0%		
229	Mercury (Hg) in the product	0	g Hg	
230	Percentage of fugitive & dumped mercury	0%		
	Disposal: Environmental Costs perkg final product			
231	Landfill (fraction products not recovered) in g en %	4310	10%	88-fixed
232	Incineration (plastics & PWB not re-used/recycled)	14298	g	91-fixed
233	Plastics: Re-use & Recycling ("cost"-side)	3484	g	92-fixed
	Re-use, Recycling Benefit	in g	% of plastics fraction	
234	Plastics: Re-use, Closed Loop Recycling (please edit%)	348	2%	4
235	Plastics: Materials Recycling (please edit% only)	3136	18%	4
236	Plastics: Thermal Recycling (please edit% only)	13938	80%	72
237	Electronics: PWB Easy to Disassemble ? (Click&select)	360	YES	98
238	Metals & TV Glass & Misc. (95% Recycling)	23712		fixed

4.5.5. IJ-Printer/MFD personal (V5)

Table 47: EcoReport input table for the end-of-life phase of product V5

Pos nr	DISPOSAL & RECYCLING Description		unit	Subtotals
	Substances released during Product Life and Landfill			
227	Refrigerant in the product (Click & select)	0	g	1-none
228	Percentage of fugitive & dumped refrigerant	0%		
229	Mercury (Hg) in the product	0	g Hg	
230	Percentage of fugitive & dumped mercury	0%		
	Disposal: Environmental Costs perkg final product			
231	Landfill (fraction products not recovered) in g en %	935	10%	88-fixed
232	Incineration (plastics & PWB not re-used/recycled)	4590	g	91-fixed
233	Plastics: Re-use & Recycling ("cost"-side)	494	g	92-fixed
	Re-use, Recycling Benefit	in g	% of plastics fraction	
234	Plastics: Re-use, Closed Loop Recycling (please edit%)	99	2%	4
235	Plastics: Materials Recycling (please edit% only)	395	8%	4
236	Plastics: Thermal Recycling (please edit% only)	4448	90%	72
237	Electronics: PWB Easy to Disassemble ? (Click&select)	142	YES	98
238	Metals & TV Glass & Misc. (95% Recycling)	3922		fixed

4.5.6. IJ-Printer/MFD workgroup (V6)

Table 48: EcoReport input table for the end-of-life phase of product V6

Pos nr	DISPOSAL & RECYCLING Description		unit	Subtotals
	Substances released during Product Life and Landfill			
227	Refrigerant in the product (Click & select)	0	g	1-none
228	Percentage of fugitive & dumped refrigerant	0%		
229	Mercury (Hg) in the product	0	g Hg	
230	Percentage of fugitive & dumped mercury	0%		
	Disposal: Environmental Costs perkg final product			
231	Landfill (fraction products not recovered) in g en %	935	10%	88-fixed
232	Incineration (plastics & PWB not re-used/recycled)	4590	g	91-fixed
233	Plastics: Re-use & Recycling ("cost"-side)	494	g	92-fixed
	Re-use, Recycling Benefit	in g	% of plastics fraction	
234	Plastics: Re-use, Closed Loop Recycling (please edit%)	99	2%	4
235	Plastics: Materials Recycling (please edit% only)	395	8%	4
236	Plastics: Thermal Recycling (please edit% only)	4448	90%	72
237	Electronics: PWB Easy to Disassemble ? (Click&select)	142	YES	98
238	Metals & TV Glass & Misc. (95% Recycling)	3922		fixed