

Contract N°. Specific contract 185/PP/ENT/IMA/12/1110333 implementing FC ENTR/29/PP/FC Lot 2

Report

Preparatory Studies for Product Group in the Ecodesign Working Plan 2012-2014: Lot 8- Power Cables

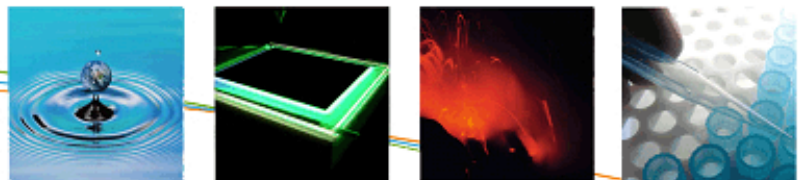
DRAFT Task 5 report - Environment & Economics (base case Life Cycle Assessment & Life Cycle Costs) (2nd version)



Contact VITO: Paul Van Tichelen, Dominic Ectors, www.erp4cables.net

Study for European Commission DG ENTR unit B1, contact: Cesar Santos Gil

20
21



VITO NV

Boeretang 200 – 2400 MOL – BELGIUM
Tel. + 32 14 33 55 11 – Fax + 32 14 33 55 99
vito@vito.be – www.vito.be

VAT BE-0244.195.916 RPR (Turnhout)
Bank 435-4508191-02 KBC (Brussel)
BE32 4354 5081 9102 (IBAN) KREDBEBB (BIC)

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30

Disclaimer:

The authors accept no liability for any material or immaterial direct or indirect damage resulting from the use of this report or its content.

The sole responsibility for the content of this report lies with the authors. It does not necessarily reflect the opinion of the European Communities. The European Commission is not responsible for any use that may be made of the information contained therein.

1 **DISTRIBUTION LIST**

- 2 Public
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10
- 11
- 12
- 13
- 14
- 15
- 16
- 17
- 18
- 19
- 20
- 21
- 22
- 23
- 24
- 25

1 EXECUTIVE SUMMARY

2 VITO is performing the preparatory study for the new upcoming eco-design directive for
3 Energy-related Products (ErP) related to power cables, on behalf of the European
4 Commission (more info [http://ec.europa.eu/enterprise/policies/sustainable-](http://ec.europa.eu/enterprise/policies/sustainable-business/ecodesign/index_en.htm)
5 [business/ecodesign/index_en.htm](http://ec.europa.eu/enterprise/policies/sustainable-business/ecodesign/index_en.htm)).

6
7 In order to improve the efficient use of resources and reduce the environmental
8 impacts of energy-related products the European Parliament and the Council have
9 adopted [Directive 2009/125/EC](#) (recast of [Directive 2005/32/EC](#)) establishing a
10 framework for the setting Ecodesign requirements (e.g. energy efficiency) for energy-
11 related products in the residential, tertiary, and industrial sectors. It prevents disparate
12 national legislations on the environmental performance of these products from
13 becoming obstacles to the intra-EU trade and contributes to sustainable development
14 by increasing energy efficiency and the level of protection of the environment, taking
15 into account the whole life cycle cost. This should benefit both businesses and
16 consumers, by enhancing product quality and environmental protection and by
17 facilitating free movement of goods across the EU. It is also possible to introduce
18 binding information requirements for components and sub-assemblies.

19
20 The MEErP methodology (Methodology for the Eco-design of Energy-related Products)
21 allows the evaluation of whether and to which extent various energy-related products
22 fulfil the criteria established by the ErP Directive for which implementing measures
23 might be considered. The MEErP model translates product specific information, covering
24 all stages of the life of the product, into environmental impacts (more info
25 [http://ec.europa.eu/enterprise/policies/sustainable-](http://ec.europa.eu/enterprise/policies/sustainable-business/ecodesign/methodology/index_en.htm)
26 [business/ecodesign/methodology/index_en.htm](http://ec.europa.eu/enterprise/policies/sustainable-business/ecodesign/methodology/index_en.htm)).

27
28 The tasks in the MEErP entail:

29 Task 1 - Scope (definitions, standards and legislation);

30 Task 2 - Markets (volumes and prices);

31 Task 3 - Users (product demand side);

32 Task 4 - Technologies (product supply side, includes both Best Available Technology
33 (BAT) and Best Not Yet Available Technology (BNAT));

34 Task 5 - Environment & Economics (base case Life Cycle Assessment (LCA) & Life Cycle
35 Costs (LCC));

36 Task 6 - Design options(improvement potential);

37 Task 7 - Scenarios (policy, scenario, impact and sensitivity analysis).

38 Tasks 1 to 4 can be performed in parallel, whereas 5, 6 and 7 are sequential.

39 Task 0 or a Quick-scan is optional to Task 1 for the case of large or inhomogeneous
40 product groups, where it is recommended to carry out a first product screening. The
41 objective is to re-group or narrow the product scope, as appropriate from an ecodesign
42 point of view, for the subsequent analysis in tasks 2-7.

43
44
45
46
47
48

1	TABLE OF CONTENTS	
2	Distribution List	I
3	Executive Summary.....	II
4	Table of Contents	III
5	List of Figures	IV
6	List of Tables.....	V
7	List of Acronyms	VI
8	CHAPTER 5 Task 5: ENVIRONMENT & ECONOMICS	7
9	5.1 <i>Product specific inputs</i>	10
10	5.1.1 <i>Identification of base cases</i>	10
11	5.1.2 <i>Manufacturing of the product: Bill Of Materials</i>	14
12	5.1.3 <i>Distribution phase: volume of packaged product</i>	16
13	5.1.4 <i>Use phase</i>	17
14	5.1.5 <i>End of Life (EoL)</i>	18
15	5.1.6 <i>Life Cycle Cost inputs</i>	18
16	5.2 <i>Base case environmental impact assessment (using EcoReport).....</i>	19
17	5.2.1 Base case 1: distribution circuit in services sector	19
18	5.2.2 Base case 2: lighting circuit in services sector	22
19	5.2.3 Base case 3: socket-outlet circuit in services sector	24
20	5.2.4 Base case 4: dedicated circuit in services sector	26
21	5.2.5 Base case 5: distribution circuit in industry sector	28
22	5.2.6 Base case 6: lighting circuit in industry sector	31
23	5.2.7 Base case 7: socket-outlet circuit in industry sector	33
24	5.2.8 Base case 8: dedicated circuit in industry sector	36
25	5.2.9 Base case 9: aluminium based dedicated circuit in industry sector	39
26	5.3 <i>Base case Life Cycle Cost for consumer.....</i>	41
27	5.4 <i>Base case Life Cycle Costs for society</i>	41
28	5.5 <i>EU totals.....</i>	42
29	5.5.1 <i>Stock specific inputs</i>	43
30	5.5.2 <i>Environmental impact at EU-28</i>	44
31	5.5.3 <i>Economic assessment at EU-28</i>	45
32	5.6 <i>Cross-checks on EU-28 impact.....</i>	46
33		

1 **LIST OF FIGURES**

2	Figure 5-1 Services Sector - Base Cases 1 & 4	12
3	Figure 5-2 Industry Sector - Base Cases 5 & 8	13
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		

1 LIST OF TABLES

2	Table 5-1: Base case identification	11
3	Table 5-2: Bill Of Materials per base case	15
4	Table 5-3: Material resource input for base case 1	16
5	Table 5-4: Calculation of volume of packaged base case per meter cable	16
6	Table 5-5: EcoReport input: volume of packaged base case	17
7	Table 5-6: Energy consumption per base case	17
8	Table 5-7: LCC input parameter per base case	19
9	Table 5-8: EcoReport tool input parameters per base case	19
10	Table 5-9: Environmental impacts related to the use of one BC1 circuit per year	21
11	Table 5-10: Environmental impacts related to the use of one BC2 circuit per year	23
12	Table 5-11: Environmental impacts related to the use of one BC3 circuit per year	25
13	Table 5-12: Environmental impacts related to the use of one BC4 circuit per year	27
14	Table 5-13: Environmental impacts related to the use of one BC5 circuit per year	29
15	Table 5-14: Environmental impacts related to the use of one BC6 circuit per year	32
16	Table 5-15: Environmental impacts related to the use of one BC7 circuit per year	34
17	Table 5-16: Environmental impacts related to the use of one BC8 circuit per year	37
18	Table 5-17: Environmental impacts related to the use of one BC9 circuit per year	40
19	Table 5-18: Life Cycle Costs for consumer per base case	41
20	Table 5-19: Life Cycle Costs for society per base case	42
21	Table 5-20: Stock input parameters per base case	43
22	Table 5-21: EU-28 total annual environmental impacts from the installed stock	44
23	Table 5-22: Total annual expenditure in the EU-28 per base case	45
24	Table 5-23: EU-28 totals check: first method	47
25	Table 5-24: EU-28 totals check: second method	50
26		
27		
28		
29		
30		
31		
32		
33		
34		
35		
36		
37		
38		
39		
40		

1 **LIST OF ACRONYMS**

α_c	corrected or circuit Load Factor
BAT	Best Available Technology
BC	Base Case
BNAT	Best Not (Yet) Available Technology
BOM	Bill Of Materials
CSA	conductor Cross-Sectional Area
Cu	Copper
EC	European Commission
EOL	End Of Life
Kd	Distribution factor
Kf	Load Form Factor
LCA	(environmental) Life Cycle Assessment
LCC	Life Cycle Costs
LV	Low Voltage
MV	Medium Voltage
Pf	Power Factor
PVC	PolyVinyl Chloride
ρ	conductor resistivity
R	Resistance
TBC	To Be Confirmed
TBD	To Be Defined
VITO	Flemish institute for Technological Research
XLPE	Cross-Linked PolyEthylene

2
3
4
5
6
7
8

9 **Use of text background colours**

10
11
12
13

- Blue: draft text
- Yellow: text requires attention to be commented
- Green: text changed in the last update

1 CHAPTER 5 TASK 5: ENVIRONMENT & ECONOMICS

2 The objective of Task 5 is to define one or two average EU product(s) or to choose a
3 representative product category as the 'Base Case' (BC) for the whole of the EU-28.
4 Throughout the rest of the study, most of the environmental and Life Cycle Cost (LCC)
5 analyses will be built on this BC. The BC is a conscious abstraction of reality, necessary
6 for practical reasons (e.g. budget and time). The question if this abstraction leads to
7 inadmissible conclusions for certain market segments will be addressed in the impact
8 and sensitivity analysis. The description of the BC is the synthesis of the results of
9 Tasks 1 to 4 and the point of reference for Tasks 6 (improvement potential) and 7
10 (impact analysis).

11 The aim of this section is to assess environmental and economic impacts of the
12 different base cases. The assessment is based on the updated version 3.06 of the
13 EcoReport Tool¹, as provided with the MEErP 2011 methodology.

14 *Remark: Further in this study the word 'power cables' will be used as a general term for*
15 *single core or multi-core LV power cables in buildings, unless otherwise stated.*

16
17

18 **Summary of Task 5:**

19

20 Previous Task 4 identified improvement options at circuit level. In this Task nine base
21 cases were selected that represent typical electrical circuits in line with the market
22 structure and data described in Task 2. For the initial LCA and LCC calculation, these
23 base cases used the 'median' electrical circuit parameters from Task 3, such as load
24 factor and cable length. The nine base cases used are:

- 25 • Base case 1: distribution circuit in the services sector;
- 26 • Base case 2: lighting circuit in the services sector;
- 27 • Base case 3: socket-outlet circuit in the services sector;
- 28 • Base case 4: dedicated circuit in the services sector;
- 29 • Base case 5: distribution circuit in the industry sector;
- 30 • Base case 6: lighting circuit in the industry sector;
- 31 • Base case 7: socket-outlet circuit in the industry sector;
- 32 • Base case 8: dedicated circuit in the industry sector
- 33 (BC1 up to and including BC8 are with copper conductors);
- 34 • Base case 9: base case 8 but with aluminium instead of copper.

35 The LCA and LCC showed that in most cases the use phase is dominant. This is due to
36 the impact of electrical cable losses. As a consequence, there will be room left for
37 economic energy savings in several of those base cases that will be analysed in detail in
38 Task 6. The data of the nine base cases was also summed using EU-28 circuit level
39 stock data and cross-checked with total EU-28 data on electricity use from Task 2. This

¹ Legal notice of EcoReport tool

This document does not necessarily reflect the view of the European Commission. It was drafted to the best of ability within budget restrictions. VHK and the European Commission do not assume any liability for any material or immaterial damage from using this document or information contained therein.

Copyright ©Van Holsteijn en Kemna BV 2005-2011. Distribution rights European Commission 2005-2011. Duplication allowed if source, draft version and legal notice are mentioned.

1 showed an overestimation compared to EU-28 data on energy use. This means that the
2 'median' parameters for the base cases from Task 3 do not reflect 'average reference'
3 parameters that can be used in a stock model in Task 7. Therefore corrections factors
4 on those 'median' parameters were calculated that fit with total EU energy
5 consumption. This also indicates that potentially a lot of circuits in the stock have a
6 relative lower loading and/or longer circuit length and/or higher share of base cases
7 with lower loading. This is also something to take into account in the sensitivity analysis
8 (Task 6).
9 Table 5-21 indicates annual electricity consumption at EU-28 level of about 42 TWh.
10 The tables in section 5.2 show that the use phase is responsible for the largest part of
11 this electricity consumption, which is also confirmed by the 35 TWh electricity losses
12 per year shown in

1 and

1
2
3

Table 5-24.

4 5.1 Product specific inputs

5 This section collects all relevant quantitative BC information from previous tasks for the
6 modelling exercise in the rest of Task 5. The input parameters are defined in previous
7 tasks. In these tasks, a parameter may have a low/minimum, average/reference or
8 high/maximum value. For the calculation in Task 5 the average/reference value of each
9 parameter is used as input.
10

11 5.1.1 Identification of base cases

12 According to the MEErP methodology, base cases should reflect average EU products.
13 Different products of similar functionalities, Bill Of Materials (BOM), technologies and
14 efficiency can be compiled into a single BC, thus it does not always represent a real
15 product.

16 For the identification of the base cases, four application types (power cable for use in
17 distribution circuit, power cable for use in lighting circuit, power cable for use in
18 socket-outlet circuit, and power cable for use in dedicated circuit) and two different
19 application sectors (services sector and industry sector) have been chosen. All base
20 cases use cables with copper conductors, except for base case nine which is based upon
21 cables with aluminium conductors.

22
23 The most appropriate base cases have been selected in accordance with the analysis
24 presented in Tasks 2, 3 and 4 concerning the analysis of market and environmental and
25 technical elements associated to products used across the EU.

26 **Nine base cases** have been identified to assess the environmental and economic
27 impacts over the life cycle:

- 28 • Base case 1: A typical power cable for use in typical distribution circuit in the
29 services sector (see Figure 5-1);
 - 30 • Base case 2: A typical power cable for use in typical lighting circuit in the
31 services sector;
 - 32 • Base case 3: A typical power cable for use in typical socket-outlet circuit in the
33 services sector;
 - 34 • Base case 4: A typical power cable for use in typical dedicated circuit in the
35 services sector (see Figure 5-1);
 - 36 • Base case 5: A typical power cable for use in typical distribution circuit in the
37 industry sector (see Figure 5-2);
 - 38 • Base case 6: A typical power cable for use in typical lighting circuit in the
39 industry sector;
 - 40 • Base case 7: A typical power cable for use in typical socket-outlet circuit in the
41 industry sector;
 - 42 • Base case 8: A typical power cable for use in typical dedicated circuit in the
43 industry sector (see Figure 5-2);
 - 44 • Base case 9: The same base case as base case 8, but instead of copper the
45 cable conductors are of aluminium.
- 46
47

1 The characteristics of each BC are summarised in **Table 5-1**. These characteristics are
 2 relevant because they have an impact on the energy consumption and the BoM. The
 3 bases cases are explained more in detail in the next paragraphs.
 4
 5

6 **Table 5-1: Base case identification**

Base case id	Unit	T	Bases cases definiton								
			BC1	BC2	BC3	BC4	BC5	BC6	BC7	BC8	BC9
Sector			Services sector	Services sector	Services sector	Services sector	Industry sector	Industry sector	Industry sector	Industry sector	Industry sector
Application circuit			Distribution circuit	Lighting circuit	Socket-outlet circuit	Dedicated circuit	Distribution circuit	Lighting circuit	Socket-outlet circuit	Dedicated circuit	Dedicated circuit
Transformer/Consumer	kVA	I	400	2.3	4	43	1250	2.3	4	108	108
Voltage	V	I	400	230	230	400	400	230	230	400	400
Load current Ib	A	I	577	10	16	62	1804	10	16	156	156
Cores		I	5	5	5	5	4	5	5	5	5
Conductor material		I	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Al
CSA	mm ²	I	120	1.5	2.5	10	300	1.5	2.5	35	70
Installation Method (IEC 60364-5-52)		I	E	E	E	E	E	E	E	E	E
Current Carrying Capacity cable (IEC 60364-5-52 / Table B52.12)	A	I	346	26	30	75	621	26	30	158	158
Cables in parallel //		I	2	1	1	1	4	1	1	1	1
Current-Carrying Capacity - total	A	I	692	26	30	75	2484	26	30	158	158
Reduction Factor (IEC 60364-5-52 / Table B52.17)		I	0.88	1	1	1	0.8	1	1	1	1
Current-Carrying Capacity cable - total - reduced	A	C	609	26	30	75	1987	26	30	158	158
I _{circuit} =I _r (circuit breaker setting)	A	I	577	10	16	62	1804	10	16	156	156
Single phase or 3-phase		I	3	1	1	3	3	1	1	3	3
I _n per cable		I	289	10	16	62	451	10	16	156	156
Circuit length	m	I	56.25	43.56	52.78	50.56	82.50	67.50	72.00	78.50	78.50

7
8
9 **Remarks:**

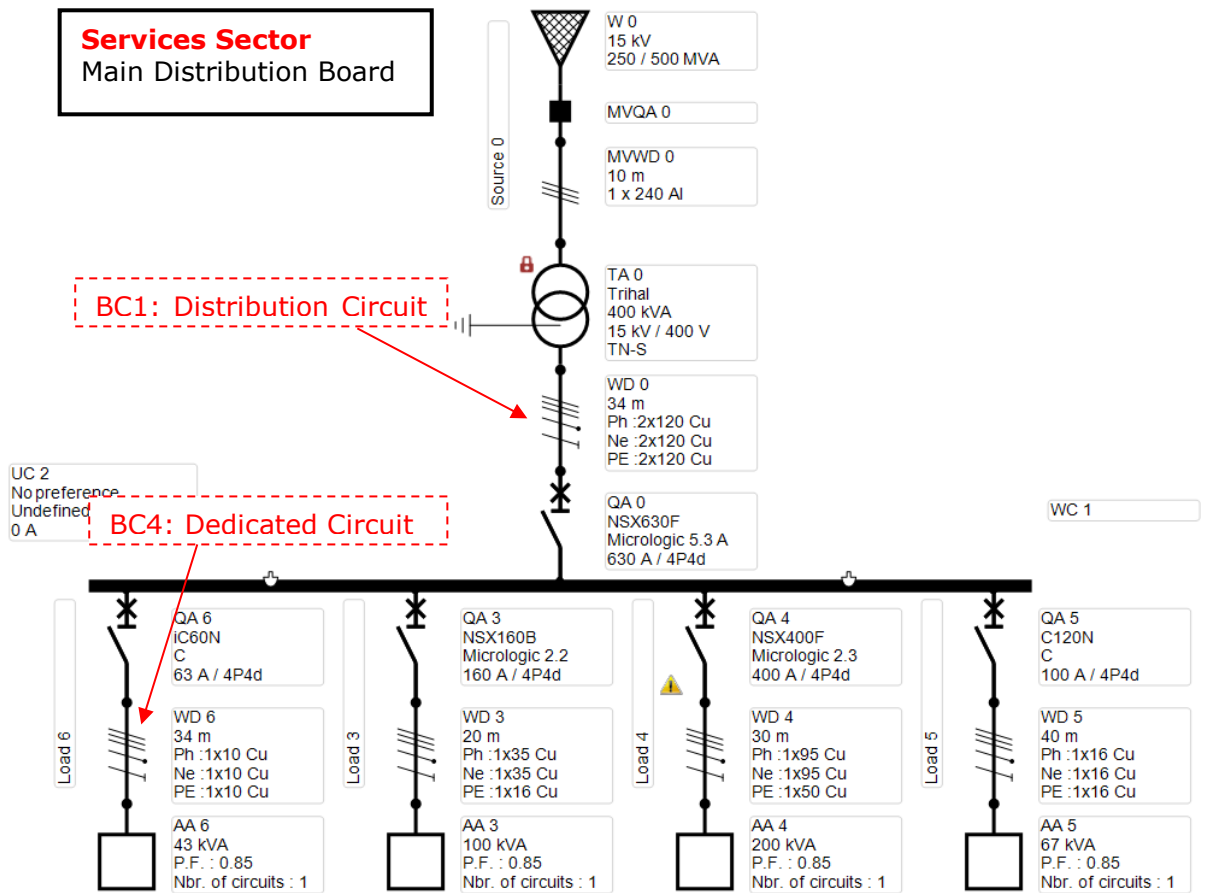
- 10 • The circuits are 100% loaded. For each circuit the required CSA according to IEC
 11 60364-5-52 is determined and checked with a commercial calculation tool.
- 12 • Installation Method E means cables arranged in a single layer on a perforated
 13 horizontal or vertical cable tray system (IEC 60364-5-52).
- 14 • Cable sizing is done according to the circuit breaker setting (I_r) and not
 15 according to the circuit breaker rating (I_n). For instance in base case 2 a 630 A
 16 (=I_n) circuit breaker will be used with I_r set at 609A.
- 17 • To make transitions between design options in later chapters possible, the
 18 number of conductors/cores of a cable has to be the same for each CSA.
 19 Therefore the cables in these base cases have always 5 cores. The BOM
 20 mentioned in Task 4 is based upon cables with 5 cores.

21
22
23 **Base Case 1: Services sector – Distribution circuit**

24
25 This base case includes the main distribution circuit - this means the LV power cable
 26 and protective device - between the 400 kVA MV/LV power transformer and the main
 27 LV distribution board (see Figure 5-1). In services sector smaller transformers are used
 28 compared to the industry. A 400 kVA transformer³ is assumed as a common used
 29 transformer in services sector.

30 Two parallel cables of each 5G120 mm² are needed to transport the maximum power
 31 from the 400 kVA transformer to the main distribution board at the given circuit length.

1
2



3

Figure 5-1 Services Sector - Base Cases 1 & 4

4

Base Case 2: Services sector - Lighting circuit

5

3G1.5 mm² and 5G1.5 mm² (two extra conductors for DALI protocol²) power cables are commonly used in lighting circuits in EU-28 countries. A 5G1.5 mm² is used in this base case. A circuit breaker of 10 A (or 16 A) can be used to protect the cable against overload and short circuit. The maximum power which can be transmitted over the cable is (230V*10A=) 2.3 kVA.

6

Base Case 3: Services sector – Socket-outlet circuit

7

A 3G2.5 mm² power cable is commonly used in socket-outlet circuits in EU-28 countries. A 5G2.5 mm² is used in this base case for reasons mentioned in the remarks above. A circuit breaker of 16 A (or 20 A) can be used to protect the cable against overload and short circuit. The maximum power which can be transmitted over the cable is (230V*16A=) 36.8 kVA.

8

9

10

11

12

13

14

15

16

17

18

19

20

Base Case 4: Services sector – Dedicated circuit

21

22

A dedicated circuit forms the connection between a main- or sub-distribution board and a dedicated consumer (see Figure 5-1). A 5G10 mm² cable is selected for the services

23

24

² DALI protocol is an open digital lighting standard: IEC 62386

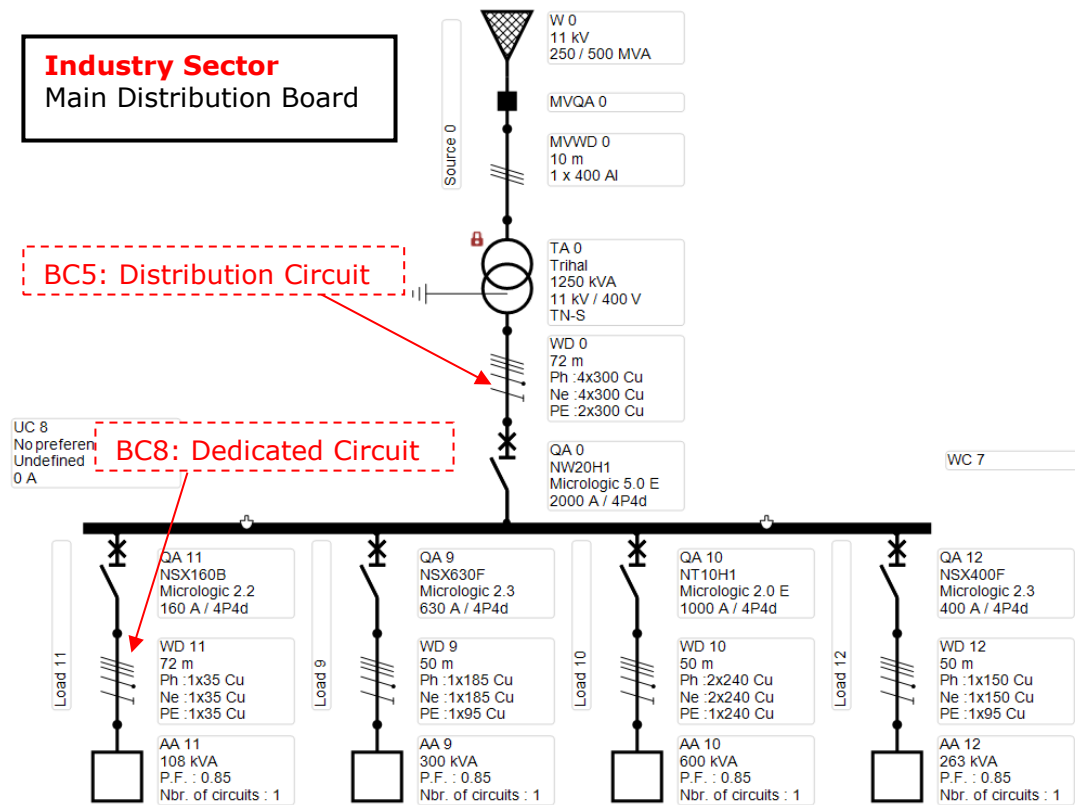
1 sector as a dedicated circuit cable. For the given cable length and cable section a load
 2 of 43 kVA can be connected to the 63 A circuit breaker in the distribution board.

3
 4 **Base Case 5: Industry sector – Distribution circuit**

5
 6 In general, transformers with a higher power rate are used in industry sector compared
 7 to the services sector. A 1250 kVA transformer is used in this BC as a common used
 8 transformer in industry³.

9 The distribution circuit contains the main distribution circuit - this means the LV power
 10 cable and protective device - between the 1250 kVA MV/LV power transformer and the
 11 main LV distribution board (see Figure 5-2).

12
 13 Four parallel cables of each 4 x 300 mm² are needed to transport the maximum power
 14 from the 1250 kVA transformer to the main distribution board at the given circuit
 15 length.



18
 19 **Figure 5-2 Industry Sector – Base Cases 5 & 8**

20
 21
 22 **Base Case 6: Industry sector – Lighting circuit**

23 A circuit similar to base case 2, but with characteristics typical for the industry, as
 24 defined in Task 3.

25
 3 EU DG ENTR- Lot 2: Distribution and power transformers:
http://www.eceee.org/ecodesign/products/distribution_power_transformers/Final_report_Feb2011
 1

1 **Base Case 7: Industry sector – Socket-outlet circuit**

2 A circuit similar to base case 3, but with characteristics typical for the industry as
3 defined in Task 3.

4
5 **Base Case 8: Industry sector – Dedicated circuit**

6
7 A 5G35 mm² cable is selected for the industry sector as a dedicated circuit cable. For
8 the given cable length and cable section a load of 108 kVA can be connected to the 160
9 A circuit breaker in the distribution board (Figure 5-2).

10
11 **Base Case 9: Industry sector – Dedicated**

12 The same base case as base case 8, but with the difference that the cable conductors
13 are of aluminium instead of copper. The aluminium cable with the smallest CSA
14 complying with the requested current requirements is selected. In this case it means
15 that a 5x35mm² copper based cable is replaced by a 5x70 mm² aluminium based
16 cable. The selection is verified by means of an electrical installation design engineering
17 tool.
18

19 **5.1.2 Manufacturing of the product: Bill Of Materials**

20 The manufacturing phase includes the extraction and processing of the required
21 materials and the following steps necessary to produce and assembly one product. The
22 MEErP 2011 EcoReport tool contains a **fixed** list of materials and processes for which
23 materials and energy indicators are provided (see for instance the 'Material Code in
24 EcoReport tool' reported in **Table 5-9**).

25
26 A frequently used LV power cable with the following specifications is selected as the
27 reference cable:

- 28 • Conductor:
 - 29 ○ Material: Cu
 - 30 ○ Flexibility: Class 1 and 2
 - 31 • Insulation material: XLPE (Cross-Linked Polyethylene)
 - 32 • Sheath material: PVC (Polyvinyl Chloride)
 - 33 • Voltage rating: 0.6/1 kV
 - 34 • Single- and multicore
 - 35 • Armoured: No
 - 36 • Standard: IEC 60502-1
- 37

38 The BOM of this preparatory study has been selected according to information included
39 in Task 2 and Task 4. An overview of the BOM per BC is shown in **Table 5-2**.

1

Table 5-2: Bill Of Materials per base case

Base case id	Unit		Bases cases definiton								
			BC1	BC2	BC3	BC4	BC5	BC6	BC7	BC8	BC9
Sector			Services sector	Services sector	Services sector	Services sector	Industry sector	Industry sector	Industry sector	Industry sector	Industry sector
Application circuit			Distribution circuit	Lighting circuit	Socket-outlet circuit	Dedicated circuit	Distribution circuit	Lighting circuit	Socket-outlet circuit	Dedicated circuit	Dedicated circuit
BoM per meter cable											
CSA	mm ²	I	120.00	1.50	2.50	10.00	300.00	1.50	2.50	35.00	70.00
Conductor material	g/m	I	5,334.00	66.68	111.13	444.50	10,668.00	66.68	111.13	1,555.75	945.00
Insulation material	g/m	I	238.41	21.47	25.56	43.97	448.07	21.47	25.56	99.92	189.62
Sheath material	g/m	I	478.79	79.39	88.56	129.78	820.05	79.39	88.56	210.34	399.11
Filler material	g/m	I	1,300.81	41.21	50.26	141.25	1,933.88	41.21	50.26	390.98	843.27
Total weight material	g/m	C	7,352.00	208.75	275.50	759.50	13,870.00	208.75	275.50	2,257.00	2,377.00
BoM per base case											
Conductor material	kg	C	600.08	2.90	5.86	22.47	3,520.44	4.50	8.00	122.13	74.18
Insulation material	kg	C	26.82	0.94	1.35	2.22	147.86	1.45	1.84	7.84	14.88
Sheath material	kg	C	53.86	3.46	4.67	6.56	270.62	5.36	6.38	16.51	31.33
Filler material	kg	C	146.34	1.79	2.65	7.14	638.18	2.78	3.62	30.69	66.20
Total weight material	kg	C	827.10	9.09	14.54	38.40	4,577.10	14.09	19.84	177.17	186.59

2

3

4

5

In the EcoReport tool the following material components are selected, based on Table 4-1 of Task 4:

6

7

8

9

10

11

12

13

14

15

16

17

18

19

20

21

22

23

24

- Conductor material: Cu or Al (depending on the BC);
- Insulation material: 100% LDPE (According to the Europacable members, there is 3% silane based crosslinking compound in the XLPE insulation, however due to the limited list of materials in the EcoReport tool 100% LDPE is used for the calculations, also given the small share of crosslinking compound.) ;
- Sheath material, composed of:
 - 50% of the sheath material weight: PVC (not recycled)⁴;
 - 25% of the sheath material weight: talcum filler as filler material in the sheath (According to the Europacable members, calcium carbonate filler is used, however in the EcoReport tool calcium carbonate cannot be chosen. Given that both talcum and calcium carbonate are mineral fillers that are used in plastic, talcum is used as a substitute.);
 - 25% of the sheath material weight: bitumen (As it is the closest to a plasticizer in the EcoReport tool.);
- Filler material: 100% talcum filler.

The material resource input for base case 1 in the EcoReport tool is shown in Table 5-3 as an example.

⁴ See minutes of second stakeholder meeting http://www.erp4cables.net/sites/erp4cables.net/files/attachments/Minutes%20stakeholder%20meeting%20MEErP%20Power%20Cables_20140603_final.pdf

1

Table 5-3: Material resource input for base case 1

Pos nr	MATERIALS Extraction & Production Description of component	Weight in g	Category Click & select	Material or Process select Category first !
1	Conductor	600075.0	4-Non-ferro	30 - Cu wire
2	Insulation	26821.0	1-BlkPlastics	1- LDPE
3	Sheath - PVC	26931.7	1-BlkPlastics	8 - PVC
4	Sheath - Filler	13465.8	2- TecPlastics	18 - Talcum filler
5	Sheath - plasticizer	13465.8	7- Misc.	56 - Bitumen
6	Filler material	146340.7	2- TecPlastics	18 - Talcum filler

2
3

4

5.1.3 Distribution phase: volume of packaged product

5 This phase includes the distribution of the packaged product. The volume of the
6 packaged product (power cable) depends on the length of cable. For a certain cable
7 section, the appropriate drum is selected. If multiple drum sizes (drum numbers) are
8 available, the average drum size has been selected. The volume of this drum is then
9 multiplied by length of cable of the BC (= circuit length x number of parallel cables)
10 divided by the maximum length of cable on this drum. Drum characteristics are listed
11 in Task 4. The calculation is shown in **Table 5-4**. An estimated spacing correction factor
12 of 15% has been chosen for the extra space between drums during transport needed
13 for handling. The EcoReport input is shown in **Table 5-5**.

14
15

16

Table 5-4: Calculation of volume of packaged base case per meter cable

	Unit	T	BC1	BC2	BC3	BC4	BC5	BC6	BC7	BC8	BC9
CSA	mm ²	I	120	1.5	2.5	10	300	1.5	2.5	35	70
Fictitious diameter	mm	I	39.96	7.56	8.64	13.50	55.90	7.56	8.64	22.95	31.32
PVC sheat tickness	mm	I	2.40	1.80	1.80	1.80	2.96	1.80	1.80	1.80	2.10
Cable outer diameter	mm	C	44.76	11.16	12.24	17.10	61.82	11.16	12.24	26.56	35.51
Drum Size		I	22	10	10	14	22	10	10	16	20
Max. cable length	m	I	842	2323	1952	2448	443	2323	1952	1326	1161
Drum Volume (formula 4.1)	m ³	I	6.04	0.70	0.70	1.80	6.04	0.70	0.70	2.63	4.99
Drum spacing	m ³	C	0.91	0.11	0.11	0.27	0.91	0.11	0.11	0.39	0.75
Correction factor (spacing)	%	I	15%	15%	15%	15%	15%	15%	15%	15%	15%
Drum Corrected Volume	m ³	C	6.95	0.81	0.81	2.07	6.95	0.81	0.81	3.03	5.74
Drum Weight	kg	I	450.00	50.00	50.00	125.00	450.00	50.00	50.00	175.00	330.00
Drum corrected volume / meter cable	m ³ /m	C	0.00825	0.00035	0.00041	0.00085	0.01568	0.00035	0.00041	0.00228	0.00494
Drum Weigth / meter cable	g/m	C	534.4	21.5	25.6	51.1	1015.8	21.5	25.6	132.0	284.2

17
18
19

1

Table 5-5: EcoReport input: volume of packaged base case

	Unit		Bases cases definiton								
Base case id			BC1	BC2	BC3	BC4	BC5	BC6	BC7	BC8	BC9
Sector			Services sector	Services sector	Services sector	Services sector	Industry sector	Industry sector	Industry sector	Industry sector	Industry sector
Application circuit			Distribution circuit	Lighting circuit	Socket-outlet circuit	Dedicated circuit	Distribution circuit	Lighting circuit	Socket-outlet circuit	Dedicated circuit	Dedicated circuit
Volume package											
Volume package per meter cable	m3	I	0.008250	0.000347	0.000412	0.000847	0.015680	0.000347	0.000412	0.002282	0.004945
Volume package per base case	m3	C	0.92811	0.01509	0.02177	0.04283	5.17450	0.02339	0.02969	0.17917	0.38816

2
3

4

5.1.4 Use phase

5 The use phase considers the amount of energy resources demanded during the lifetime
6 of power cables. In this study, the amount of energy loss due to the resistance of the
7 power cable is regarded as the energy consumption of the power cable. The calculated
8 result of the energy consumption value per BC and the input parameters for this
9 calculation are listed in **Table 5-6**. Average consumption of energy per BC has been
10 calculated based on parameters, models and formulas described in Task 2 and Task 3.

11

12

Table 5-6: Energy consumption per base case

Parameter	Unit	T	Base cases								
Base case id			BC1	BC2	BC3	BC4	BC5	BC6	BC7	BC8	BC9
Sector			Services sector	Services sector	Services sector	Services sector	Industry sector	Industry sector	Industry sector	Industry sector	Industry sector
Application circuit			Distribution circuit	Lighting circuit	Socket-outlet circuit	Dedicated circuit	Distribution circuit	Lighting circuit	Socket-outlet circuit	Dedicated circuit	Dedicated circuit
Loaded cores		I	6	2	2	3	12	2	2	3	3
Cables in parallel		I	2	1	1	1	4	1	1	1	1
Conductor material		I	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Al
In per cable	A	I	289	10	16	62	451	10	16	156	156
CSA	mm ²	I	120	1.5	2.5	10	300	1.5	2.5	35	70
Length of circuit	m	I	56	44	53	51	83	68	72	79	79
P_t	$\Omega \cdot m$ m^2/m	I	0.0167	0.0167	0.0167	0.0167	0.0167	0.0167	0.0167	0.0167	0.0265
R (formula 3.2) per wire	Ω	C	0.008	0.485	0.353	0.084	0.005	0.752	0.481	0.037	0.030
Kd		I	1.00	0.37	0.40	1.00	1.00	0.37	0.44	1.00	1.00
Kf		I	1.21	1.27	1.27	1.21	1.02	1.06	1.06	1.01	1.01
αc		I	0.41	0.24	0.15	0.41	0.57	0.34	0.27	0.61	0.61
Pf		I	0.80	1.00	0.80	0.80	0.80	1.00	0.80	0.80	0.80
Annual energy loss (formula 3.5) per loaded core	kWh	C	1392.06	15.22	10.81	694.00	2797.39	31.38	39.16	3011.51	2389.38
Annual energy loss (formula 3.5) per BC	kWh	C	8352.36	30.44	21.61	2082.01	33568.63	62.75	78.33	9034.54	7168.13
Annual energy transported (formula 3.6) per BC	kVAh	C	1,383,543	6,233	4,787	148,731	5,121,230	7,249	7,423	465,153	465,153
Energy loss ratio (formula 3.7)		C	0.60%	0.49%	0.45%	1.40%	0.66%	0.87%	1.06%	1.94%	1.54%

13
14

1 **5.1.5 End of Life (EoL)**

2 Recycling of materials can avoid the extraction of raw materials and the production of
3 virgin materials, which is modelled in the EcoReport tool as credits (avoided impacts),
4 i.e. negative impacts. Defaults values of the EcoReport have been used for recycling
5 rates of the materials, except for ferro and non-ferro materials. For instance, default
6 values for the recycling rate of metals and plastics are 94% and 29% respectively.
7 These recycling rates are considered comparable with the outcomes of the previous
8 tasks and thus suitable for the current environmental analysis. Only the re-use of
9 metals is set to 0% instead of 1% and recycling of metals is set to 95% instead of 94%
10 (see section 3.3 in Task 3).
11

12 **5.1.6 Life Cycle Cost inputs**

13 Average market data and consumer expenditure data have been estimated in Task 2.
14 These have been summarized in **Table 5-7** and form the data input for carrying out the
15 economic assessment of the base cases. As mentioned in Task 3, there are no repair
16 and maintenance costs for installed power cables.

17 Because altering the cable size can have an impact on the price of the used connectors,
18 the connector price is included in the base case product price. Connectors usually serve
19 a range of cable sizes, for instance from 0.14 mm² till 4 mm², 0.2 mm² till 10 mm², 0.5
20 mm² till 16 mm² and so on. In the base case calculation the smallest connector, able to
21 fit the cable, is selected.

22
23 **Base case connector price = CP x CC x NC x NEN (formula 5.1)**

24
25 **Where:**

- 26 CP: connector price for one wire;
27 CC: cores per cable;
28 NC: number of cables in the base case;
29 NEN: number of end-nodes in a base case.

30
31 This means that the connector price doubles when the amount of cables in a base case
32 doubles. Also for base cases with a lot of end-nodes like the base cases for lighting
33 circuits or socket circuits, the connector price will be a substantial part of the base case
34 product price.

35 Larger connectors may also have an impact on the distribution boards. This is however
36 not included in the base case product price, nor is the cost for potential larger ducts
37 and the building space needed for this. The connector prices are listed in Task 2.
38 Discounted prices are used.

39
40

1

Table 5-7: LCC input parameter per base case

	Unit		Bases cases definiton								
Base case id			BC1	BC2	BC3	BC4	BC5	BC6	BC7	BC8	BC9
Sector			Services sector	Services sector	Services sector	Services sector	Industry sector	Industry sector	Industry sector	Industry sector	Industry sector
Application circuit			Distribution circuit	Lighting circuit	Socket-outlet circuit	Dedicated circuit	Distribution circuit	Lighting circuit	Socket-outlet circuit	Dedicated circuit	Dedicated circuit
LCC data											
Year		I	2010	2010	2010	2010	2010	2010	2010	2010	2010
Electricity rate	€/kWh	I	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
Product price for 1 meter cable	€	I	56.60	0.71	1.18	4.72	113.21	0.71	1.18	16.51	18.79
Price connectors	€	I	359.20	35.59	24.87	15.54	876.80	40.94	18.07	43.25	111.31
Base case product price	€	C	6727.15	66.41	87.11	254.01	38235.44	88.70	102.97	1339.24	1586.41
Base case installation cost	€	I	693.23	78.65	98.45	137.78	3572.78	107.30	113.40	334.55	391.53
Product life	Year	I	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00
Product service life	Year	I	23.75	23.75	23.75	23.75	23.75	23.75	23.75	23.75	23.75

2
3

4 5.2 Base case environmental impact assessment (using EcoReport)

5 In this section, the EcoReport tool 2011 version 3.06 is used to calculate the outputs
6 per environmental indicator and 'cradle-to-grave' stages of a product life.
7 A summary of all input parameters values used in the EcoReport tool is listed in **Table**
8 **5-8**. For parameters not mentioned in **Table 5-8**, the default parameters of the
9 EcoReport tool are used.

10

11

Table 5-8: EcoReport tool input parameters per base case

	Unit	Base cases: ecoport input								
Base case id		BC1	BC2	BC3	BC4	BC5	BC6	BC7	BC8	BC9
CSA	mm ²	120	1.5	2.5	10	300	1.5	2.5	35	70
Conductor material	g	600075.0	2904.1	5864.9	22471.9	3520440.0	4500.6	8001.0	122126.4	74182.5
Insulation material	g	26821.0	935.3	1349.2	2223.0	147862.8	1449.5	1840.7	7.8	14.9
Sheath material	g	53863.3	3458.1	4673.7	6561.1	270615.7	5359.1	6376.0	16512.0	31330.4
Filler material	g	146340.7	1794.8	2652.4	7140.9	638181.6	2781.4	3618.4	30692.3	66196.7
Annual energy loss (formula 3.5) per BC	kWh	8352.36	30.44	21.61	2082.01	33568.63	62.75	78.33	9034.54	7168.13
Volume	m ³	0.93	0.02	0.02	0.04	5.17	0.02	0.03	0.18	0.39
Product life	Year	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00
Product service life	Year	23.75	23.75	23.75	23.75	23.75	23.75	23.75	23.75	23.75
Base case product price	€	6727.15	66.41	87.11	254.01	38235.44	88.70	102.97	1339.24	1586.41
Annual sales (base case units)	mln. Units	0.13	2.86	3.77	0.98	0.03	1.78	2.00	0.24	0.24
EU Stock (base case units)	mln. Units	3.23	71.43	94.32	24.62	0.71	44.44	49.99	5.94	5.94
Base case installation cost	€	693.23	78.65	98.45	137.78	3572.78	107.30	113.40	334.55	391.53
Electricity rate	€/kWh	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
EoL mass fraction to re-use, non-Ferro material	%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Conductor material		Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Al

12
13

14 5.2.1 Base case 1: distribution circuit in services sector

15 The environmental impacts related to the use of one BC1 circuit per year, calculated by
16 means of the EcoReport tool, are shown in Table 5-9.
17

1

DRAFT

Table 5-9: Environmental impacts related to the use of one BC1 circuit per year

Life Cycle phases -->		PRODUCTION			DISTRI-	USE	END-OF-LIFE*			TOTAL
Resources Use and Emissions		Material	Manuf.	Total	BUTION		Disposal	Recycl.	Stock	
Materials		unit								
1	Bulk Plastics	g		2,150		22	1,194	977	0	0
2	TecPlastics	g		6,392		64	3,551	2,905	0	0
3	Ferro	g		0		0	0	0	0	0
4	Non-ferro	g		24,003		240	1,212	23,031	0	0
5	Coating	g		0		0	0	0	0	0
6	Electronics	g		0		0	0	0	0	0
7	Misc.	g		539		5	185	359	0	0
8	Extra	g		0		0	0	0	0	0
9	Auxiliaries	g		0		0	0	0	0	0
10	Refrigerant	g		0		0	0	0	0	0
	Total weight	g		33,084		331	6,142	27,272	0	0
							see note!			
Other Resources & Waste						debet		credit		
11	Total Energy (GER)	MJ	3,033	349	3,382	49	71,443	18	-1,092	73,799
12	of which, electricity (in primary MJ)	MJ	26	210	236	0	71,413	0	-2	71,647
13	Water (process)	ltr	19	3	22	0	0	0	-2	20
14	Water (cooling)	ltr	115	99	214	0	3,175	0	-9	3,380
15	Waste, non-haz./landfill	g	448	1,093	1,542	27	36,806	15	-127	38,263
16	Waste, hazardous/incinerated	g	17	0	17	1	1,127	0	-3	1,141
Emissions (Air)										
17	Greenhouse Gases in GWP100	kg CO2 eq.	157	19	177	3	3,050	0	-58	3,172
18	Acidification, emissions	g SO2 eq.	7,057	83	7,140	10	13,560	4	-2,670	18,043
19	Volatile Organic Compounds (VOC)	g	5	0	5	1	1,595	0	-1	1,600
20	Persistent Organic Pollutants (POP)	ng i-Teq	90	0	90	0	168	0	-34	224
21	Heavy Metals	mg Ni eq.	1,327	0	1,327	1	735	1	-504	1,561
22	PAHs	mg Ni eq.	133	0	133	2	168	0	-50	253
23	Particulate Matter (PM, dust)	g	212	13	225	127	288	5	-63	581
Emissions (Water)										
24	Heavy Metals	mg Hg/20	2,264	0	2,264	0	330	1	-859	1,736
25	Eutrophication	g PO4	4	0	4	0	14	0	-1	17

1

2
3

1 **5.2.2 Base case 2: lighting circuit in services sector**

2 The environmental impacts related to the use of one BC2 circuit per year, calculated by
3 means of the EcoReport tool, are shown in Table 5-10.
4

DRAFT

Table 5-10: Environmental impacts related to the use of one BC2 circuit per year

Life Cycle phases -->		PRODUCTION			DISTRI-	USE	END-OF-LIFE*			TOTAL
Resources Use and Emissions		Material	Manuf.	Total	BUTION		Disposal	Recycl.	Stock	
Materials		unit								
1	Bulk Plastics	g		107		1	59	48	0	0
2	TecPlastics	g		106		1	59	48	0	0
3	Ferro	g		0		0	0	0	0	0
4	Non-ferro	g		116		1	6	111	0	0
5	Coating	g		0		0	0	0	0	0
6	Electronics	g		0		0	0	0	0	0
7	Misc.	g		35		0	12	23	0	0
8	Extra	g		0		0	0	0	0	0
9	Auxiliaries	g		0		0	0	0	0	0
10	Refrigerant	g		0		0	0	0	0	0
	Total weight	g		364		4	136	231	0	0
Other Resources & Waste		see note!								
						debet		credit		
11	Total Energy (GER)	MJ	23	9	32	5	261	0	-6	292
12	of which, electricity (in primary MJ)	MJ	1	5	7	0	260	0	0	267
13	Water (process)	ltr	1	0	1	0	0	0	0	1
14	Water (cooling)	ltr	6	2	8	0	12	0	0	20
15	Waste, non-haz./landfill	g	8	27	36	5	134	1	-1	174
16	Waste, hazardous/incinerated	g	1	0	1	0	4	0	0	5
Emissions (Air)										
17	Greenhouse Gases in GWP100	kg CO2 eq.	1	0	2	0	11	0	0	13
18	Acidification, emissions	g SO2 eq.	36	2	38	1	50	0	-13	75
19	Volatile Organic Compounds (VOC)	g	0	0	0	0	6	0	0	6
20	Persistent Organic Pollutants (POP)	ng i-Teq	0	0	0	0	1	0	0	1
21	Heavy Metals	mg Ni eq.	7	0	7	0	3	0	-3	7
22	PAHs	mg Ni eq.	1	0	1	0	1	0	0	1
23	Particulate Matter (PM, dust)	g	10	0	10	2	1	0	-3	11
Emissions (Water)										
24	Heavy Metals	mg Hg/20	11	0	11	0	1	0	-4	8
25	Eutrophication	g PO4	0	0	0	0	0	0	0	0

1
2
3
4
5
6

5.2.3 Base case 3: socket-outlet circuit in services sector

The environmental impacts related to the use of one BC3 circuit per year, calculated by means of the EcoReport tool, are shown in Table 5-11.

DRAFT

Table 5-11: Environmental impacts related to the use of one BC3 circuit per year

Life Cycle phases --> Resources Use and Emissions		PRODUCTION			DISTRIBUTION	USE	END-OF-LIFE*			TOTAL
		Material	Manuf.	Total			Disposal	Recycl.	Stock	
Materials		unit								
1	Bulk Plastics	g				1	82	67	0	0
2	TecPlastics	g				2	85	69	0	0
3	Ferro	g				0	0	0	0	0
4	Non-ferro	g				2	12	225	0	0
5	Coating	g				0	0	0	0	0
6	Electronics	g				0	0	0	0	0
7	Misc.	g				0	16	31	0	0
8	Extra	g				0	0	0	0	0
9	Auxiliaries	g				0	0	0	0	0
10	Refrigerant	g				0	0	0	0	0
	Total weight	g				6	195	393	0	0
Other Resources & Waste							see note! debet credit			
11	Total Energy (GER)	MJ	41	12	53	5	185	1	-12	232
12	of which, electricity (in primary MJ)	MJ	2	7	9	0	185	0	0	194
13	Water (process)	ltr	1	0	2	0	0	0	0	1
14	Water (cooling)	ltr	8	3	12	0	8	0	-1	19
15	Waste, non-haz./landfill	g	12	38	51	5	95	1	-2	150
16	Waste, hazardous/incinerated	g	1	0	1	0	3	0	0	4
Emissions (Air)										
17	Greenhouse Gases in GWP100	kg CO2 eq.	2	1	3	0	8	0	-1	10
18	Acidification, emissions	g SO2 eq.	71	3	74	1	36	0	-26	84
19	Volatile Organic Compounds (VOC)	g	0	0	0	0	4	0	0	4
20	Persistent Organic Pollutants (POP)	ng i-Teq	1	0	1	0	0	0	0	1
21	Heavy Metals	mg Ni eq.	13	0	13	0	2	0	-5	11
22	PAHs	mg Ni eq.	1	0	1	0	0	0	0	1
23	Particulate Matter (PM, dust)	g	13	0	14	3	1	0	-4	14
Emissions (Water)										
24	Heavy Metals	mg Hg/20	23	0	23	0	1	0	-8	15
25	Eutrophication	g PO4	0	0	0	0	0	0	0	0

1
2
3
4
5
6

5.2.4 Base case 4: dedicated circuit in services sector

The environmental impacts related to the use of one BC4 circuit per year, calculated by means of the EcoReport tool, are shown in Table 5-12.

DRAFT

Table 5-12: Environmental impacts related to the use of one BC4 circuit per year

Life Cycle phases -->		PRODUCTION			DISTRI-	USE	END-OF-LIFE*			TOTAL
Resources Use and Emissions		Material	Manuf.	Total	BUTION		Disposal	Recycl.	Stock	
Materials		unit								
1	Bulk Plastics	g		220		2	122	100	0	0
2	TecPlastics	g		351		4	195	160	0	0
3	Ferro	g		0		0	0	0	0	0
4	Non-ferro	g		899		9	45	862	0	0
5	Coating	g		0		0	0	0	0	0
6	Electronics	g		0		0	0	0	0	0
7	Misc.	g		66		1	23	44	0	0
8	Extra	g		0		0	0	0	0	0
9	Auxiliaries	g		0		0	0	0	0	0
10	Refrigerant	g		0		0	0	0	0	0
	Total weight	g		1,536		15	385	1,166	0	0
							see note!			
Other Resources & Waste						debet credit				
11	Total Energy (GER)	MJ	126	23	149	6	17,802	1	-42	17,917
12	of which, electricity (in primary MJ)	MJ	3	14	17	0	17,801	0	0	17,818
13	Water (process)	ltr	2	0	2	0	0	0	0	2
14	Water (cooling)	ltr	12	7	19	0	791	0	-1	809
15	Waste, non-haz./landfill	g	26	73	99	5	9,174	1	-5	9,274
16	Waste, hazardous/incinerated	g	1	0	1	0	281	0	0	282
Emissions (Air)										
17	Greenhouse Gases in GWP100	kg CO2 eq.	6	1	8	0	760	0	-2	766
18	Acidification, emissions	g SO2 eq.	266	6	272	1	3,365	0	-100	3,539
19	Volatile Organic Compounds (VOC)	g	1	0	1	0	398	0	0	398
20	Persistent Organic Pollutants (POP)	ng i-Teq	3	0	3	0	42	0	-1	44
21	Heavy Metals	mg Ni eq.	50	0	50	0	180	0	-19	212
22	PAHs	mg Ni eq.	5	0	5	0	42	0	-2	45
23	Particulate Matter (PM, dust)	g	20	1	21	6	71	1	-6	93
Emissions (Water)										
24	Heavy Metals	mg Hg/20	85	0	85	0	77	0	-32	131
25	Eutrophication	g PO4	0	0	0	0	3	0	0	4

1 **5.2.5 Base case 5: distribution circuit in industry sector**

2 The environmental impacts related to the use of one BC5 circuit per year, calculated by
3 means of the EcoReport tool, are shown in Table 5-13.

DRAFT

Table 5-13: Environmental impacts related to the use of one BC5 circuit per year

Life Cycle phases -->		PRODUCTION			DISTRI-	USE	END-OF-LIFE*			TOTAL
Resources Use and Emissions		Material	Manuf.	Total	BUTION		Disposal	Recycl.	Stock	
Materials		unit								
1	Bulk Plastics	g		11,327		113	6,292	5,148	0	0
2	TecPlastics	g		28,233		282	15,684	12,832	0	0
3	Ferro	g		0		0	0	0	0	0
4	Non-ferro	g		140,818		1,408	7,111	#####	0	0
5	Coating	g		0		0	0	0	0	0
6	Electronics	g		0		0	0	0	0	0
7	Misc.	g		2,706		27	929	1,804	0	0
8	Extra	g		0		0	0	0	0	0
9	Auxiliaries	g		0		0	0	0	0	0
10	Refrigerant	g		0		0	0	0	0	0
	Total weight	g		183,084		1,831	30,016	#####	0	0
							see note!			
Other Resources & Waste										
						debet		credit		
11	Total Energy (GER)	MJ	17,595	1,616	19,211	253	287,188	98	-6,380	300,370
12	of which, electricity (in primary MJ)	MJ	139	973	1,112	1	287,013	0	-11	288,115
13	Water (process)	ltr	97	15	111	0	1	0	-11	101
14	Water (cooling)	ltr	602	459	1,061	0	12,762	0	-47	13,775
15	Waste, non-haz./landfill	g	2,500	5,064	7,564	128	147,932	78	-728	154,974
16	Waste, hazardous/incinerated	g	91	0	91	3	4,529	0	-18	4,605
Emissions (Air)										
17	Greenhouse Gases in GWP100	kg CO2 eq.	915	90	1,005	16	12,261	0	-337	12,945
18	Acidification, emissions	g SO2 eq.	41,354	387	41,741	49	54,627	21	-15,658	80,781
19	Volatile Organic Compounds (VOC)	g	26	0	26	4	6,410	0	-7	6,434
20	Persistent Organic Pollutants (POP)	ng i-Teq	528	0	528	1	675	0	-201	1,004
21	Heavy Metals	mg Ni eq.	7,779	0	7,779	7	2,980	8	-2,953	7,821
22	PAHs	mg Ni eq.	777	0	777	9	677	0	-291	1,173
23	Particulate Matter (PM, dust)	g	1,124	60	1,183	708	1,159	24	-341	2,734
Emissions (Water)										
24	Heavy Metals	mg Hg/20	13,278	0	13,278	0	1,368	4	-5,040	9,611
25	Eutrophication	g PO4	24	1	25	0	54	1	-9	72

1

2

DRAFT

1
2
3
4
5

5.2.6 Base case 6: lighting circuit in industry sector

The environmental impacts related to the use of one BC6 circuit per year, calculated by means of the EcoReport tool, are shown in Table 5-14.

Table 5-14: Environmental impacts related to the use of one BC6 circuit per year

Life Cycle phases --> Resources Use and Emissions		PRODUCTION			DISTRIBUTION	USE	END-OF-LIFE*			TOTAL
		Material	Manuf.	Total			Disposal	Recycl.	Stock	
Materials		unit								
1	Bulk Plastics	g				2	92	75	0	0
2	TecPlastics	g				2	92	75	0	0
3	Ferro	g				0	0	0	0	0
4	Non-ferro	g				2	9	173	0	0
5	Coating	g				0	0	0	0	0
6	Electronics	g				0	0	0	0	0
7	Misc.	g				1	18	36	0	0
8	Extra	g				0	0	0	0	0
9	Auxiliaries	g				0	0	0	0	0
10	Refrigerant	g				0	0	0	0	0
	Total weight	g				6	211	358	0	0
Other Resources & Waste							see note! debet credit			
11	Total Energy (GER)	MJ	36	13	49	6	537	1	-10	583
12	of which, electricity (in primary MJ)	MJ	2	8	10	0	537	0	0	546
13	Water (process)	ltr	2	0	2	0	0	0	0	2
14	Water (cooling)	ltr	9	4	13	0	24	0	-1	36
15	Waste, non-haz./landfill	g	13	42	55	5	277	1	-2	336
16	Waste, hazardous/incinerated	g	1	0	1	0	8	0	0	9
Emissions (Air)										
17	Greenhouse Gases in GWP100	kg CO2 eq.	2	1	2	0	23	0	0	25
18	Acidification, emissions	g SO2 eq.	55	3	59	1	102	0	-20	141
19	Volatile Organic Compounds (VOC)	g	0	0	0	0	12	0	0	12
20	Persistent Organic Pollutants (POP)	ng i-Teq	1	0	1	0	1	0	0	2
21	Heavy Metals	mg Ni eq.	10	0	10	0	6	0	-4	12
22	PAHs	mg Ni eq.	1	0	1	0	1	0	0	2
23	Particulate Matter (PM, dust)	g	15	0	15	3	2	0	-4	17
Emissions (Water)										
24	Heavy Metals	mg Hg/20	17	0	17	0	2	0	-7	13
25	Eutrophication	g PO4	0	0	0	0	0	0	0	0

1

2
3

1 **5.2.7 Base case 7: socket-outlet circuit in industry sector**

2 The environmental impacts related to the use of one BC7 circuit per year, calculated by
3 means of the EcoReport tool, are shown in Table 5-15.
4

Table 5-15: Environmental impacts related to the use of one BC7 circuit per year

Life Cycle phases -->		PRODUCTION			DISTRI-	USE	END-OF-LIFE*			TOTAL	
Resources Use and Emissions		Material	Manuf.	Total	BUTION		Disposal	Recycl.	Stock		
Materials		unit									
1	Bulk Plastics	g					2	112	91	0	0
2	TecPlastics	g					2	116	95	0	0
3	Ferro	g					0	0	0	0	0
4	Non-ferro	g					3	16	307	0	0
5	Coating	g					0	0	0	0	0
6	Electronics	g					0	0	0	0	0
7	Misc.	g					1	22	43	0	0
8	Extra	g					0	0	0	0	0
9	Auxiliaries	g					0	0	0	0	0
10	Refrigerant	g					0	0	0	0	0
	Total weight	g					8	266	536	0	0
							see note!				
Other Resources & Waste							debet	credit			
11	Total Energy (GER)	MJ	55	17	72	6	670	1	-16		733
12	of which, electricity (in primary MJ)	MJ	2	10	12	0	670	0	0		682
13	Water (process)	ltr	2	0	2	0	0	0	0		2
14	Water (cooling)	ltr	11	5	16	0	30	0	-1		45
15	Waste, non-haz./landfill	g	17	52	69	5	345	1	-3		418
16	Waste, hazardous/incinerated	g	1	0	1	0	11	0	0		12
Emissions (Air)											
17	Greenhouse Gases in GWP100	kg CO2 eq.	3	1	3	0	29	0	-1		32
18	Acidification, emissions	g SO2 eq.	97	4	101	1	127	0	-36		194
19	Volatile Organic Compounds (VOC)	g	1	0	1	0	15	0	0		15
20	Persistent Organic Pollutants (POP)	ng i-Teq	1	0	1	0	2	0	0		2
21	Heavy Metals	mg Ni eq.	18	0	18	0	7	0	-7		19
22	PAHs	mg Ni eq.	2	0	2	0	2	0	-1		3
23	Particulate Matter (PM, dust)	g	18	1	18	4	3	1	-5		21
Emissions (Water)											
24	Heavy Metals	mg Hg/20	31	0	31	0	3	0	-12		22
25	Eutrophication	g PO4	0	0	0	0	0	0	0		0

1

2

1 **5.2.8 Base case 8: dedicated circuit in industry sector**

2 The environmental impacts related to the use of one BC8 circuit per year, calculated by
3 means of the EcoReport tool, are shown in Table 5-16.

DRAFT

Table 5-16: Environmental impacts related to the use of one BC8 circuit per year

Life Cycle phases -->		PRODUCTION			DISTRI- BUTION	USE	END-OF-LIFE*			TOTAL
		Material	Manuf.	Total			Disposal	Recycl.	Stock	
Resources Use and Emissions										
Materials		unit								
1	Bulk Plastics	g			331	3	184	150	0	0
2	TecPlastics	g			1,393	14	774	633	0	0
3	Ferro	g			0	0	0	0	0	0
4	Non-ferro	g			4,885	49	247	4,687	0	0
5	Coating	g			0	0	0	0	0	0
6	Electronics	g			0	0	0	0	0	0
7	Misc.	g			165	2	57	110	0	0
8	Extra	g			0	0	0	0	0	0
9	Auxiliaries	g			0	0	0	0	0	0
10	Refrigerant	g			0	0	0	0	0	0
	Total weight	g			6,774	68	1,261	5,581	0	0
Other Resources & Waste							see note! debet credit			
11	Total Energy (GER)	MJ	610	70	681	13	77,251	3	-222	77,726
12	of which, electricity (in primary MJ)	MJ	4	42	46	0	77,245	0	0	77,291
13	Water (process)	ltr	5	1	5	0	0	0	-1	5
14	Water (cooling)	ltr	20	20	40	0	3,433	0	-2	3,472
15	Waste, non-haz./landfill	g	90	221	310	9	39,808	3	-26	40,104
16	Waste, hazardous/incinerated	g	3	0	3	0	1,219	0	-1	1,221
Emissions (Air)										
17	Greenhouse Gases in GWP100	kg CO2 eq.	32	4	36	1	3,298	0	-12	3,323
18	Acidification, emissions	g SO2 eq.	1,437	17	1,454	3	14,605	1	-543	15,519
19	Volatile Organic Compounds (VOC)	g	1	0	1	0	1,725	0	0	1,726
20	Persistent Organic Pollutants (POP)	ng i-Teq	18	0	18	0	180	0	-7	192
21	Heavy Metals	mg Ni eq.	271	0	271	0	784	0	-103	952
22	PAHs	mg Ni eq.	27	0	27	0	181	0	-10	198
23	Particulate Matter (PM, dust)	g	58	3	60	25	310	1	-17	379
Emissions (Water)										
24	Heavy Metals	mg Hg/20	461	0	461	0	337	0	-175	624
25	Eutrophication	g PO4	1	0	1	0	15	0	0	15

DRAFT

1 **5.2.9 Base case 9: aluminium based dedicated circuit in industry sector**

2 The environmental impacts related to the use of one BC9 circuit per year, calculated by
3 means of the EcoReport tool, are shown in Table 5-17.

Table 5-17: Environmental impacts related to the use of one BC9 circuit per year

Life Cycle phases -->		PRODUCTION			DISTRI-	USE	END-OF-LIFE*			TOTAL	
Resources Use and Emissions		Material	Manuf.	Total	BUTION		Disposal	Recycl.	Stock		
Materials		unit									
1	Bulk Plastics	g		627		6	348	285	0	0	
2	TecPlastics	g		2,961		30	1,645	1,346	0	0	
3	Ferro	g		0		0	0	0	0	0	
4	Non-ferro	g		2,967		30	150	2,847	0	0	
5	Coating	g		0		0	0	0	0	0	
6	Electronics	g		0		0	0	0	0	0	
7	Misc.	g		313		3	108	209	0	0	
8	Extra	g		0		0	0	0	0	0	
9	Auxiliaries	g		0		0	0	0	0	0	
10	Refrigerant	g		0		0	0	0	0	0	
	Total weight	g		6,869		69	2,251	4,687	0	0	
Other Resources & Waste		see note!									
									debet	credit	
11	Total Energy (GER)	MJ	652	147	799	23	61,294	5	-229	61,891	
12	of which, electricity (in primary MJ)	MJ	7	88	95	0	61,288	0	-1	61,382	
13	Water (process)	ltr	9	1	10	0	0	0	-1	9	
14	Water (cooling)	ltr	39	42	81	0	2,724	0	-3	2,802	
15	Waste, non-haz./landfill	g	1,127	459	1,587	14	31,595	16	-412	32,799	
16	Waste, hazardous/incinerated	g	3	0	3	0	967	0	0	970	
Emissions (Air)											
17	Greenhouse Gases in GWP100	kg CO2 eq.	34	8	42	2	2,616	0	-12	2,648	
18	Acidification, emissions	g SO2 eq.	219	35	254	5	11,579	0	-78	11,759	
19	Volatile Organic Compounds (VOC)	g	3	0	3	0	1,369	0	-1	1,371	
20	Persistent Organic Pollutants (POP)	ng i-Teq	15	0	15	0	143	0	-6	153	
21	Heavy Metals	mg Ni eq.	14	0	14	1	620	0	-5	629	
22	PAHs	mg Ni eq.	288	0	288	1	146	0	-109	326	
23	Particulate Matter (PM, dust)	g	133	5	139	53	246	3	-41	400	
Emissions (Water)											
24	Heavy Metals	mg Hg/20	107	0	107	0	265	0	-40	332	
25	Eutrophication	g PO4	0	0	0	0	12	0	0	12	

1

2

1 5.3 Base case Life Cycle Cost for consumer

2 This section includes a calculation of the LCC for consumers using the new LCC
3 equations available in the MEERP methodology including the escalation rate.

4
5 LCC have been calculated using the EcoReport tool based upon the economic input
6 parameters shown in Table 5-7. The results of this calculation are shown in Table 5-18
7 referred to the lifetime considered for each of the base cases. Product price, installation
8 costs and energy (electricity) costs during the whole life cycle have been considered.
9

10 **Table 5-18: Life Cycle Costs for consumer per base case**

Base case id	Unit	Life Cycle Costs per base case								
		BC1	BC2	BC3	BC4	BC5	BC6	BC7	BC8	BC9
Sector		Services sector	Services sector	Services sector	Services sector	Industry sector	Industry sector	Industry sector	Industry sector	Industry sector
Application circuit		Distribution circuit	Lighting circuit	Socket-outlet circuit	Dedicated circuit	Distribution circuit	Lighting circuit	Socket-outlet circuit	Dedicated circuit	Dedicated circuit
Product price	€	6727.15	66.41	87.11	254.01	38235.44	88.70	102.97	1339.24	1586.41
Installation/ acquisition costs (if any)	€	693.23	78.65	98.45	137.78	3572.78	107.30	113.40	334.55	391.53
Electricity	€	22968.99	83.72	59.43	5725.54	92313.73	172.57	215.40	24845.00	19712.35
Total	€	30389.36	228.78	244.99	6117.33	134121.95	368.57	431.77	26518.79	21690.29
Product price	%	22%	29%	36%	4%	29%	24%	24%	5%	7%
Installation/ acquisition costs (if any)	%	2%	34%	40%	2%	3%	29%	26%	1%	2%
Electricity	%	76%	37%	24%	94%	69%	47%	50%	94%	91%
Total	%	100%	100%	100%	100%	100%	100%	100%	100%	100%

11
12

13 5.4 Base case Life Cycle Costs for society

14 This section includes a calculation of the LCC for society as described in the MEERP
15 methodology, following the extended LCC equations with CO₂ stock price, societal
16 damage of certain emissions, etc.

17
18 LCC for society have been calculated using the EcoReport tool. The results of this
19 calculation are shown in Table 5-19 referred to the lifetime considered for each of the
20 base cases.

1

Table 5-19: Life Cycle Costs for society per base case

	Unit	Life Cycle Costs per base case								
Base case id		BC1	BC2	BC3	BC4	BC5	BC6	BC7	BC8	BC9
Sector		sector	sector	sector	sector	sector	sector	sector	sector	sector
Application circuit		Distribution circuit	Lighting circuit	Socket-outlet circuit	Dedicated circuit	Distribution circuit	Lighting circuit	Socket-outlet circuit	Dedicated circuit	Dedicated circuit
Product price	€	6727.15	66.41	87.11	254.01	38235.44	88.70	102.97	1339.24	1586.41
Installation/ acquisition costs (if any)	€	693.23	78.65	98.45	137.78	3572.78	107.30	113.40	334.55	391.53
Electricity	€	22968.99	83.72	59.43	5725.54	92313.73	172.57	215.40	24845.00	19712.35
External damages total, of which	€	6448.68	32.62	41.64	1115.20	30155.54	57.97	80.57	4906.73	3702.13
- production PPext	€	6448.68	32.62	41.64	1115.20	30155.54	57.97	80.57	4906.73	3702.13
- lifetime operating expense N*OEext	€	4101.38	15.01	10.78	1018.93	16513.54	30.87	38.59	4421.96	3506.93
- end-of-life OEExt	€	618.55	4.00	7.35	24.60	3613.25	6.20	10.03	127.57	41.35
Total	€	36838.04	261.40	286.63	7232.53	164277.49	426.54	512.34	31425.52	25392.42
Product price	%	18%	25%	30%	4%	23%	21%	20%	4%	6%
Installation/ acquisition costs (if any)	%	2%	30%	34%	2%	2%	25%	22%	1%	2%
Electricity	%	62%	32%	21%	79%	56%	40%	42%	79%	78%
which	%	18%	12%	15%	15%	18%	14%	16%	16%	15%
Total	%	100%	100%	100%	100%	100%	100%	100%	100%	100%

2
3

4 5.5 EU totals

5 Following the MEErP 2011 methodology, EU Totals have been calculated using the
6 EcoReport tool in which environmental impacts and LCC outcomes have been
7 aggregated according to stock and market data estimated in Task 2.

8 As explained in section 5.6, three reference parameters had to be corrected to fit EU-28
9 stock and EU-28 electricity consumption. These correction factors are applied in
10 sections 5.5 and 5.6.

5.5.1 Stock specific inputs

Table 5-20 shows the stock input parameters per BC. The nine base cases are assumed to represent the installed stock in the EU-28.

Table 5-20: Stock input parameters per base case

Base case id	Unit		Bases cases definiton								
			BC1	BC2	BC3	BC4	BC5	BC6	BC7	BC8	BC9
Sector			Services sector	Services sector	Services sector	Services sector	Industry sector	Industry sector	Industry sector	Industry sector	Industry sector
Application circuit			Distribution circuit	Lighting circuit	Socket-outlet circuit	Dedicated circuit	Distribution circuit	Lighting circuit	Socket-outlet circuit	Dedicated circuit	Dedicated circuit
Stock and sales data (fixed total stock)											
Year			2010	2010	2010	2010	2010	2010	2010	2010	2010
EU Stock per base case cable (Conductor weight)	kg	I	1.94E+09	2.07E+08	5.53E+08	5.53E+08	2.50E+09	2.00E+08	4.00E+08	7.25E+08	4.40E+08
EU Stock (units of 1 cable)	m	C	3.63E+08	3.11E+09	4.98E+09	1.24E+09	2.34E+08	3.00E+09	3.60E+09	4.66E+08	4.66E+08
EU Stock (base case units)	mln. Units	C	1.75	38.82	51.26	13.38	0.39	24.15	27.17	3.23	3.23
Annual sales (base case units)	mln. Units	C	0.07	1.55	2.05	0.54	0.02	0.97	1.09	0.13	0.13
BC weightfactor of total stock		I	14.00%	1.50%	4.00%	4.00%	50.00%	4.00%	8.00%	14.50%	

4
5

5.5.2 Environmental impact at EU-28

The total annual impacts from the EU stock of products are presented in Table 5-21.

Table 5-21: EU-28 total annual environmental impacts from the installed stock

Base case id	Unit	Environmental									Total (BC1-BC8)
		BC1	BC2	BC3	BC4	BC5	BC6	BC7	BC8	BC9	
Sector		Services sector	Services sector	Services sector	Services sector	Industry sector	Industry sector	Industry sector	Industry sector	Industry sector	
Application circuit		Distribution circuit	Lighting circuit	Socket-outlet circuit	Dedicated circuit	Distribution circuit	Lighting circuit	Socket-outlet circuit	Dedicated circuit	Dedicated circuit	
Materials											
Plastics	Mt	0.028	0.015	0.029	0.014	0.028	0.015	0.021	0.010	0.022	0.16
Ferrous metals	Mt	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00
Non-ferrous metals	Mt	0.078	0.008	0.022	0.022	0.101	0.008	0.016	0.029	0.018	0.29
Other resources & waste											
Total Energy (GER)	PJ	71.80	7.41	9.94	119.13	67.59	8.64	12.64	124.82	100.65	421.96
of which, electricity	TWh	6.82	0.60	0.61	12.86	6.05	0.75	1.05	13.44	10.70	42.16
Water (process)*	mln.m3	0.07	0.08	0.15	0.06	0.08	0.08	0.11	0.03	0.06	0.67
Waste, non-haz./ landfill*	Mt	0.04	0.01	0.01	0.06	0.03	0.01	0.01	0.06	0.06	0.22
Waste, hazardous/ incinerated*	kton	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
Emissions (Air)											
Greenhouse Gases in GWP100	mt CO2eq.	3.17	0.33	0.46	5.12	3.02	0.38	0.57	5.37	4.35	18.43
Acidifying agents (AP)	kt SO2eq.	34.76	3.70	7.98	28.57	40.12	3.85	6.80	31.53	19.63	157.29
Volatile Org. Compounds (VOC)	kt	1.37	0.13	0.14	2.59	1.22	0.16	0.23	2.70	2.16	8.55
Persistent Org. Pollutants (POP)	g i-Teq.	0.44	0.04	0.10	0.35	0.50	0.05	0.08	0.39	0.31	1.95
Heavy Metals (HM)	ton Ni eq.	4.94	0.54	1.33	2.42	6.13	0.54	1.02	2.85	1.05	19.76
PAHs	ton Ni eq.	0.58	0.07	0.15	0.40	0.69	0.07	0.12	0.45	1.96	2.53
Particulate Matter (PM, dust)	kt	1.39	0.88	1.59	1.13	1.57	0.85	1.17	0.99	1.53	9.56
Emissions (Water)											
Heavy Metals (HM)	ton Hg/20	7.64	0.84	2.17	2.62	9.76	0.81	1.59	3.29	1.05	28.72
Eutrophication (EP)	kt PO4	0.03	0.00	0.01	0.03	0.03	0.01	0.01	0.03	0.02	0.14

Note: the total electricity consumption in TWh in the above table includes the electricity consumption during all phases of the life cycle, and must be higher than the energy losses values (energy consumption in use phase) listed in section 5.6.

5.5.3 Economic assessment at EU-28

Table 5-22 shows the total annual expenditure in Europe, due to the stock of products currently installed in the EU-28.

Table 5-22: Total annual expenditure in the EU-28 per base case

	Unit	Total annual expenditure in the EU-28 per base case									Total (BC1-BC8)
Base case id	0	BC1	BC2	BC3	BC4	BC5	BC6	BC7	BC8	BC9	
Sector	0	Services sector	Services sector	Services sector	Services sector	Industry sector	Industry sector	Industry sector	Industry sector	Industry sector	
Application circuit	0	Distribution circuit	Lighting circuit	Socket-outlet circuit	Dedicated circuit	Distribution circuit	Lighting circuit	Socket-outlet circuit	Dedicated circuit	Dedicated circuit	
Product price	mIn. €	847.05	143.33	285.81	243.13	1074.73	124.44	189.43	313.33	364.64	3221.25
Installation/ acquisition costs (if any)	mIn. €	85.28	177.12	314.98	127.14	96.57	156.67	205.04	76.12	88.51	1238.92
Electricity	mIn. €	741.11	59.81	56.06	1409.45	655.56	76.69	107.69	1474.92	1170.22	4581.27
Total	mIn. €	1673.44	380.25	656.85	1779.73	1826.85	357.80	502.15	1864.36	1623.37	9041.43
Product price	%	26%	4%	9%	8%	33%	4%	6%	10%	11%	100%
Installation/ acquisition costs (if any)	%	7%	14%	25%	10%	8%	13%	17%	6%	7%	100%
Electricity	%	16%	1%	1%	31%	14%	2%	2%	32%	26%	100%
Total	%	19%	4%	7%	20%	20%	4%	6%	21%	18%	100%

7
8
9
10

1 **5.6 Cross-checks on EU-28 impact**

2 To verify the outcomes of the calculation some cross-checks were added.

3

4 There are two possible cross-checking methods with different starting assumptions for
5 the calculation:

6 1. Fixed total stock/annual sales (figures in Task 2) -> EU-28 annual transported
7 active energy is calculated

8 2. Fixed EU-28 energy consumption -> total stock/annual sales is calculated

9

10 In case of the first method, the amount of energy transported per BC multiplied by the
11 number of BC units must be lower than the amount of electricity consumed in the EU-
12 28 services and industry sector. The results of the first method (comparison between
13 the amounts of energy transported with the total electricity consumption in Europe) are
14 shown in Table 5-23.

15

16

17 In case of the second method the calculated annual replacement sales multiplied by the
18 product life (= stock) should be about the same as the stock/annual sales figures
19 mentioned in Task 2.

20 Table 5-24 shows the results when using the second method (fixed energy
21 consumption).

22

23 In both methods the losses in the base cases are calculated and should be equal.

1

Table 5-23: EU-28 totals check: first method

Base case id	Unit	T	Base cases								Total over all BC
			BC1	BC2	BC3	BC4	BC5	BC6	BC7	BC8	
Sector			Services	Services	Services	Services	Industry	Industry	Industry	Industry	
Application circuit			Distribution	Lighting	Socket-	Dedicated	Distribution	Lighting	Socket-	Dedicated	
Method 1: fixed stock	kg	I									7.08E+09
Energy distribution factor	%	I	100%	20%	20%	60%	100%	10%	15%	75%	
EU Stock (base case units)	mln. Units	I	1.75	38.82	51.26	13.38	0.39	24.15	27.17	3.23	
Number of buildings per sector (Task 2 Table 2-9)	mln Units	I	11.41	11.41	11.41	11.41	2.58	2.58	2.58	2.58	
Annual energy loss (formula 3.5) per BC	kWh	I	3842.09	14.00	9.94	957.73	15441.57	28.87	36.03	4155.89	
Annual energy transported (formula 3.6) per BC	kVAh	I	691,772	3,117	2,394	74,365	2,560,615	3,625	3,712	232,577	
Checks											
Annual energy loss Eu-28 (=BC loss * #BC units)	TWh	C	6.74	0.54	0.51	12.81	5.96	0.70	0.98	13.41	34.91
Annual energy transported Eu-28 (=BC annual energy transport * #BC units)	TWh	C	1,213	121	123	995	988	88	101	750	
Annual energy transported Eu-28 corrected with energy distribution factor	TWh	C	1,213	605	614	1,658	988	875	672	1,000	
Number of BC units (circuits) per building		C	0.2	3.4	4.5	1.2	0.1	9.4	10.5	1.3	

2
3

1
2

Table 5-24: EU-28 totals check: second method

Base case id	Unit		Base cases								Total over all BC
			BC1	BC2	BC3	BC4	BC5	BC6	BC7	BC8	
Sector			Services	Services	Services	Services	Industry	Industry	Industry	Industry	
Application circuit			Distribution	Lighting	Socket-	Dedicated	Distribution	Lighting	Socket-	Dedicated	
Method 2: fixed EU-28 energy consumption	TWh	I	904				1030				1934
Energy distribution factor	%	I	100%	20%	20%	60%	100%	10%	15%	75%	
Number of buildings per sector (Task 2 Table 2-9)	mln Units	I	11.41	11.41	11.41	11.41	2.58	2.58	2.58	2.58	
Annual energy transported (formula 3.6) per BC	kVAh	I	691,772	3,117	2,394	74,365	2,560,615	3,625	3,712	232,577	
EU28 energy consumption (distributed via energy distribution factor)	TWh	C	904.12	180.82	180.82	542.47	1029.62	102.96	154.44	772.21	1933.74
Checks											
Annual energy loss Eu-28 (=BC loss * #BC units)	TWh	C	5.02	0.81	0.75	6.99	6.21	0.82	1.50	13.80	35.90
BC stock (= EU-28 energy consumption / energy transported per BC)	mln Units	C	1.31	58.02	75.54	7.29	0.40	28.41	41.61	3.32	215.90
BC stock (weight)	kTon	C	1443.07	310.02	815.24	301.62	2604.63	235.22	612.56	746.10	7068.48

3
4

1
2 NOTE: The EU-28 totals mentioned in the previous sections are based upon a fixed Cu
3 stock for the reference year.
4

5 The cross-checks at EU level indicated that the outcome for the losses were too high.
6 The bases cases as such, although abstract cases, are not representative for the
7 average total stock and losses in Europe. Therefore corrections factors on those
8 'median' parameters were calculated that fit with total EU energy consumption. With
9 the fitted parameters the total energy transported by the base cases equals the energy
10 consumed at EU level, and the stock equals the stock figures in Task 3. To accomplish
11 this, the following three reference parameters are corrected:

- 12 • The reference circuit length (Task 3) is multiplied by 1.84;
- 13 • The reference load factor (Task 3) is multiplied by 0.5;
- 14 • The weight distribution towards the circuits (Task 2) is altered (see Table 5-20).

15
16 This also indicates that potentially a lot of circuits in the stock have a relative lower
17 loading and/or longer circuit length and/or higher share of bases case with lower
18 loading. This is also something to take into account in the sensitivity analysis (Task 6).
19

20
21
22