23/07/2014

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

2nd stakeholder meeting

Paul Van Tichelen

Brussels, DG Enterprise

3rd of June 2014

Agenda

- » 10:00-10:10 Welcome
- » 10:10-10:20 Short presentation of participants
- » 10:20:-10:30 Short overview MEErP
- » 10:30-13:00 Presentation of draft Task reports 1-5, including: updates, questions & answers, discussion
- » 13:00-14:00 Break &lunch
- » 14:00-14:30 Data gaps identified to complete the study
- » 14:30-15:15 Discussion on approach to fill data gaps and the potential launch of a new enquiry
- » 15:15-15:30 Any other business
- » 15:30 -15:45 Planning and Closure

EC policy officer & VITO Study Team

- EC policy officer: Cesar Santos
- VITO Preparotory Study Team:
  - Arnoud Lust: Contract Manager: Arnoud Lust (FC ENTR/29/PP/FC Lot 2) and FC DG ENER Lot 1
  - Main author power cables study&coordinator: Paul Van Tichelen
  - Co-authors:
    - Dominic Ectors (market and use data, ..)
    - Marcel Stevens (technical standards, ..)
    - Wai Chung Lam (LCA, MEErP and scenarios, ..)
  - Administrative contacts:
    - Magalie Wellens +32 14 33 58 04
    - Katrien Bultynck +32 14 33 59 96
  - Website: Karel Styns (webmaster).

Introduction ErP Directive

- Background is the Ecodesign Directive 2009/125/EC:
  - Framework Directive
  - binding requirements through 'Implementing Measures' (EC Regulation ..)
  - For products but it is possible to introduce information requirements for components and sub-assemblies
  - Product groups are first identified in a Working Plan, such as power cables in the 2nd working plan year 2012-2014
  - **A preparatory study provides the necessary information to prepare for the next phases in the policy process, a.o.: impact assessment, the consultation forum, ..)**
  - Approach of preparatory study is well defined in the Methodology for the Ecodesign of Energy-related Products (MEErP)
  - Further info: http://ec.europa.eu/enterprise/policies/sustainable-business/ecodesign/index_en.htm

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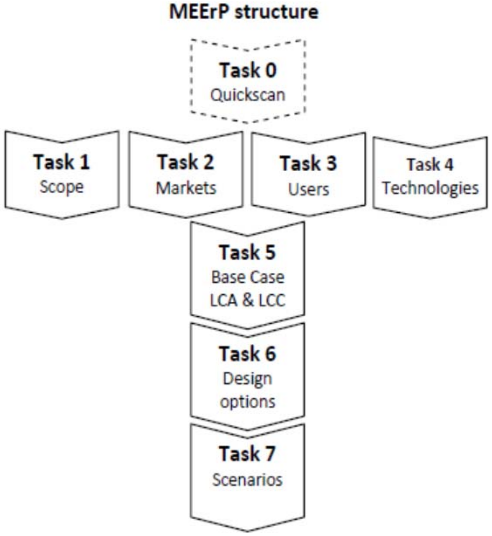
MEErP in a nutshell

- Tasks in MEErP (chapters in final report):
- Task 1 - Scope (definitions, standards and legislation, first screening);
- Task 2 – Markets (volumes and prices);
- Task 3 – Users (product demand side);
- Task 4 - Technologies (product supply side, includes both BAT and BNAT);
- Task 5 – Environment & Economics (Base case LCA & LCC);
- Task 6 – Design options;
- Task 7 – Scenarios (Policy, scenario, impact and sensitivit
- Tasks 1 to 4 can be performed in parallel



Task 1 Scope

- **Identify relevant** Prodcom/ EN&ISO/ Labelling **categories > Stakeholder input!**
  - Define preliminary product scope, definition, primary ("functional unit“)
  - Define secondary performance parameters:
- Test **standards**, also **under development**
- Legislation
- First screening

Task 2 Market Data

- Generic economic data (.. Eurostat?)
- Market and Stock data
- Market trends
- Consumer expenditure base data
- Recommendations (.. Scope, barriers&opportunities)

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Task 3 Users

- **System aspects:**
  - **use phase energy consumption .. Cable losses**
- **End of Life behaviour**
- **Local infrastructure (barriers & opportunities)**
- Recommendations

Task 4 Technologies

- Technical product description
  - Existing products.. **Working towards 'Base Cases'** (=conscious abstraction of reality' ..has to fit with previous tasks & workable model)
  - Improvement options: **BAT&BNAT**
- **Production, distribution and end&of&life** > BOM > Ecoreport format&tool
- Recommendations

Task 5-7

- **Task 5: Environment Economics**
  - Base Case Environmental Impact Assessment(EcoReport Tool)
  - Base Case Life Cycle Costs for consumer
  - Base Case Life Cycle Costs for society
  - EU wide impact
- **Task 6: Design options**
  - .. Identify LLCC & BAT > target levels & benchmark values
  - .. Long term potential& system analysis
- Task 7: Scenarios
  - Policy analysis

Task 7 Scenarios

- Task 7: Scenarios
  - Policy analysis
  - Scenario analysis unit stock/sale & environmental
  - Impact analysis (socio) economic
  - Sensitivity Analysis
  - Summary

Note: MEErP 2011 is not an automatic law making procedure; the preparatory study is an analytical document at the responsibility of the contractor. Political and legislative choices, at the responsibility of the Commission, are indispensable in the follow up.

Planning (preliminary)

- 28 Jun 2013 ■Project kick-off meeting with EC
- July 2013 ■Launch website www.erp4cables.net
- Aug 2013 ■ Launch first series of enquiries to registered stakeholders
- 5 dec 2013■ 1st stakeholder meeting on Draft Task 1-3
- **3 June 2014 ■ 2nd stakeholder meeting on Draft Task 1-5**
- Early Nov 2014 ■ 3rd stakeholder meeting on Draft Task 1-7
- End Feb 2015 ■ Publication Final Report Task 1-7

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

Stakeholder meeting: Task 1

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3rd of June2014

Task 1: Content

- “Product scope” of the study
- Product categories based on
  - Prodcom
  - EN- or ISO-standards
  - Other product-specific categories
- Definitions & Terminolgy
- Primary & secondary product performance parameters
- Product Standards & Legislation
  - EU level
  - Member state level
- First screening

Task 1: Product scope

- Focus: “Installed power cables & wires **in** buildings”
  - Fixed wired; LV (≤ 1000Vac)
- Excluded:
  - …
  - Residential from Tasks 3-6
- **SCOPE proposal: Losses in installed power cables in buildings after the meter taking into account the installation as a system(circuit breaker, load ..)**

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Task 1: Product scope

- **Electric circuit**
- **Product categories**
  - Prodcom – NACE 27321380:

    "Other electric conductors, for a voltage < 1000V, not fitted with connectors" = Too broad: cords, flexible wires,… also included
  - **EN-, IEC-standards:**
    - **IEC 60228: "conductors of insulated cables"**
    - **Class-1(solid), -2(stranded),-5(flexible),-6(very flexible)**
    - **IEC 60227-1: PVC cables – 5 categories**
    - **IEC 60245-1: Rubber insulated cables – 5 categories**
    - **….**
  - **Other possibilities**: categories according to
    - **Field of application**, composition of the cable…

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Task 1: Product performance parameter

- Primary product performance paramater or “Functional unit”:
  - **“Current-Carrying capacity” of the cable/conductor [Amperes]**
    - **Rated current of the circuit ?**
  - *“the maximum value of electric current which can be carried continuously by a conductor (a cable), under specified conditions without its steady-state temperature exceeding a specified value (see IEV 826-11-13)”*
- Secondary product performance parameters
  - Construction of the cable (see Task 2)
    - **‘Nominal’ CSA**, DC resistance, Rated voltage, insulation material, conductor material, number of cores, construction of the conductor, maximum diameter….
  - Use of the cable (see Task 3)
    - Electrical installation: Supply param., installation method, Tamb…
    - Circuit level: dV, I load, I max, LF, Kf, PF, Kd…..

Task 1: Measurement & test standards

- Conductors & cables
  - EN13601 & -13602: Copper and copper alloys
  - **EN 60228**: Conductors of insulated cables
    - Class1,2,5,6; Links **'Nominal CSA with Rdc max',** …
  - EN 50525-1: Low voltage energy cables
  - EN 50395: Electrical test methods for low voltage energy cables

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Task 1: Measurement & test standards

- Electrical installation:
  - **(IEC)HD 60364-5-52**: LV electrical installations – … wiring systems
    - Correction factors, methods of installation, **dV max**, ….
  - IEC 60287-1-1: Calculation of current rating & losses -100% load factor
  - **IEC 60287-3-2**: Calculation of current rating – **Economic optimization single cable segment – not for distributed loads**
  - IEC 60364-6: Low Voltage electrical installations – verification
  - **IEC 60364-8-1 / FprHD 60364-8-1: 2013: Low voltage electrical installation - Part 8-1: Energy efficiency – DRAFT version:**
    - **Reduction of energy losses in wiring:**
      - **Reducing the voltage drop. Reference to IEC 60364-5-52;**
      - **Increasing the cross sectional area. Reference to IEC 60287-3-2;**
      - **Power factor correction to improve the power factor of the load circuit;**
      - **Reduction of harmonic currents at the load level.**
    - **Qualitative but not quantitative ?**

Legislation

- EU Directives applicable on LV cables
- Member state level
  - National wiring regulation rules
  - Overview of national wiring regulations available ?
- Third country legislation ??
- Voluntary initiatives: e.g. ELEKTRO+ (Ge), ACI (UK),..

Insulation materials (I)

- Most used insulation materials voor electric cables & wires:

Type	Name	Tmax oper.
PVC	Polyvinyl Chloride	70°C
XLPE	Cross-Linked PolyEthylene	90°C
EPR	Ethylene Propylene Rubber	90°C

- Low Smoke Halogen free insulation materials
  - Based on Thermoplastic Elastomeren (TPE) compounds (e.g. PE, PP)
  - Compliant to:
    - IEC 60754-1: Amount of halogen acid gas
    - IEC 60754-2: Degree of acidity of gases
    - IEC 61034-2: Smoke density

Insulation materials (II)

- Flame retardant wires /cables:
  - Single wire: Compliant to IEC 60332-1/2
  - Bundled cables: Compliant to IEC 60332-3

- Fire resitant cable:
  - Compliant to IEC 60331-21 (Uo/U≤0,6/1 kV)

Task 1: First screening

- **Note: these values are updated in later chapters!**
- Focus in taks 3-6 on service and industry sector

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

Stakeholder meeting: Task 2

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Content

Sales data

- Prodcom sales data: 2200 kTon in 2010 (broad range, incl. data ..)
- ECI:
  - World demand for copper: 24200 kTon Cu
  - Estimate 48 % for Cables: 11000 kTon Cu
- Sales (from working plan) (2010):
  - Industry: 241 kTon Cu
  - Services: 216 kTon Cu
  - Residential: 284 kTon Cu
    - = Total: 760 kTon
- CRU report: 1073 kTon (all LV cables also distribution grid)

Stock data

- Working plan: 18788 kTon (equivalent to 25 years service life)
- Background data on floor area:
  - BPIE: 24000 M m² from which about 75 % residential (18000 M m²)
  - Ecofys (non-residential): 12356 M m²
  - 24000 Mm²/ 501 M habitants = 48 m² per habitant
  - note: figures are probably higher?
- Background data on energy consumption (see task 5):
  - Electric Energy demand Residential (2010): about 800 TWh
  - Electric Energy demand Industry (2010): 1080 TWh
  - Energy demand service&other (2010): about 887 TWh
- Stock per floor space area
  - Residential (ECI): 0,291 kg/m²
  - Non-residential: 0,54 kg/m² (service) – 1,39 kg/m² (industry) (working plan

Stock

- Working plan: 18788 kTon (related to sales & 25 years service life)
- Power cable stock = building stock floor area x kg cable/m^2
- Buildings (BPIE):
    - **24 billion m^2** of useful floor space (industry floor space excluded?)
    - The residential stock : 75% of the building stock: 18 billion
- Buildings (Ecofys study):
    - non-residential building stock: 12.3566 – 13.2906 billion m^2
    - industry building stock: 2.752 billion m^2
- **29 – 139 kg/100m^2 depending on sector** (based upon CuIoU survey)
- Results in:
    - Residential buildings: 5241 kTon versus 7515 kTon in working plan
    - Services buildings: 3250 kTon versus 4734 kTon in working plan
    - Industry buildings: 3825 kTon versus 6538 kTon in working plan

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Example of office building (Vito)

Table 2-14: Example of an real office building

Amount of Ligth circuits	**33**
Amount of Socket outlet circuits	62
Amount of Dedicated circuits	34
Amount of Main feeders	1
Amount of Sub feeders	11
Cu total (kg)	2851
Floorspace (m²)	3059
Cu (kg/100m²)	93

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Distribution of power cables based upon CSA residential buildings

Table 2-15: Distribution of LV cables in the residential buildings[1]

CSA (mm²)	% Weight	% Length
1.5	23.4	27.5
2.5	38.9	40
4	6,6	4.9
6	9,3	5.7
10	6.1	<1

The total length of 1.5 +2.5 mm² cables counts for 67.5% of the total length of the installed cables in the residential sector.

[1] Source: CuIoU survey European Copper Institute

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Distribution of power cables based upon CSA non-residential buildings

Table 2-16: Distribution of LV cables in non-residential buildings[1]

CSA (mm²)	% Weight	% Length
1.5	2	15
2.5	13	58.6
4	2	4.9
6	3	5.1
10	3	3.2
16	3	2.4
25	4	2
35	6	1.9
50	5	1.2
70	11	1.8
95	12	1.4
120	9	0.9
150	6	0.4
185	13	0.8
240	7	0.4
300	0	0
400	3	0.1
500	0	0
600	0	0

The total length of 1.5 +2.5 mm² cables counts for 73.6% of the total length of the installed cables in the non-residential sector.

[1] Source: CuIoU survey European Copper Institute

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Sales rate and stock data summary

Table 2-18: Summary of growth rates

Sector	Stock growth rate	Replacement sales rate	New sales rate	Total sales rate	Stock (Reference year: 2010)
Unit	**% p.a.**	**% p.a.**	**% p.a.**	**% p.a.**	**kTon Cu**
Residential sector	1.00%	0.59%	1.00%	1.59%	7515
Services sector	2.10%	7.08%	2.10%	9.18%	4734
Industry sector	3.10%	7.08%	3.10%	10.18%	6538
Total sector (weighted)	2.01%	4.48%	2.01%	6.49%	18787

Table 2-21: Is stock correct???

Sector	Building floor area	Amount of Cu material per 100m² empirical	Amount of Cu material per 100m² according working plan
Unit	Million m²	kg/100m²	kg/100m²
Residential	18000	29.1	41.75
Services	6000	54	78.9
Industry	2752	139	237

Source: BPIE, Ecofys study, Heinze study,

Product cost

- Product unit is (CSA [mm^2] x l [m] x N).
- Product cost
  - Average user price (web shops - 2013) around
    - **0.075 €/ (mm^2x m x 1 core)**.
  - Average (2005-2010) factory price (ProdCom) around
    - **0.047 €/ mm^2 x m**.

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Other costs, installation time (source: ECI)

Section	Installation time per meter	Installation time for the cable ends
mm2	Min	Min
1	1.75	5
1.5	2.45	7
2.5	3.15	9
4	3.85	12
6	5.25	12
10	5.95	15
16	7	17
25	8.75	20.4
35	9.8	25.5
50	10.5	30.6
70	11.9	36
95	12.6	45
120	14	45
150	15.75	60
185	17.5	60
240	21	85
300	24.5	120
400	28	200
500	35	360
630	42	480

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

Stakeholder meeting: Task 3

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Task 3 Users

- **Systems aspects of the use phase for ErPs with direct impact**
  - Definition of the User and context
  - Loss parameters directly related to the cable itself
  - Other functional cable parameters not directly related to losses
  - Loss parameters directly related to the electrical circuit and network topology
  - Parameters related to the building and loading
  - Formulas used for power losses in cables
- **Systems aspects of the use phase for ErPs with indirect impact**
- **End of Life behaviour**
- Local infrastructure (barriers & opportunities), e.g. cable bending
- Recommendations

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Product to systems approach

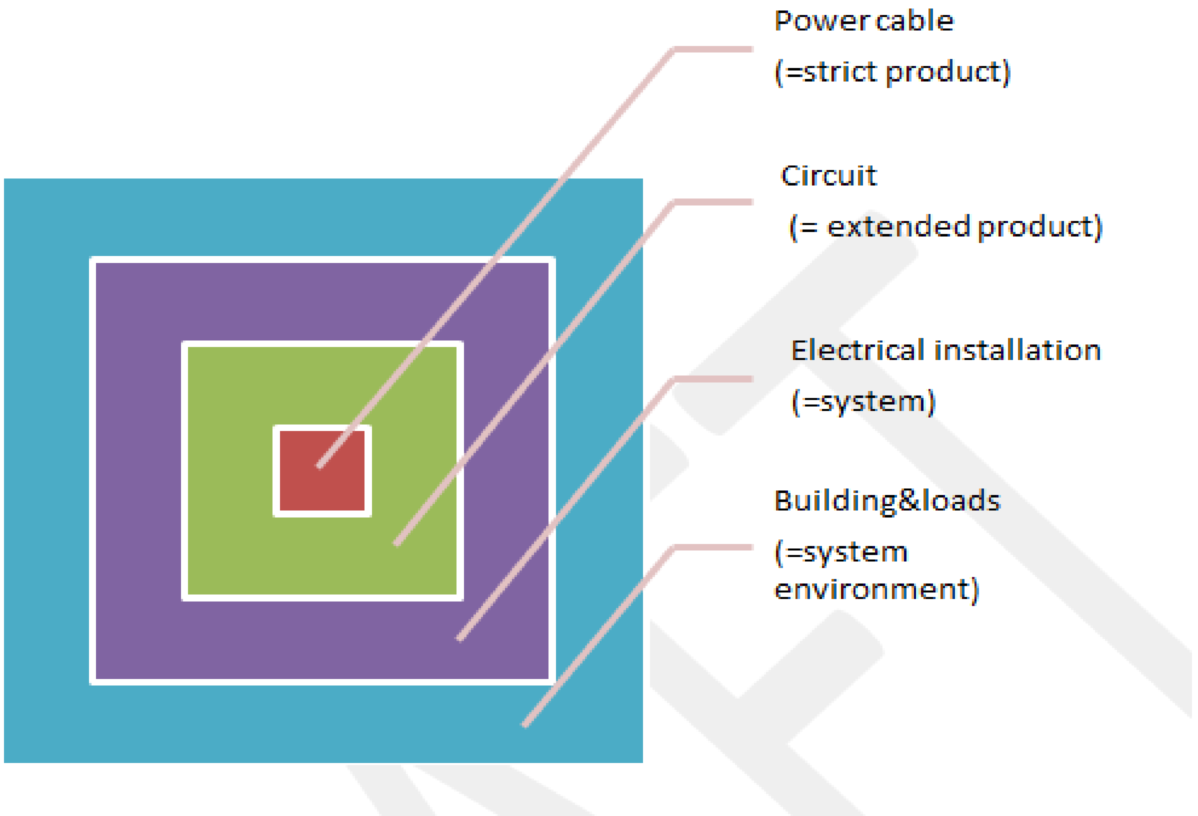

Figure 3-1: From strict product to systems approach

Loss parameters directly related to the cable itself

- R= ρ_t.l/A (Ohm) (formula 3.2)

- 3.1.2.1 Conductor material electrical resistance
- 3.1.2.2 **Cross-sectional area (CSA)**
- 3.1.2.3 Length of cable
- 3.1.2.4 Number of cores
- 3.1.2.5 Skin effect

CSA per circuit application type & sector

Table 3-2: Typical cable cross sectional areas depending on the circuit type

Sector	Circuit application type	CSA (mm^2) min	CSA (mm^2) ref	CSA (mm^2) max
Residential	Distribution circuit	6	10	16
	Lighting circuit	1	1.5	2.5
	Socket-outlet circuit	1.5	2.5	6
	Dedicated circuit	2.5	4	6
Services	Distribution circuit	10	35	600
	Lighting circuit	1.5	1.5	2.5
	Socket-outlet circuit	1.5	2.5	6
	Dedicated circuit	2.5	35	95
Industry	Distribution circuit	25	95	600
	Lighting circuit	1.5	1.5	2.5
	Socket-outlet circuit	1.5	2.5	10
	Dedicated circuit	2.5	35	600

Own estimates
New input from stakeholder, not processed yet.

Other functional cable parameters not directly related to losses

- **Insulation material > see OVAMs paper**
- Construction of the conductor

Loss parameters directly related to the electrical circuit and network topology

- 3.1.4.1 Single phase or three phase circuit
- 3.1.4.2 Maximum voltage drop in a circuit
- 3.1.4.3 Overcurrent protection in a circuit
- 3.1.4.4 Circuit network topology
- 3.1.4.5 **Circuit length**
- 3.1.4.6 Effect of load distribution
- 3.1.4.7 Effect of not simultaneous functioning of distributed loads
- 3.1.4.8 Ambient temperature
- 3.1.4.9 Temperature effect caused by the 'method of installation'
- 3.1.4.10 Single or three phase system
- 3.1.4.11 Number of distribution levels
- 3.1.4.12 Rated Diversity Factor DF at installation level

Circuit length

» Based upon enquiry, but corrected (factor 1. 2 for branches in lighting circuits)

Table 3-6: Corrected (and rounded) average circuit length in meters

Sector	Circuit application type	Average length min (m)	Average length ref (m)	Average length max(m)
Residential	Distribution circuit	5	17	40
	Lighting circuit	12	21	3
	Socket-outlet circuit	5	20	50
	Dedicated circuit	5	17	40
Services	Distribution circuit	10	34	80
	Lighting circuit	14	38	72
	Socket-outlet circuit	10	31	65
	Dedicated circuit	10	34	80
Industry	Distribution circuit	15	72	200
	Lighting circuit	24	65	120
	Socket-outlet circuit	15	48	100
	Dedicated circuit	15	72	200

Parameters related to the building and loading

- 3.1.5.1 **Load Factor (αc) and load form factor (Kf)**
- 3.1.5.2 Power factor
- 3.1.5.3 Impact of harmonics
- 3.1.5.4 Number of loaded conductors and impact of phase imbalance and harmonics

Load factors (αc) and load form factors (Kf)

- Load factor α_c (**LF**)=Pavg/Srated (Srated: rated apparent power)
- Load Form factor Kf = Prms/Pavg

Table 3-12: Load form factor and load factors to be used in this study

		Lighting circuit			Socket-outlet circuit			Dedicated circuit			Distribution circuit		
		Low	Ref	High	Low	Ref	High	Low	Ref	High	Low	Ref	High
Residential sector	Kf	3.12	2.11	1.67	4.38	1.74	1.34	4.61	3.99	3.12	1.24	1.14	1.08
	α_c	0.02	0.05	0.10	0.00	0.04	0.10	0.01	0.02	0.05	0.03	0.06	0.22
	Kf . α_c	0.06	0.11	0.17	0.02	0.06	0.13	0.05	0.08	0.14	0.03	0.07	0.23
Services sector	Kf	1.50	1.27	1.16	1.50	1.27	1.16	1.37	1.21	1.13	1.37	1.21	1.13
	α_c	0.15	0.24	0.41	0.07	0.15	0.24	0.29	0.41	0.54	0.29	0.41	0.54
	Kf . α_c	0.22	0.31	0.48	0.11	0.19	0.27	0.39	0.49	0.61	0.39	0.49	0.61
Industry sector	Kf	1.11	1.06	1.03	1.11	1.06	1.03	1.03	1.01	1.00	1.05	1.02	1.01
	α_c	0.23	0.34	0.54	0.12	0.27	0.46	0.46	0.61	0.76	0.43	0.57	0.72
	Kf . α_c	0.26	0.36	0.55	0.13	0.29	0.47	0.47	0.61	0.76	0.45	0.58	0.72

Formula 3.2 used for power losses in cables

$$R_t = \rho_t . l/A \ (\Omega) \qquad \text{(formula 3.2)}$$

where,

- R_t = resistance of the conductor at temperature t (Ω)
- l= length of the cable (meter)
  - **Length = circuit length x number of loaded conductors (2 or 3)**
- A= cross sectional area of the conductor (mm^2)
- ρ_t is specific electrical resistivity of the conductor at temperature t ($\Omega.mm^2/m$)

Formula 3.5 used for power losses in cables

$$E_{circuit,(y)} [kVAh] = Kd \cdot Rt \cdot Imax^2 \cdot (\alpha c \cdot Kf)^2 \cdot 8760 / 1000 \qquad \text{(formula 3.5)}$$

where,

- Kd = the distribution factor
- R_t = cable resistance at temperature t (see formula 3.2)
- Imax = the maximum rated current of the cable
- α_c = The **corrected** load factor
- Kf = Load form factor (=Prms/Pavg)
- PF = the power factor of the load served by the power cable

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Formula Active energy transported &loss ratio

Eactive(y) [kWh] = $\sqrt{3} \cdot V \cdot I_{max} \cdot \alpha c \cdot Kf \cdot PF \cdot 8760 / 1000$ (three phase)

where,

- V = electrical installation voltage (V =230 for single phase and 400 for three phase)
- Imax = the maximum rated current of the cable
- αc = The corrected load factor
- Kf = Load form factor (=Prms/Pavg)
- PF = the power factor of the load served by the power cable

Loss ratio = Ecircuit (y)/ Eactive(y)

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End-of-Life behaviour, Ecotool input parameters

Sector	Product life	Service life	Vacancy
Unit	Year	Year	%
Residential sector	169.49	161.02	5%
Services sector	14.12	13.42	5%
Industry sector	14.12	13.42	5%
Total sector (weighted)	76.27	72.46	5%

	Bulk Plastics	TecPlastics	Ferro	Non-ferro	Coating	Electronics	Misc., excluding refrigant & Hg	refrigerant	Hg (mercury), **in mg/unit**	Extra	Auxiliaries
EoL mass fraction to re-use, in %	1%	1%	1%	0%	1%	**1%**	1%	1%	1%	1%	**5%**
EoL mass fraction to (materials) recycling, in %	29%	**29%**	94%	95%	94%	**50%**	**64%**	**30%**	**39%**	**60%**	**30%**
EoL mass fraction to (heat) recovery, in %	15%	**15%**		0%		**0%**	**1%**	**0%**	**0%**	**0%**	**10%**
EoL mass fraction to non-recov. incineration, in %	22%	**22%**		0%		**30%**	**5%**	**5%**	**5%**	**10%**	**10%**
EoL mass fraction to landfill/missing/fugitive, in %	33%	**33%**		5%		**19%**	**29%**	**64%**	**55%**	**29%**	**45%**

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

Stakeholder meeting: Task 4

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Brussels, DG Enterprise

3rd of June 2014

Task 4: Technologies

- BAT
  - Product level (power cable)
  - System level (electrical installation/-circuit)
- BNAT
  - Product level (power cable)
  - System level (electrical installation/-circuit)
- Production, distrubition and End of Live (Task 3)
- Improvement options & recommendations

Task 4: BAT

- BAT at Product level (power cable)
  - BAT to improve Energy losses
    - **Maximum resistance** / CSA, composition Cu/Al … in EN standards
    - Variations in conductivity → modification "real" CSA (< d max)
    - → No improvement potential at product level
  - BAT to improve impact from material usage: ?

- BAT at System level (electrical installation/-circuit)
  - Increasing CSA of the cables (power losses ↘)
  - Power factor correction (reactive energy losses ↘)
  - Reduction of harmonic currents (power losses ↘),.....
  - → see FprHD 60364-8-1 "LV electrical installations – energy efficiency"

Task 4: Technologies - BNAT

- BNAT at Product level (power cable)
  - ?

- BNAT at System level (electrical installation/-circuit)
  - Energy efficiency at appliance level
  - Building and home automation
  - Peak reduction control systems
  - DC power distribution in commercial buildings
  - Note: BNAT? With the purpose to decrease cable losses

Task 4: Production, distrubition and End of Live

- Production: Bill of Material – manufacturing process: see OVAM paper
  - Representative cable
    - Conductor: Cu; Flexibility: Class 1 and 2 (IEC 60228)
    - Insulation material: XLPE (Cross-Linked Polyethylene)
    - Sheath material: PVC (Polyvinyl Chloride)
    - Voltage rating: 0.6/1 kV
    - Standard: IEC 60502-1
  - Insulation- & sheath weight: calculated according to IEC 60502-1
  - Filler material (FM):
    - PVC
    - Weigth FM= Avg. Cable Weigth - Weigth (Cu +XLPE+PVC)

Task 4: BOM

» Spreadsheets\BoM.xlsx

Task 4: Distribution

- Packaging
  - In cartons & plastic: small CSA & -lengths
  - Drums/reels: larger CSA & -lengths
- Drums:
  - Different sizes
  - Recuperated
- Volume
  - $V_{product} = V_{drum} / l_{max} \cdot l_{product}$ (m^3)

Distribution example

Dc (mm)- Ficitious diameter - acc. To IE(	mm	6.05
Drum Size		10
Max. cable length	m	1952
Drum Volume (formula	m^3	0.70
Drum spacing	m^3	0.11
Correction factor (spacing)	%	15%
Drum Corrected Volume	m^3	0.81
Drum Weight	kg	50.00
Drum corrected volume / meter cable	m^3/m	0.00041
Drum Weigth / meter cable	g/m	25.6

Task 4: Improvement options & Recommendations

Option Name	Description	In the scope of this study
At cable level		
Low loss cable as a product	Because no BNAT technologies are available at cable level that could reduce the energy losses in an economical feasible manner. Labelling information on the cable about energy losses is not a scenario and can be implemented by the scenarios mentioned in "at circuit level" part.	Not applicable
Cable with low impact insulation material	Under consideration, more input is needed	?
At circuit level (system level)		
S+x scenario	Using, for a particular circuit and load, a cable with a larger CSA (S+x) than necessary (according current standards and regulation) will result in a lower cable resistance R, and thus lower energy losses. The CSA increments are conform the current, standardized CSA values (no new CSA values are considered).	Yes
2S scenario	By installing, for a particular circuit and load, instead of one cable with a particular CSA_x one or more cables in parallel with the same CSA (or even smaller CSA than the original foreseen CSA_x) the losses in the circuit can be reduced.	Yes
Topology scenario	Keeping the topology in mind when designing the electrical system of a building can reduce the energy losses in the circuits. For instance, to keep losses to a minimum, the main distribution transformers and switchboards are to be located to keep the distances (circuit lengths) to main loads to a minimum. The building's use, construction and space availability has to be taken into account to obtain the best position. One such method to determine the best position is the barycentre method.	No?

23/07/2014

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

Stakeholder meeting: Task 5

Dominic Ectors

Brussels, DG Enterprise

3rd of June2014

Task 5: aim

- **Task 5: Environment Economics**
  - Base Case Environmental Impact Assessment(EcoReport Tool)
  - Base Case Life Cycle Costs for consumer
  - Base Case Life Cycle Costs for society
  - EU wide impact

- to assess environmental and economic impacts of the different base cases.
- based upon EcoReport Tool version 3.06 , as provided with the MEErP 2011 methodology.

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Task 5 content (1)

- 5.1 Product-specific inputs
  - 5.1.1 Identification of base cases
  - 5.1.2 Manufacturing of the product: Bill Of Materials
  - 5.1.3 Distribution phase: volume of packaged product
  - 5.1.4 Use phase
  - 5.1.5 End of Life (EoL)
  - 5.1.6 Life Cycle Cost Inputs
- 5.2 Base case environmental impact assessment (using EcoReport)
- 5.3 Base case Life Cycle Cost for consumer
- 5.4 Base case Life Cycle Costs for society

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Task 5 content (2)

- 5.5 EU totals
  - 5.5.1 Stock specific inputs
  - 5.5.2 Environmental impact at EU-28
  - 5.5.3 Economic assessment at EU-28
- 5.6 Cross checks

5.1 PRODUCT-SPECIFIC INPUTS

5.1 Product-specific inputs
5.1.1 Identification of base cases

- Selection criteria

Base case identification

- Base case 1: A typical power cable for use in typical **lighting circuit** in the **services sector**
- Base case 2: A typical power cable for use in typical **distribution circuit** in the **services sector**
- Base case 3: A typical power cable for use in typical **distribution circuit** in the **industry sector**
- Base case 4: A typical power cable for use in typical **dedicated circuit** in the **services sector**
- Base case 5: A typical power cable for use in typical **dedicated circuit** in the **industry sector**

Base Case 1: Services sector - Ligthing circuit

- Multi wire cable:
  - CSA: 1,5mm² → 3G1,5mm²: L-, N-, PE-wire
  - Average length: 38m
- Circuit breaker: 10A
- Maximum apparent power: 10Ax230V= 2,3 kVA

Base Case 2: Services sector – Distribution circuit

- Circuit between transformer and main distribution board
- 400kVA transformer – commonly used
- Multiwire cable
  - CSA 120mm^2→ 5G120mm^2: L1-, L2-, L3-, N-, PE-wire
  - Average length: 34m
  - 2 cables in parallel
- Circuit breaker
  - 630 A (Ir setting 577A)

Base Case 3: Industry sector – Distribution circuit

- Circuit between transformer and main distribution board
- 1250kVA transformer – commonly used
- Multiwire cable
  - CSA $300mm^2 \rightarrow 4x300mm^2$: L1-, L2-, L3-, N-wire
  - Average length: 72m
  - 4 cables in parallel
- Circuit breaker
  - 2000 A (Ir setting 1804 A)

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Base Case 4: Services sector – Dedicated circuit

- Circuit between distribution board and consumer
- Multiwire cable
  - CSA 10mm² → 5G10 mm²: L1-, L2-, L3-, N-, PE-wire
  - Average length: 34m
- Circuit breaker: 63A
- Maximum apparent power= 43kVA

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Base Case 5: Industry sector – Dedicated circuit

- Circuit between distribution board and consumer
- Multiwire cable
  - CSA 35mm^2→ 5G35 mm^2: L1-, L2-, L3-, N-, PE-wire
  - Average length: 72m
- Circuit breaker
  - 160A (Ir setting 156A)
- Maximum apparent power= 108kVA

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5.1.2 Manufacturing of the product: Bill Of Materials

- Reference Cable
  - Conductor:
    - Material: Cu
    - Flexibility: Class 1 and 2 (IEC 60228)
  - Insulation material: XLPE (Cross-Linked Polyethylene)
  - Sheath material: PVC (Polyvinyl Chloride)
  - Voltage rating: 0.6/1 kV
  - Single- and multicore
  - Armoured: No
  - Standard: IEC 60502-1

5.1.2 Bill Of Materials: base cases

Base case id		BC1	BC2	BC3	BC4	BC5
Sector		Services sector	Services sector	Industry sector	Services sector	Industry sector
Application circuit		Lighting circuit	Distribution circuit	Distribution circuit	Dedicated circuit	Dedicated circuit
BoM per meter cable						
CSA	**mm²**	1.50	120.00	300.00	10.00	35.00
Cu	g/m	40.01	5,334.00	10,668.00	444.50	1,555.75
XLPE	g/m	12.88	238.41	448.07	43.97	99.92
PVC	g/m	66.57	478.79	820.05	129.78	210.34
Filler material	g/m	40.54	1,300.81	1,933.88	141.25	390.98
Total weight material	g/m	160.00	7,352.00	13,870.00	759.50	2,257.00
BoM per base case						
Cu	g	1,520.19	362,712.00	3,072,384.00	15,113.00	112,014.00
XLPE	g	489.62	16,211.82	129,043.88	1,495.02	7,194.35
PVC	g	2,529.63	32,557.38	236,173.68	4,412.49	15,144.74
Filler material	g	1,540.57	88,454.79	556,958.44	4,802.48	28,150.91
Total weight material	kg	6.08	499.94	3,994.56	25.82	162.50

5.1.3 Distribution phase: volume of packaged product

	Unit	BC1	BC2	BC3	BC4	BC5
Cable outer diameter	mm	9.65	44.76	61.82	17.10	26.56
Drum Size		10	22	22	14	18
Max. cable length	m	2810	842.00	443.00	2448.00	1926.00
Drum Volume (formula	m^3	0.70	6.04	9.04	1.80	4.04
Drum spacing	m^3	0.11	0.91	1.36	0.27	0.61
Correction factor (spacing)	%	15%	15%	15%	15%	15%
Drum Corrected Volume	m^3	0.81	6.95	10.40	2.07	4.65
Drum Weight	kg	50.00	450.00	595.00	125.00	290.00
Drum corrected volume / meter cable	m^3/m	0.00029	0.00825	0.02348	0.00085	0.00241
Drum Weigth / meter cable	g/m	17.8	534.4	1343.1	51.1	150.6

	Unit	**Bases cases definiton**				
Base case id		BC1	BC2	BC3	BC4	BC5
Sector		Services sector	Services sector	Industry sector	Services sector	Industry sector
Application circuit		Lighting circuit	Distribution circuit	Distribution circuit	Dedicated circuit	Dedicated circuit
Volume package						
Volume package per meter cable	m3	0.000286477	0.008249843	0.023475576	0.000847092	0.002414355
Volume package per base case	m3	0.01089	0.56099	6.76097	0.02880	0.17383

5.1.4 Use phase

Parameter	Unit	Base cases				
Base case id		BC1	BC2	BC3	BC4	BC5
Sector		Services sector	Services sector	Industry sector	Services sector	Industry sector
Application circuit		Lighting circuit	Distribution circuit	Distribution circuit	Dedicated circuit	Dedicated circuit
Loaded cores		2	6	12	3	3
Cables in parallel		1	2	4	1	1
Conductor material		Cu	Cu	Cu	Cu	Cu
Imax per cable	A	10	289	451	62	156
CSA	mm^2	1.5	120	300	10	35
Length of circuit	m	38	34	72	34	72
ρ_t	$\Omega.mm^2/m$	0.0167	0.0167	0.0167	0.0167	0.0167
R (formula 3.2) per wire	Ω	0.423	0.005	0.004	0.057	0.034
Kd		0.38	1.00	1.00	1.00	1.00
Kf		1.27	1.21	1.02	1.21	1.01
αc		0.24	0.41	0.57	0.41	0.61
Pf		1.00	0.80	0.80	0.80	0.80
Annual energy loss (formula 3.5) per loaded core	kVAh	13.42	841.42	2441.35	466.74	2762.15
Annual energy loss (formula 3.5) per BC	kVAh	26.85	5048.54	29296.26	1400.21	8286.46
Annual energy transported (formula 3.6) per BC	kWh	6,233.33	1,383,543.21	5,121,229.66	148,730.89	465,153.33
Energy loss ratio (formula 3.7)		0.43%	0.36%	0.57%	0.94%	1.78%

$E_{circuit,}(y)$ [kVAh] = $Kd \,.\, R_t \,.\, I_{circuit}^2 \,.\, (\alpha \,.\, Kf)^2 \,.\, 8760 / 1000$ (formula 3.5)

$E_{active}(y)$ [kWh] = $\sqrt{3}$. V . $I_{circuit}$. α . Kf . PF . 8760 / 1000 (1-,3-phase) (formula 3.6)

Loss ratio = $E_{circuit}(y) / E_{active}(y)$ (formula 3.7)

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5.1.5 End of Life (EoL)

- Defaults values of the EcoReport have been used for recycling rates of the materials
- Only the re-use of metals is set to 0% instead of 1% and recycling of metals is set to 95% instead of 94% (see section 3.3 in Task 3)

5.1.6 Life Cycle Cost Inputs

	Unit	Bases cases definiton				
Base case id		BC1	BC2	BC3	BC4	BC5
Sector		Services sector	Services sector	Industry sector	Services sector	Industry sector
Application circuit		Lighting circuit	Distribution circuit	Distribution circuit	Dedicated circuit	Dedicated circuit
LCC data						
Year		2010	2010	2010	2010	2010
Electricity rate	€/kWh	0.11	0.11	0.11	0.11	0.11
Product price for 1 meter cable	€	0.82	58.23	116.45	6.11	18.10
Bace case product price	€	31.16	3959.30	33537.60	207.74	1303.20
Base case installation cost	€	39.54	205.80	744.18	85.83	288.78
Product life	Year	14.12	14.12	14.12	14.12	14.12
Product service life	Year	13.42	13.42	13.42	13.42	13.42

real product prices 2014 (not formula)

Cost per meter + ends (2, should be per node)

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5.2 BASE CASE ENVIRONMENTAL IMPACT ASSESSMENT (USING ECOREPORT)

EcoReport tool: input summary

	Unit	Base cases: ecoreport input				
Base case id		BC1	BC2	BC3	BC4	BC5
CSA	mm^2	1.5	120	300	10	35
Cu	g/m	1520.19	362712.00	3072384.00	15113.00	112014.00
XLPE	g/m	489.62	16211.82	129043.88	1495.02	7194.35
PVC	g/m	2529.63	32557.38	236173.68	4412.49	15144.74
Annual energy loss (formula 3.5) per BC	kVAh	26.85	5048.54	29296.26	1400.21	8286.46
Volume	m3	0.01	0.56	6.76	0.03	0.17
Product life	Year	14.12	14.12	14.12	14.12	14.12
Bace case product price	€	31.16	3959.30	33537.60	207.74	1303.20
Annual sales (base case units)	mln. Units	32.86	0.42	0.04	1.76	1.44
EU Stock (base case units)	mln. Units	464.07	5.98	0.51	24.85	20.27
Base case installation cost	€	39.54	205.80	744.18	85.83	288.78
Electricity rate	€/kWh	0.11	0.11	0.11	0.11	0.11
Filler material	g	1540.57	88454.79	556958.44	4802.48	28150.91
EoL mass fraction to re-use, non-Ferro material	%	0%	0%	0%	0%	0%
Product service life	Year	13.42	13.42	13.42	13.42	13.42

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EcoReport tool: base cases

- Spreadsheets\EcoReport_v3_06_BC1.xlsx
- Spreadsheets\EcoReport_v3_06_BC3.xlsx

5.3 BASE CASE LIFE CYCLE COST FOR CONSUMER

Base Case Life Cycle Cost for consumer

	Unit	Bases cases definiton				
Base case id		BC1	BC2	BC3	BC4	BC5
Sector		Services	Services	Industry	Services	Industry
Application circuit		Lighting	Distribution	Distribution	Dedicated	Dedicated
Product price	€	€ 31.16	€ 3,959.30	€ 33,537.60	€ 207.74	€ 1,303.20
Installation/ acquisition costs (if any)	€	€ 39.54	€ 205.80	€ 744.18	€ 85.83	€ 288.78
Electricity	€	€ 39.62	€ 7,843.77	€ 45,516.79	€ 2,175.47	€ 12,874.45
Total	€	€ 110.32	€ 12,008.87	€ 79,798.57	€ 2,469.04	€ 14,466.43
Product price	%	28%	33%	42%	8%	9%
Installation/ acquisition costs (if any)	%	36%	2%	1%	3%	2%
Electricity	%	36%	65%	57%	88%	89%
Total	%	100%	100%	100%	100%	100%

Cost per meter + ends (2, should be per node)

Running costs discounted to their Net Present Value

5.4 BASE CASE LIFE CYCLE COSTS FOR SOCIETY

5.4 Base case Life Cycle Costs for society

	Unit	Bases cases definiton				
Base case id		BC1	BC2	BC3	BC4	BC5
Sector		Services	Services	Industry	Services	Industry
Application circuit		Lighting	Distribution	Distribution	Dedicated	Dedicated
Product price	€	€ 31.16	€ 3,959.30	€ 33,537.60	€ 207.74	€ 1,303.20
Installation/ acquisition costs (if any)	€	€ 39.54	€ 205.80	€ 744.18	€ 85.83	€ 288.78
Electricity	€	€ 39.62	€ 7,843.77	€ 45,516.79	€ 2,175.47	€ 12,874.45
External damages total, of which	€	€ 14.80	€ 2,853.02	€ 20,314.59	€ 466.55	€ 2,839.66
- production PPext	€	€ 5.80	€ 1,011.41	€ 8,633.25	€ 43.72	€ 314.19
- lifetime operating expense N*OEext	€	€ 7.46	€ 1,478.00	€ 8,602.24	€ 407.66	€ 2,413.13
- end-of-life OELext	€	€ 1.54	€ 363.61	€ 3,079.09	€ 15.17	€ 112.33
Total	€	€ 125.12	€ 14,861.89	€ 100,113.15	€ 2,935.60	€ 17,306.09
Product price	%	25%	27%	33%	7%	8%
Installation/ acquisition costs (if any)	%	32%	1%	1%	3%	2%
Electricity	%	32%	53%	45%	74%	74%
External damages total, of which	%	12%	19%	20%	16%	16%
Total	%	100%	100%	100%	100%	100%

Corrected (wrong in report and print)

5.5 EU TOTALS

EU totals: stock specific input

	Unit	Bases cases definiton				
Base case id		BC1	BC2	BC3	BC4	BC5
Sector		Services sector	Services sector	Industry sector	Services sector	Industry sector
Application circuit		Lighting circuit	Distribution circuit	Distribution circuit	Dedicated circuit	Dedicated circuit
Stock and sales data (fixed total stock)						
Year		2010	2010	2010	2010	2010
EU Stock per base case cable (Cu weight)	kg	7.05E+08	2.17E+09	1.55E+09	3.76E+08	2.27E+09
EU Stock (units of 1 cable)	m	1.76E+10	4.07E+08	1.46E+08	8.45E+08	1.46E+09
EU Stock (base case units)	mln. Units	464.07	5.98	0.51	24.85	20.27
Annual sales (base case units)	mln. Units	32.86	0.42	0.04	1.76	1.44

Environmental impact at EU-28 (annual)

	Unit	Bases cases definiton					
Base case id		BC1	BC2	BC3	BC4	BC5	Total
Sector		Services sector	Services sector	Industry sector	Services sector	Industry sector	
Application circuit		Lighting circuit	Distribution circuit	Distribution circuit	Dedicated circuit	Dedicated circuit	
Materials							
Plastics	Mt	0.151	0.059	0.033	0.019	0.073	0.34
Ferrous metals	Mt	0.000	0.000	0.000	0.000	0.000	0.00
Non-ferrous metals	Mt	0.050	0.155	0.111	0.027	0.162	0.51
Other resources & waste							
Total Energy (GER)	PJ	132.94	294.36	149.10	317.99	1536.52	2,430.91
of which, electricity	TWh	12.89	30.36	14.92	34.86	168.18	261.19
Water (process)*	mln.m3	9.46	3.63	2.01	1.15	4.41	20.66
Waste, non-haz./ landfill*	Mt	0.08	0.15	0.07	0.16	0.79	1.26
Waste, hazardous/ incinerated*	kton	0.00	0.00	0.00	0.00	0.02	0.04
Emissions (Air)							
Greenhouse Gases in GWP100	mt CO2eq.	6.05	12.83	6.54	13.64	65.88	104.95
Acidifying agents (AP)	kt SO2eq.	38.61	97.39	58.12	67.29	333.95	595.36
Volatile Org. Compounds (VOC)	kt	2.52	6.08	2.99	7.00	33.77	52.35
Persistent Org. Pollutants (POP)	g i-Teq.	0.47	1.22	0.73	0.83	4.14	7.39
Heavy Metals (HM)	ton Ni eq.	4.10	11.30	7.48	4.66	24.24	51.77
PAHs	ton Ni eq.	0.65	1.48	0.92	0.88	4.42	8.35
Particulate Matter (PM, dust)	kt	2.07	2.43	1.73	1.53	7.48	15.25
Emissions (Water)							
Heavy Metals (HM)	ton Hg/20	5.24	15.76	11.03	3.88	21.79	57.70
Eutrophication (EP)	kt PO4	0.03	0.08	0.04	0.06	0.31	0.53

Too high

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Economic assessment at EU-28 (annual)

	Unit	Bases cases definiton					Total
Base case id		BC1	BC2	BC3	BC4	BC5	
Sector		Services	Services	Industry	Services	Industry	
Application circuit		Lighting	Distribution	Distribution	Dedicated	Dedicated	
Product price	mln. €	1023.79	1676.22	1201.30	365.55	1870.31	6137.18
Installation/ acquisition costs (if any)	mln. €	1299.11	87.13	26.66	151.04	414.45	1978.38
Electricity	mln. €	1370.37	3320.76	1630.39	3828.08	18476.95	28626.56
Total	mln. €	3693.28	5084.11	2858.35	4344.67	20761.71	36742.12
Product price	%	17%	27%	20%	6%	30%	100%
Installation/ acquisition costs (if any)	%	66%	4%	1%	8%	21%	100%
Electricity	%	5%	12%	6%	13%	65%	100%
Total	%	10%	14%	8%	12%	57%	100%

5.6 CROSS CHECKS

Used method: fixed stock

CSA Cu weight

1.5: 1.93%
2.5: 12.56%
4: 1.68%
.
.
.
630: 0.00%

→ BC1: 16.18%

→ BC2: 49.73%

x total kg Cu stock (per sector) → kg Cu per BC (EU-28)

L , CSA → # BC units per BC

→ EU-28 electricity losses

→ EU-28 active electricity transport

Per BC unit

$$E_{circuit,}(y)\ [kVAh] = Kd \,.\, R_t \,.\, Imax^2 \,.\, (\alpha_c \,.\, Kf)^2 \,.\, 8760 / 1000$$

→ EU-28 electricity losses

$$E_{active}(y)\ [kWh] = \sqrt{3} \,.\, V \,.\, Imax \,.\, \alpha_c \,.\, Kf \,.\, PF \,.\, 8760 / 1000$$

→ EU-28 active electricity transport

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Cross checks: fixed stock (sales, lifetime)

	Unit	Bases cases definiton					Total over all BC
Base case id		BC1	BC2	BC3	BC4	BC5	
Sector		Services	Services	Industry	Services	Industry	
Application circuit		Lighting	Distribution	Distribution	Dedicated	Dedicated	
Method 1: fixed stock	**kg**						**7.08E+09**
Energy distribution factor	%	10%	100%	100%	85%	85%	
EU Stock (base case units)	mln. Units	464.07	5.98	0.51	24.85	20.27	
Number of buildings per sector (Task 2 Table 2-9)	mln Units	11.41	11.41	2.58	11.41	2.58	
Annual energy loss (formula 3.5) per BC	kVAh	26.85	5048.54	29296.26	1400.21	8286.46	
Annual energy transported (formula 3.6) per BC	kWh	6,233	1,383,543	5,121,230	148,731	465,153	
Checks							
Annual energy loss Eu-28 (=BC loss * #BC units)	TWh	12.46	30.19	14.82	34.80	167.97	260.24
Annual energy transported Eu-28 (=BC annual energy transport * #BC units)	TWh	2,893	8,273	2,591	3,697	9,429	
Annual energy transported Eu-28 corrected with energy distribution factor	TWh	28,927	8,273	2,591	4,349	11,093	
Number of BC units (circuits) per building		40.7	0.5	0.2	2.2	7.9	

Too high

Cross checks: fixed EU-28 electricity consumption

	Unit	Bases cases definiton					Total over all BC
Base case id		BC1	BC2	BC3	BC4	BC5	
Sector		Services	Services	Industry	Services	Industry	
Application circuit		Lighting	Distribution	Distribution	Dedicated	Dedicated	
Method 2: fixed EU-28 energy consumption	TWh		904	1030			1934
Energy distribution factor	%	10%	100%	100%	85%	85%	
Number of buildings per sector (Task 2 Table 2-9)	mln Units	11.41	11.41	2.58	11.41	2.58	
Annual energy transported (formula 3.6) per BC	kWh	6,233	1,383,543	5,121,230	148,731	465,153	
EU28 energy consumption (distributed via energy distribution factor)	TWh	90.41	904.12	1029.62	768.50	875.17	
Checks							
BC stock (= EU-28 energy consumption / energy transported per BC)	mln Units	14.50	0.65	0.20	5.17	1.88	22.41
BC stock (weight)	kg	2.20E+07	2.37E+08	6.18E+08	7.81E+07	2.11E+08	**1.17E+09**
Number of BC units (circuits) per building		1.3	0.1	0.1	0.5	0.7	

Cross checks: fixed stock; L x 3, α /3

	Unit	Bases cases definiton					Total over all BC
Base case id		BC1	BC2	BC3	BC4	BC5	
Sector		Services	Services	Industry	Services	Industry	
Application circuit		Lighting	Distribution	Distribution	Dedicated	Dedicated	
Method 1: fixed stock	**kg**						**7.08E+09**
Energy distribution factor	%	10%	100%	100%	85%	85%	
EU Stock (base case units)	mln. Units	154.69	1.99	0.17	8.28	6.76	
Number of buildings per sector (Task 2 Table 2-9)	mln Units	11.41	11.41	2.58	11.41	2.58	
Annual energy loss (formula 3.5) per BC	kVAh	8.77	1649.36	9571.09	457.45	2707.19	
Annual energy transported (formula 3.6) per BC	kWh	2,057	456,569	1,690,006	49,081	153,501	
Checks							
Annual energy loss Eu-28 (=BC loss * #BC units)	TWh	1.36	3.29	1.61	3.79	18.29	28.34
Annual energy transported Eu-28 (=BC annual energy transport * #BC units)	TWh	318	910	285	407	1,037	
Annual energy transported Eu-28 corrected with energy distribution factor	TWh	3,182	910	285	478	1,220	
Number of BC units (circuits) per building		13.6	0.2	0.1	0.7	2.6	

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Cross checks: fixed EU-28 electricity consumption; L x 3, α /3

	Unit	Bases cases definiton					Total over all BC
Base case id		BC1	BC2	BC3	BC4	BC5	
Sector		Services	Services	Industry	Services	Industry	
Application circuit		Lighting	Distribution	Distribution	Dedicated	Dedicated	
Method 2: fixed EU-28 energy consumption	TWh		904	1030			1934
Energy distribution factor	%	10%	100%	100%	85%	85%	
Number of buildings per sector (Task 2 Table 2-9)	mln Units	11.41	11.41	2.58	11.41	2.58	
Annual energy transported (formula 3.6) per BC	kWh	2,057	456,569	1,690,006	49,081	153,501	
EU28 energy consumption (distributed via energy distribution factor)	TWh	90.41	904.12	1029.62	768.50	875.17	
Checks							
BC stock (= EU-28 energy consumption / energy transported per BC)	mln Units	43.95	1.98	0.61	15.66	5.70	67.90
BC stock (weight)	kg	2.00E+08	2.15E+09	5.62E+09	7.10E+08	1.92E+09	**1.06E+10**
Number of BC units (circuits) per building		3.9	0.2	0.2	1.4	2.2	

Reasons

- Stock too high ?
- Energy consumption too high ? Load and load form factor.
- Average circuit length too low?
- Base case not representative (real versus virtual BC) ?
- Bug or wrong interpretation ?

- Solution
  - Extra checks (cross checks, method and tooling)
  - Extra base cases (virtual or real, extra circuit types, low loading, high loading…)
  - Validation of used data

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23/07/2014

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

Stakeholder meeting: Data gaps / data validation

Dominic Ectors

Brussels, DG Enterprise

3rd of June 2014

Weight factors CSA

- Link to weightfactors.xlsx
  - Based upon ECI survey, 34 buildings (services & industry) in different countries
- Impact: relative importance of BC's

- GAP:
  - To cable manufacturers
  - sales information per section
    - per cable type, or for one cable type, or overall
    - if not possible in absolute figures, then relative factors (like the weight factors)

BOM

- Filler material (amount and type of material)
- Cable types & insulation materials

Validation of installation

- To installers and engineering companies
- Validation of circuit characteristics
  - table 3-2: CSA per circuit type (min/max)
  - table 3-4: average circuit length per circuit type (L)
  - table 3-7: number of nodes per circuit type (Kd factor)
  - commonly used cable types per circuit type
- Number of circuits (per circuit type) per building type and building floor area

Loading characteristics

- Measurements of existing electrical installations
  - Determination/verification of load factor and load form factor
  - Circuit breaker settings per circuit type and section ($I_{circuit}$)
- However, will be very different per installation, per circuit

Building info

- Used sources: BPIE, Ecofys study, Eurostat, MEErP (contradictions)
- Data:
  - Floor area per sector
  - Stock
  - Growth of stock (new & replacement / refurbishment)
  - % cable replacement when refurbishment
  - Number of buildings per sector

- Potential new sources:
  - Euroconstruct,…
- In combination with Cu/m^2 floor area -> Cu stock

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Industry sector

- Inside buildings versus outside
  - What is included (gray zone) in figures?
- Energy use
  - 1030 TWh according Eurostat (Industry sector)
- Floor area

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