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Report

Preparatory Studies for Product Group in the Ecodesign Working Plan 2012-2014:

Lot 8- Power Cables

Task 2 report – Markets (volumes and prices) (3rd version)

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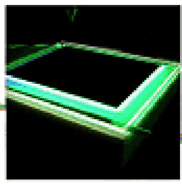
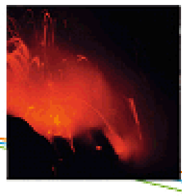
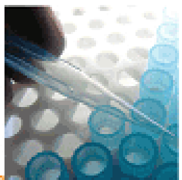

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EXECUTIVE SUMMARY

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

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

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

The tasks in the MEErP entail:
Task 1 - Scope (definitions, standards and legislation);
Task 2 – Markets (volumes and prices);
Task 3 – Users (product demand side);
Task 4 - Technologies (product supply side, includes both Best Available Technology (BAT) and Best Not Yet Available Technology (BNAT));
Task 5 – Environment & Economics (Base case Life Cycle Assessment (LCA) & Life Cycle Costs (LCC));
Task 6 – Design options (improvement potential);
Task 7 – Scenarios (policy, scenario, impact and sensitivity analysis).
Tasks 1 to 4 can be performed in parallel, whereas 5, 6 and 7 are sequential.
Task 0 or a Quick-scan is optional to Task 1 for the case of large or inhomogeneous product groups, where it is recommended to carry out a first product screening. The objective is to re-group or narrow the product scope, as appropriate from an ecodesign point of view, for the subsequent analysis in Tasks 2-7.

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List of Acronyms

Al	Aluminium
Avg	Average
BPIE	Buildings Performance Institute Europe
CSA	conductor Cross-Sectional Area
Cu	Copper
EC	European Commission
ERP	Energy Related Product
EU	European Union
LCA	Life Cost Analysis
LCC	Life Cost Calculation
LV	Low Voltage
MEErP	Methodology for Ecodesign of Energy-related Products
MEEuP	Methodology for Ecodesign of Energy-using Products
NACE	Nomenclature statistique des activités économiques dans la Communauté européenne
PRODCOM	PRODuction COMmunautaire
PVC	Polyvinylchloride
SME	Small and Medium sized Enterprise
TBC	To Be Completed
TBD	To Be Defined
USGS	US Geological Survey
VAT	Value Added Tax
Vac	Voltage Alternate Current
VITO	Flemish institute for Technological Research

Use of text background colours

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

CHAPTER 2 MARKETS

The objective of Task 2 is to present the economic and market analysis related to the products. The aims are:

- to place the product group within the total of EU industry and trade policy (subtask 2.1);
- To provide market and cost inputs for the EU-wide environmental impact of the product group (subtask 2.2);
- To provide insight in the latest market trends so as to indicate the place of possible Ecodesign measures in the context of the market structures and ongoing trends in product design (subtask 2.3, also relevant for the impact analyses in Task 3); And finally,
- To provide a practical data set of prices and rates to be used in a Life Cycle Cost (LCC) calculation (subtask 2.4).

Summary of results:

The stock or stock growth rate of power cables in buildings are linked to the stock and stock growth rate of buildings respectively. The stock, stock growth rate, replacement, and demolition rates for power cables were deduced from the corresponding building parameters. Absolute stock and sales were estimated based upon these figures and verified with PRODCOM data. The input from stakeholders regarding product lifetime is taken into account.

The results can be found in Table 2-1. These values will be used in the Tasks 5 up to and including 7.

Table 2-1: Summary of cable stock, growth and sales rates

Sector	Product life	Service life	Vacancy	Stock growth rate	Demolition rate	Replace-ment sales rate	New sales rate	Total sales rate	Stock (Reference year: 2010)	
Unit	Year	Year	%	% p.a.	% p.a.	% p.a.	% p.a.	% p.a.	kTon Cu	%
Residential sector	64.00	60.80	5%	0.90%	0.10%	1.18%	0.90%	2.08%	5241	43%
Services sector	25.00	23.75	5%	1.90%	0.20%	3.20%	1.90%	5.10%	3250	26%
Industry sector	25.00	23.75	5%	2.90%	0.20%	2.80%	2.90%	5.70%	3825	31%
Total sector (weighted)	41.60	39.52	5%	1.79%	0.16%	2.22%	1.79%	4.00%	12316	100%

Installation times, cable and connector prices are defined in this chapter along with energy and financial rates. For copper power cables this study uses an average discounted cable price of 0.09434 €/ (mm^2. m).

The input market stock, sales and growth data was not directly available and as explained in the respective sections the deduced and projected data has a certain degree of uncertainty, therefore a complementary sensitivity analysis is performed in Tasks 6 and 7.

2.1 Generic economic data

2.1.1 Definition of 'Generic economic data' and objective

'Generic economic data' gives an overview of production and trade data as reported in the official EU statistics. It places the power cables within the total of EU industry and trade. To investigate the market, Europroms -PRODCOM statistics are screened, and verified with recent data from stakeholders.

2.1.2 PRODCOM data

The PRODCOM statistics (published by Eurostat) have the advantage of being the official EU source. PRODCOM data is based on manufactured goods whose definitions are standardised across the EU thus guaranteeing comparability. Although it is used and referenced in other EU policy documents regarding trade and economic policy, it does have its limitations. Many data points are unknown, estimated, confidential and therefore not available.

Based on the scope defined in Task 1 only one relevant category (see Table 2-2) for this study has been found in the PRODCOM database.

Table 2-2: PRODCOM data relevant NACE code

PRODCOM NACE code	Description
27321380	Other electric conductors, for a voltage <= 1000 V, not fitted with connectors

The market data in quantity of units and monetary value (see Table 2-3) was obtained for the NACE code 27321380 from EUROSTAT for the years 2007 – 2012.

Table 2-3: EU27 PRODCOM data on NACE code 27321380

Year	Quantity in kton				Value in million €			
	Produc-tion	**Import**	**Export**	**Apparent EU consump-tion**	**Produc-tion**	**Import**	**Export**	**Apparent EU consump-tion**
2007	1550				9300			
2008	2171				11648			
2009	1920				8400			
2010	2200				11100			
2011	2280				12600			
2012	2128				12300			

Table 2-4: Value per kg based on PRODCOM data (NACE code 27321380)

Year	**Value in 1000 €**	**Quantity in ton**	**€/kg**
2007	9300000	1550000	6.00
2008	11647510	2171223	5.36
2009	8400000	1920000	4.38
2010	11100000	2200000	5.05
2011	12600000	2280000	5.53
2012	12300000	2128632	5.78
Average			**5.35**

Table 2-4 shows that the average value per kilo cable is **5.35** EURO/kg for the years 2007 up to and including 2012.

Note: The PRODCOM data include a broad range of electrical wires and cables, such as wires and cables for electrical installations inside and outside the buildings (e.g. LV distribution cables), wires and cables for data communication (coax cables are excluded), flexible cords, wires for internal wiring of control panels, instrumentation cables, elevator cable, and others. Be aware that this category includes cables and wires with conductors made of copper, aluminium or any other material. The values in Table 2-3 and Table 2-4 are expressed in kg product (cable) regardless of the material used.
As such the PRODCOM data can only be used as a reality check, i.e. an upper limit to verify figures from other sources.

2.1.3 Generic economic data

For 2007 the global (world) copper demand was 24.2 million tonnes, of which 48% was used in the manufacturing of electric cables[1], or about 11 million tonnes.

2.2 Market and stock data

2.2.1 Sales data

2.2.1.1 Sales data from EU cable industry associations

To verify the PRODCOM data with recent data from stakeholders a questionnaire was sent to the cable manufacturers[2].

[1] Source: www.eurocopper.eu> marketdata, EGEMIN study 2011 Modified Cable Sizing Strategies
[2] questionnaire for cable manufacturers, sent in context of this study, September 30th, 2013

2.2.1.2 Sales of power cables in Europe according to working plan[3]

Table 2-5: Sales of power cables (kton Copper)

Annual Sales (kton eq. Copper)	2000	2005	2010	2015	2020	2025	2030
Industry	226	245	241	253	266	279	293
Services	202	219	216	227	238	250	263
Residential	284	308	303	318	334	351	368
Total	712	772	760	798	838	880	924

Table 2-5 shows that annual sales of wiring, expressed as kilotons equivalent copper, which was estimated to be 760 kton in 2010 and is expected to increase to 924 kton by 2030.

2.2.1.3 CRU Wire and Cable Quarterly report

Table 2-6 and Table 2-7 are extracted from the CRU[4] Wire and Cable Quarterly, Q3 2013 report[5]. Please note that CRU includes Russia and all of East Europe in Europe.

The in Table 2-6 mentioned insulated cables includes the cables used in building and construction, which also includes power distribution cables and diverse industrial cables etc. from low to high voltage. Winding wire is enamelled wire (magnetic wire) used in transformers.

Table 2-6: Ktons of conductor for Europe 2013f (source: CRU Wire and Cable Quarterly, Q3 2013)

000 tons conductor content by region (2013f)

Europe	Cu	Al
Bare Overhead Conductors	0	306
Insulated Cables	1828	531
Winding Wire	424	38
Subtotal	**2252**	**874**

[3] Study of the Amended Ecodesign Working Plan, Final report Task 3 – version 6 Dec. 2011

[4] http://www.crugroup.com/about-cru/industries_we_cover/wirecable/
[5] http://www.crugroup.com/about-cru/industries_we_cover/wirecable/

Table 2-7: European consumption of wire and cable by type (000 ton conductor independent of metal, 2013f) (source: CRU Wire and Cable Quarterly, Q3 2013)

Europe	
LV Energy	1073
Power Cable	1114
External Telecom	68
Internal/Data	218
Winding Wire	465
Sub-Total	**2938**

In the CRU report the following product sectors are used (Table 2-7):

- LV Energy: all cable whose primary function is the transmission of energy and rated at below 1kVac;
- Power Cable: comprises all energy cable rated at 1kVac and above;
- External Telecom: metallic cable used in telecommunication networks installed outside buildings;
- Internal/Data: all other types of cable used for the transmission of voice/data, including internal telephone cable, LAN data cable and all types of co-axials;
- Winding Wire: all types of round and flat enamelled and taped wire used in the windings of motors, transformers etc.;
- Fibre Optic Cable: all types of cable containing optical fibres.

Note: there is a small mismatch between the Table 2-6 and Table 2-7 because some cables that are produced in Europe can be exported or others can be imported to fit the consumption in the second table.

Based upon Table 2-7 one can conclude that about 37 % (= 1073/2938) of wire and cable consumption in Europe is for LV energy cables. This category, however, includes among others the sales of cables for the LV distribution grid, LV cables for industry and original equipment manufacturer (OEM) application, meaning automotive, rolling stock, and so on. As such, these figures can only be used as an upper limit to verify data from other sources.

2.2.1.4 Sales data from annual reports of cable manufacturers

According to Europacable, the two largest European manufacturers of LV indoor power cables are Nexans and Prysmian. Economic market data can be found in some form in their annual reports[6, 7]. Such data can be useful as an upper limit to cross check with projected annual EU27 cable sales in end user prices.
Some key figures for the annual reports are:

- Nexans reported for 2013 global sales of 6711 Meuro with 57 % European geographic sales and 25 % sales in the distribution and installers business (incl. data cables).
- Prysmian Group reported for 2013 a global sales of 7273 MEuro with 63 % Europe - Middle-East - Africa geographic sales and 26 % sales in the trade and installers business.

[6] http://www.nexans.com/eservice/navigation/NavigationPublication.nx?CZ=Corporate&language=en&publicationId=-3506

[7] http://investoren.prysmian.com/phoenix.zhtml?c=211070&p=irol-reportsannual

Note: these figures also cover products and geographic areas that are outside the proposed scope of the study in Task 1.
For more information on the European manufacturers and production structure, consult also section 2.3.

2.2.2 Stock data

Power cables are used in all type of buildings both residential and non-residential (industry and service). The annual sale depends on the amount of new buildings and building renovations. Especially building renovation is considered to increase in the coming years.

2.2.2.1 Stock data according to working plan

As illustrated in Table 2-8, the total amount of copper installed in buildings ('stock') was estimated to be 18788 kton in 2010 and is expected to increase to 21583 kton by 2030.

Table 2-8: Total amount of copper installed in buildings[8]

Stock (ktons eq. Copper)	***2000***	***2005***	***2010***	***2015***	***2020***	***2025***	***2030***
Industry	*5991*	*6102*	*6538*	*6951*	*7395*	*7453*	*7511*
Services	*4338*	*4419*	*4734*	*5033*	*5355*	*5397*	*5439*
Residential	*6886*	*7014*	*7515*	*7989*	*8500*	*8567*	*8633*
Total	*17215*	*17536*	*18788*	*19974*	*21250*	*21417*	*21583*

2.2.2.2 Building stock

2.2.2.2.1 BPIE

Buildings Performance Institute Europe (BPIE) estimates that there are **24 billion m²** of useful floor space (industry floor space excluded?) in the EU27 countries[9]. The residential stock is the biggest segment with an EU floor space of **75%** of the building stock. Within the residential sector, different types of single family houses (e.g. detached, semi-detached and terraced houses) and apartment blocks are found. Apartment blocks may accommodate several households typically ranging from 2-15 units or in some cases holding more than 20-30 units (e.g. social housing units or high rise residential buildings).

2.2.2.2.2 Ecofys report

[8] Study of the Amended Ecodesign Working Plan, Final report Task 3 – version 6 Dec. 2011
[9] BPIE study: Europe's buildings under the microscope – October 2011 http://www.bpie.eu/documents/BPIE/HR_%20CbC_study.pdf

The Ecofys study 'Panorama of the European non-residential construction sector'[10] was conducted by investigating five reference countries (Sweden, Germany, Poland, Hungary and Spain) and extrapolating the results to European scale.
The number of non-residential buildings and the total floor area of these buildings are shown per building group in Table 2-9 up to and including Table 2-11.

Table 2-9: Extrapolated EU27 non–residential building stock[10] (year 2009?)

	Non-government owned offices	Trade facilities	Gastronomic facilities	Health facilities	Educational facilities	Industrial buildings	Public buildings	Other buildings	Total
Northern Europe EU27									
Buildings	27,134	16,679	6,597	20,288	59,247	194,613	27,134	26,885	**356,547**
Floor area [Mio m²]	47.7	29.3	11.6	35.6	104.1	194.6	9.0	47.2	**479.1**
Western Europe EU27									
Buildings	1,200,354	1,192,100	1,465,150	121,663	144,214	1,180,094	871,799	642,660	**6,818,034**
Floor area [Mio m²]	917.4	1,490.1	596.0	781.1	905.4	1,180.1	871.8	642.7	**7.384.6**
North Eastern Europe EU27									
Buildings	39,860	333,388	85,764	19,043	37,356	275,103	168,553	1,124,362	**2,083,428**
Floor area [Mio m²]	53.1	213.8	35.0	15.5	99.3	349.3	135.0	360.3	**1,261.2**
South Eastern Europe EU27									
Buildings	4,627	734,185	232,186	19,887	56,246	204,413	159,798	103,114	**1,514,456**
Floor area [Mio m²]	36.1	131.7	124.7	46.3	63.7	316.4	92.3	141.2	**952.5**
Southern Europe EU27									
Buildings	86,395	312,650	118,469	52,653	158,694	522,299	25,090	396,655	**1,672,906**
Floor area [Mio m²]	117.7	426.0	161.4	71.7	216.2	711.6	34.2	540.4	**2,279.2**
Total EU27									
Buildings EU27	1,358,370	2,589,001	1,908,167	233,535	455,757	2,376,522	1,230,343	2,293,676	**12,455,371**
Floor area EU27	1,171.9	2,291.0	928.7	950.2	1,388.7	2,752.0	1,142.3	1,731.8	**12,356.6**

[10] Ecofys report, Panorama of the European non-residential construction sector, 9 December 2011

Table 2-10: Number of non-residential buildings in the EU27 [1,000 units][11]

Age structure	Private offices	Trade facilities	Gastro-nomic facilities	Health facilities	Educa-tional facilities	Industrial buildings	Public buildings	Other buildings	Total
Until 1980	594.2	1,566.7	1,291.4	143.9	333.7	1,636.2	687.4	1.841.1	**8.102.7**
1980 -1989	223.1	329.7	373.5	29.9	71.7	329.3	173.5	183.6	**1701.8**
1990 -1999	373.3	459.1	207.2	38.4	56.1	237.1	318.1	505.7	**2,190.9**
2000-2009	197.3	481.3	99.7	35.3	22.2	377.6	177.0	601.0	**1,999.5**
Total	**1,387.8**	**2,836.8**	**1,971.8**	**247.6**	**483.1**	**2,580.2**	**1,356.0**	**3,131.4**	**13,994.8**

Table 2-11: Floor area of the non-residential building stock in the EU27 [Mio m²][11]

Age structure	Private offices	Trade facilities	Gastro-nomic facilities	Health facilities	Educa-tional facilities	Industrial buildings	Public buildings	Other buildings	Total
Until 1980	507.6	1,247.5	609.2	611.8	1,124.5	1,867.0	619.3	1,190.3	**7,783.1**
1980 -1989	185.8	272.1	176.0	121.7	152.4	362.5	169.0	205.6	**1,642.2**
1990 -1999	307.4	409.4	97.4	123.1	124.6	219.4	279.0	202.9	**1,757.1**
2000-2009	210.3	520.2	71.7	104.9	60.6	561.5	175.7	400.1	**2,108.2**
Total	**1,211.2**	**2,449.2**	**954.3**	**961.5**	**1.462.1**	**3,010.4**	**1,242.9**	**1,999.0**	**13,290.6**

2.2.2.2.3 Building Research & Information study[12]

This study compares European residential building stocks regarding performance, renovation and policy opportunities.

The study states:

- In most European countries the rate of new construction in the residential sector is around 1% of the total stock.
- The annual demolition rate in the European Union varied between 0.025% and 0.23% of the total stock in 2003.

2.2.2.2.4 The Fundamental Importance of Buildings in Future EU Energy Saving Policies paper

Figure 2-1 displays an extract of the paper 'The Fundamental Importance of Buildings in Future EU Energy Saving Policies'[13].

[11] Prepared by a Taskforce of Actors and Stakeholders from the European Construction Sector, 12th July 2010

[12] Comparing European residential building stocks: performance, renovation and policy opportunities. OTB Research Institute for Housing, Urban and Mobility Studies, TU Delft, Department of Architecture, University of Cambridge, 2 December 2010

3.2 It is estimated that there are about 210 million buildings in the European Union providing approximately 53 billion square metres of usable indoor space for our activities. These buildings are divided into the following types[3]:

Type	Number constructed before 1973	Number constructed after 1973	Overall percentage of total stock
Individual Private Residences	42,840,000	28,560,000	34
Private Apartment Buildings	17,640,000	11,760,000	14
Public (Social) Housing	16,800,000	8,400,000	12
Commercial Buildings	18,900,000	44,100,000	30
Public Buildings	5,040,000	11,760,000	8
Other (Leisure, Industrial…)	1,890,000	2,310,000	2
Totals:	**103,110,000**	**106,890,000**	**100**

Note:
The table above seeks to establish a baseline for the quantum of buildings in the European Union. The division into sub-sections of building types follows a generally accepted sub-division of the building stock and it is further broken down to reflect construction before the first major oil crisis in 1973 as the buildings built before that time were built in an era where there was little or no consciousness of the need to design for energy efficient performance.

Figure 2-1 Building stock according paper [13]

This paper also states that it will be necessary to increase the rate of deep energy renovation (of buildings) by a factor of two to three times the current rate of between 1.2% and 1.4% in the decades up to 2050 in order to reach the short and long term EU targets of reducing CO_2 emissions by 80-95% by 2050 as compared to 1990 levels.

2.2.2.2.5 Think study[14]

This study states, referring to DG Energy[15], the following:
"Buildings must be central to the EU's energy efficiency policy, as nearly 40% of final energy consumption (and 36% of greenhouse gas emissions) is in houses, offices, shops and other buildings. Moreover, buildings provide the second largest untapped cost effective potential for energy savings after the energy sector. In this context, it is important to stress that buildings constructed today will be there for the next 50 to 100 years. For example, 92% of the building stock from 2005 will still be there in 2020 and 75% in 2050. This is due to the very low demolition rates (about 0.5% per year) and new built construction rates (about 1.0% per year).Moreover, the current general

[13] The Fundamental Importance of Buildings in Future EU Energy Saving Policies, A Paper Prepared by a Taskforce of Actors and Stakeholders from the European Construction Sector, 12th July 2010, http://www.euroace.org/LinkClick.aspx?fileticket=IYFmSEm7faM%3D&tabid=159

[14] How to Refurbish All Buildings by 2050; Final Report June 2012; http://www.eui.eu/Projects/THINK/Documents/Thinktopic/THINKTopic72012.pdf

[15] European Commission Directorate- General for Energy. Consultation Paper "Financial support for energy efficiency in buildings". European Commission, Directorate-General for Energy, Brussels. February 2012

refurbishment cycles are between 30-40 years but those which lead to energy efficiency improvements are at longer intervals (60-80 years). With approximately 3% of the building stock being renovated per year, this signifies that in only half of the cases energy efficiency improvements are included (i.e. 1.5% energy-related renovation rate per year)."

2.2.2.2.6 Relation between stock and loading

Building stock data and energy consumption can be used to calculate the energy consumption per square meter and per sector. Table 2-12 shows the final consumption of electricity in TWh per year for EU28 according to Eurostat.

Table 2-12 EU28 annual final consumption of electricity by industry and households/services in TWh[16]

	Final annual energy consumption in TWh											
Year	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Industry	1075	1081	1089	1120	1133	1131	1142	1119	966	1030	1037	1008
Households	744	753	787	798	806	818	810	820	820	845	803	828
Services	703	716	741	763	780	822	837	864	867	904	885	898

The origin of the consumption is shown in Figure 2-2.

[16] Eurostat, http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&plugin=1&language=en&pcode=ten00094

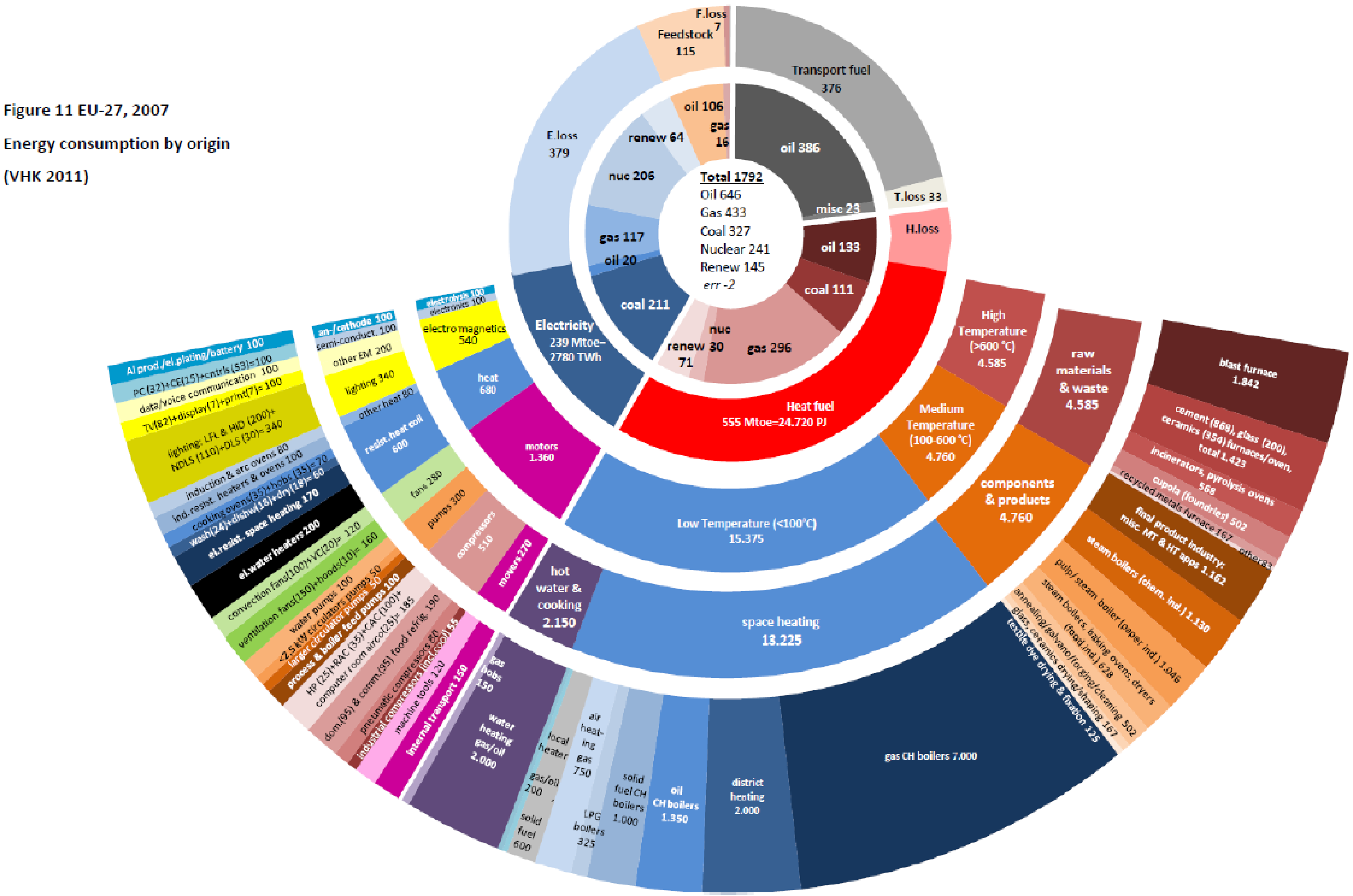

Figure 2-2 Energy consumption by origin, EU27, 2007 (VHK 2011)[51]

2.2.2.3 Power cable stock

The tables in this paragraph shows the stock data, i.e. estimations of the amount of copper of fixed wired conductors and cables in residential and non-residential buildings divided into services and industry sector.

Table 2-13: Stock of LV cables and wires in residential buildings[17]

Avg living area	109	m²
Avg Cu/100m²	**29.1**	kg/100m²
EU27 Building floor space	2,40E+10	m²
Residential Floor space	1,80E+10	m² (75% total building floor space)
Total Cu	**5241**	kton

Remark: In the study of the Amended Ecodesign Working Plan, Final report Task 3 (v. 16 Dec. 2011), the determined stock in residential buildings was: 7515kton (= **41.75** kg/100m²) in 2010.

The diversity in terms of typology within the non-residential sector is vast. Compared to the residential sector, this sector is more complex and heterogeneous. It includes types such as offices, shops, hospitals, hotels, restaurants, supermarkets, schools, universities, and sports centres while in some cases multiple functions exist in the same building. The non-residential stock counts for about 25%[18] of the total EU27 Building floor space.

Table 2-14: Stock of LV cables and wires in non-residential buildings - Services[19]

Avg Cu/100m²	**54**	kg/100m²
EU27 Building floor space	2.40E+10	m²
Floor space	6.00E+09	m² (25% total building floor space)
Total Cu	**3250**	kton

Remark: In the study of the Amended Ecodesign Working Plan, Final report Task 3 (v. 16 Dec. 2011), the determined stock in services buildings was: 4734 kton (= **78.9** kg/100m²) in 2010.

[17] Source: CuIoU survey European Copper Institute, year 2000
[18] Europe's Buildings under the Microscope (2011), http://www.bpie.eu/documents/BPIE/HR_%20CbC_study.pdf
[19] Source: CuIoU survey European Copper Institute, year 2000

Table 2-15: Stock of LV cables and wires in non-residential buildings - Industry[20]

Avg Cu/100m^2	**139**	kg/100m^2
EU27 Building floor space	2.40E+10	m^2
Floor space	2752E+06	m^2
Total Cu	**3825**	kton

Remark: In the study of the Amended Ecodesign Working Plan, Final report Task 3 (v. 16 Dec. 2011), the determined stock in industry buildings was: 6538 kton (= 237.6 kg/100m^2) in 2010.

General assumption in Amended Ecodesign Working Plan:
Stock in non-residential buildings is 1.5 times the stock in residential buildings. This means 1.5 x 5241 kton= **7861** kton as a total amount of copper used in non-residential (services + industry) buildings (Amount determined in Working Plan: 11272 kton).

The amount of copper and circuits in a real office building[21] is shown in Table 2-16 as an example. The calculated figure of 93 kg/100m^2 for this this building is about 18% above proposed average (78.9 kg/100m^2).

Table 2-16: Example of a real office building[21]

Amount of Lighting 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
Floor space (m^2)	3059
Cu (kg/100m^2)	**93**

2.2.2.4 Distribution of power cables based upon cross sectional area

Distribution of LV cables in residential buildings shown in Table 2-17 and in non-residential buildings shown in Table 2-18 is based upon a survey of the European Copper Institute[22].

Table 2-17: Distribution of LV cables in the residential buildings[23]

CSA (mm^2)	% 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

[20] Source: CuIoU survey European Copper Institute, year 2000
[21] EnergyVille building, Waterschei, Belgium
[22] Source: CuIoU survey European Copper Institute, year 2000
[23] Source: CuIoU survey European Copper Institute , year 2000

Wires and cables with a CSA of 1.5 mm² are most common for lighting circuits; whereas 2.5 mm² wires and cables are most common for socket outlet circuits. These circuits count for about 60.9 % of the total copper used in fixed wired electrical installations in residential buildings.

Wires and cables with a CSA above 2.5 mm² are mostly used for dedicated circuits, e.g. electrical circuits for electrical heating, cooking, and washing machine.
In residential buildings cables with a CSA of more than 10 mm² are generally used for:

- Connecting the LV circuit board to the main LV feeder in the street.
- Connection between the LV main circuit board and sub LV circuit boards in the building (e.g. apartment).
- Equipotential and secondary bonding.

Note: In the UK 1 mm² wiring is also used for lighting circuits. In Germany 1.5 mm² wire and cable are also used for socket outlet circuits.

Table 2-18: Distribution of LV cables in non-residential buildings[24]

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

Wires and cables with a CSA of 1.5 mm² are most common for lighting circuits; whereas 2.5 mm² wires and cables are most common for socket outlet circuits. These circuits count for about 15 % of the total Copper used in fixed wired electrical installations in non-residential buildings. The total length of these cables counts for 73.6% of the total length of the installed cables.

[24] Source: CuIoU survey European Copper Institute, year 2000

2.2.3 New sales rate

The new sales are directly related to construction of new buildings. Hence, the new sales of power cables will be equal to the power cable stock of the previous year multiplied by the buildings stock growth rate.

2.2.3.1 BPIE

In terms of growth, annual construction rates in the residential sector are around 1% over the period between 2005 and 2010[26]. Except in The Netherlands (in the case of multi-family houses), all other countries experienced a decrease in the rate of new build in recent years, reflecting the impact of the current financial crisis in the construction sector[25].

2.2.3.2 Ecofys

The Ecofys study[29] estimates the overall new construction rate for the non-residential buildings at **2.1%** and the new construction rate for the industrial buildings at **3.1%** (see Table 2-19).

2.2.4 Replacement sales rate

The replacement sales are directly related to the building renovations. However, renovations do not always include a replacement of the electric wiring. Hence, the replacement sales rate needs to be corrected downwards.

The renovation rates of buildings will have a large impact on future market trends. In the BPIE study[26] three scenarios of renovation rates (in combination with different renovation depths) are considered.

Public buildings are in the limelight at the moment due to policies requiring them to become close to zero energy buildings by the end of 2018 and a sectorial renovation rate of **at least 3%** is recommended.

Most estimates of overall renovation rates (other than those relating to single energy saving measures) are mainly between around 0.5% and 2.5% of the building stock per year.

2.2.4.1 Working Plan

In the Working Plan the refurbishment rate has been set at **3%** following the rationale applied for thermal insulation products.

[25] http://www.bpie.eu/
[26] BPIE study: Europe's buildings under the microscope – October 2011 http://www.bpie.eu/documents/BPIE/HR_%20CbC_study.pdf

2.2.4.2 BPIE

In the BPIE study[27], it is assumed that the current, at that time 2011, prevailing building renovation rate across Europe was **1%**.

2.2.4.3 Ecofys

The Ecofys study[29] estimates the overall renovation rate for the non-residential building sector at **12.4%** ().

The Heinze[28], [29] study allows a better understanding of the non-residential modernisation market in Germany. The study is based on an extensive architect survey and investigates what kind of modernisation activities are typically realized in building renovations. The study indicates that in **59%** of all renovation activities in Germany the power cables are replaced.

[27] Europe's Buildings under the Microscope (2011), http://www.bpie.eu/documents/BPIE/HR_%20CbC_study.pdf

[28] Modernisierungsmarkt 2008 - Modernisierungsaktivitäten von Bewohnern und privaten Vermietern im Wohnungsbau: Produktbereich Dach. Heinze GmbH. (Unpublished). Germany.

[29] Also referred to in: Ecofys report, Panorama of the European non-residential construction sector, 9 December 2011

Table 2-19: Summary of metabolism rates in representative countries and EU27[30]

	Germany	Hungary	Poland	Spain	Sweden	EU27 (weighted)
New construction rate						
Private offices	0.7 %	4.0%	5.3 %	4.7 %	1.2 %	**2.6 %**
Trade facilities	2.4 %	1.9 %	4.4 %	1.5 %	3.5 %	**2.4 %**
Gastronomic facilities	0.1 %	0.9 %	2.6 %	1.4 %	1.8 %	**0.9 %**
Health facilities	1.4 %	0.8 %	3.1 %	3.1%	0.5 %	**2.0 %**
Educational facilities	1.4 %	0.8 %	1.0 %	0.5%	0.4 %	**1.0 %**
Industrial buildings	3.5 %	1.7 %	1.9 %	3.5 %	1.3 %	**3.1 %**
Public buildings	0.9 %	0.7 %	5.3 %	4.0 %	n.a. %	**2.2 %**
Other buildings	1.0 %	2.7 %	1.6 %	8.4 %	2.5 %	**3.2 %**
Total (weighted)	**1.0 %**	**1.7 %**	**2.3 %**	**4.2 %**	**1.3 %**	**2.1 %**
Demolition rate						
Non-residential sector	0.29 %	n.a.	n.a.	0.1 %	0.6 %*	**0.2 %**
Renovation rate						
Overall renovation rate	**11.0 %**	**6.2 %**	**5.6 %**	**20.1 %**	**14.3 %**	**12.4 %**
Energy related renovation rate	2.3 %	1.7 %	1.2 %	4.1 %	2.8 %	**2.6 %**
Not energy related renovation rate	8.7 %	4.5 %	4.4 %	16.0 %	11.4 %	**9.8 %**

2.2.4.4 Euroconstruct

Euroconstruct [31] is a European research group for research and analysis of the construction industry, which includes 19 European countries (the EC19 countries include Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, Czech Republic, Hungary, Poland and Slovak Republic). GDP and construction output in Euroconstruct countries is shown in Figure 2-3. Construction output per segments is listed in Table 2-20.

[30] Ecofys report, Panorama of the European non-residential construction sector, 9 December 2011
[31] http://www.euroconstruct.org/

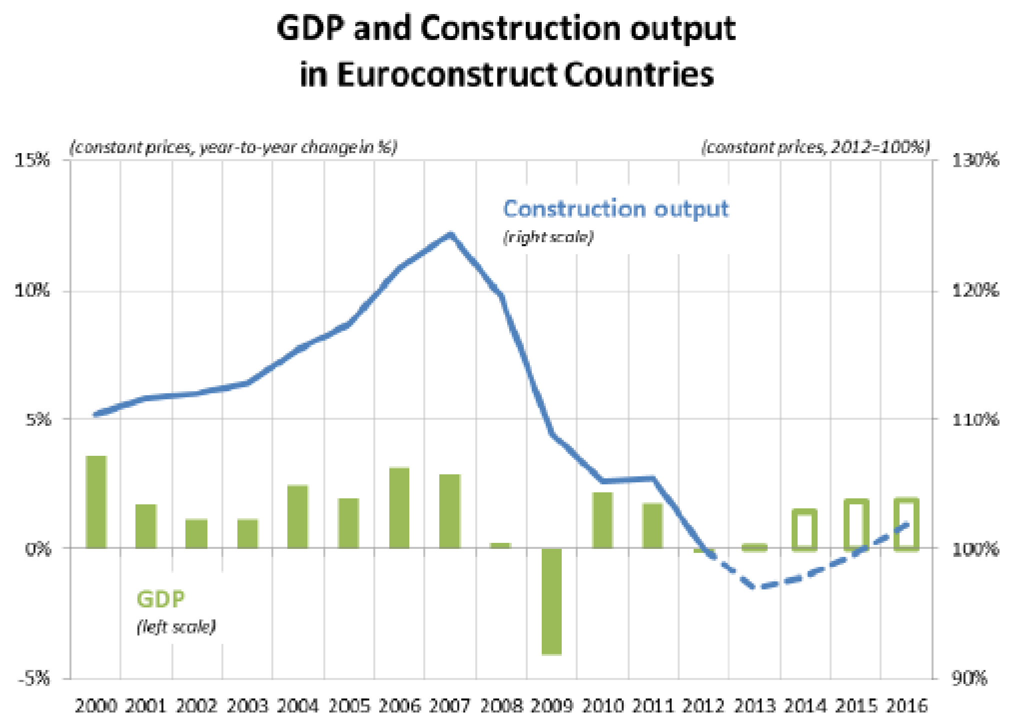

Figure 2-3 GDP and Construction output in Euroconstruct Countries[32]

Table 2-20: Construction output by segments[32]

Construction Output by Segments (EC19)							
							(% change in real terms)
				Estimate	Forecasts		Outlook
Country	2010	2011	2012	2013	2014	2015	2016
Residential	-1,9	1,9	-4,2	-2,2	1,4	2,2	2,3
Non-Residential	-5,3	0,0	-4,6	-3,4	0,0	1,4	2,3
Civil Engineering	-3,6	-2,4	-8,2	-4,0	1,2	1,6	1,7
Total construction output	-3,4	0,3	-5,2	-3,0	0,9	1,8	2,2

2.2.5 Market and stock data summary

The assumed building stock and rates, based upon the previous sections, are shown in Table 2-21.

[32] 76th Euroconstruct conference, Prague, 28-29th November 2013, press release, http://www.euroconstruct.org/

Table 2-21: Summary of building stock, growth rates and construction sales

Sector	Building product time	Building service life	Vacancy	New building construction rate	Building demolition rate	Building refurbish-ment rate	Building stock growth rate	Stock Number of buildings	
Unit	Year	Year	%	% p.a.	% p.a.	% p.a.	% p.a.	(1000 units)	%
Residential sector	47.62	45.24	5%	1.00%	0.10%	2.00%	0.90%	200000	93%
Services sector	8.20	7.79	5%	2.10%	0.20%	12.00%	1.90%	11415	5%
Industry sector	8.20	7.79	5%	3.10%	0.20%	12.00%	2.90%	2580	1%
Total sector (weighted)	45.04	42.79	5%	1.08%	0.11%	2.65%	0.98%	213995	100%

Some of the stakeholders remarked[33] that an average building lifetime between renovations of 8 years (12.4%) for the services and industrial sector is rather short. The product lifetime of cables and circuits is explained in Task 3. The stock and sales are calculated based upon reference year 2010 and in accordance with the product lifetime figures described in Task 3.

It is assumed that in **59%** of all building renovation activities the power cables are replaced (cfr. 2.2.4.3).

The assumed cables stock and sales rates, based upon the building construction rates, can be found in Table 2-22. However, the product lifetime is adapted according the comments of the stakeholders.

Table 2-22: Summary of cable stock, growth and sales rates

Sector	Product life	Service life	Vacancy	Stock growth rate	Demolition rate	Replace-ment sales rate	New sales rate	Total sales rate	Stock (Reference year: 2010)	
Unit	Year	Year	%	% p.a.	% p.a.	% p.a.	% p.a.	% p.a.	kTon Cu	%
Residential sector	64.00	60.80	5%	0.90%	0.10%	1.18%	0.90%	2.08%	5241	43%
Services sector	25.00	23.75	5%	1.90%	0.20%	3.20%	1.90%	5.10%	3250	26%
Industry sector	25.00	23.75	5%	2.90%	0.20%	2.80%	2.90%	5.70%	3825	31%
Total sector (weighted)	41.60	39.52	5%	1.79%	0.16%	2.22%	1.79%	4.00%	12316	100%

Table 2-32 the absolute values of stock and sales are calculated based upon the figures in Table 2-22.

[33] Minutes of the second stakeholder meeting, http://erp4cables.net/node/6

Table 2-23: Summary of stock data per 100m² floor area

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

2.3 Market trends

Power cables are a mature product and available in standardized sizes. Power cables are a mature product and available in standardized sizes. As described earlier, the annual sale of power cables depends on the amount of new buildings built and existing buildings renovated. Especially the latter is considered to increase in the coming years.

2.3.1 Market production structures

Most cables in buildings use copper conductors. According to the European Copper Institute[34], the direct copper industry in Europe is made up of around 500 companies, with an estimated turnover of about €45 billion, and employs around 50,000 people.
While the global economic situation remained relatively weak in 2012, the world demand for copper was at a record high of around 25.5 million tonnes, made up of 20.5 million tonnes of refined metal production plus 5 million tonnes of direct-melt scrap. The EU27 demand, impacted by the ongoing malaise in the construction sector, was estimated at around 4 million tonnes.

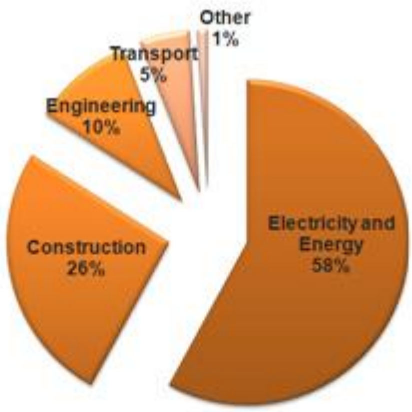

Figure 2-4: Use of refined copper within Europe (ECI, 2012)

To meet the modern world's increasing demand for copper, which has doubled in the last 25 years, it has been important to exploit copper's ability to be 100% recycled, without any loss in performance. Throughout the last ten years, it is estimated that

[34] See comments of European copper institute - second stakeholder meeting http://www.erp4cables.net/sites/erp4cables.net/files/attachments/ECI%20comments%20to%20Task%20123.pdf and http://www.copperalliance.eu/industry/economy

41% of the EU27's copper demand has been met through the recovery and recycling of value chain offcuts, plus end-of-life products[35] .

In 2011, the copper mine production in Europe was 926,868 tonnes, representing 5.7% of the world. Chile was the largest miner, with a 32% share, followed by China (8%), Peru (8%), USA (7%) and Australia (6%)[34].

China was the world's largest producer of refined copper, with 27% of the world output, followed by Chile (16%), Japan (7%) and USA and Russia (5% each)[36].

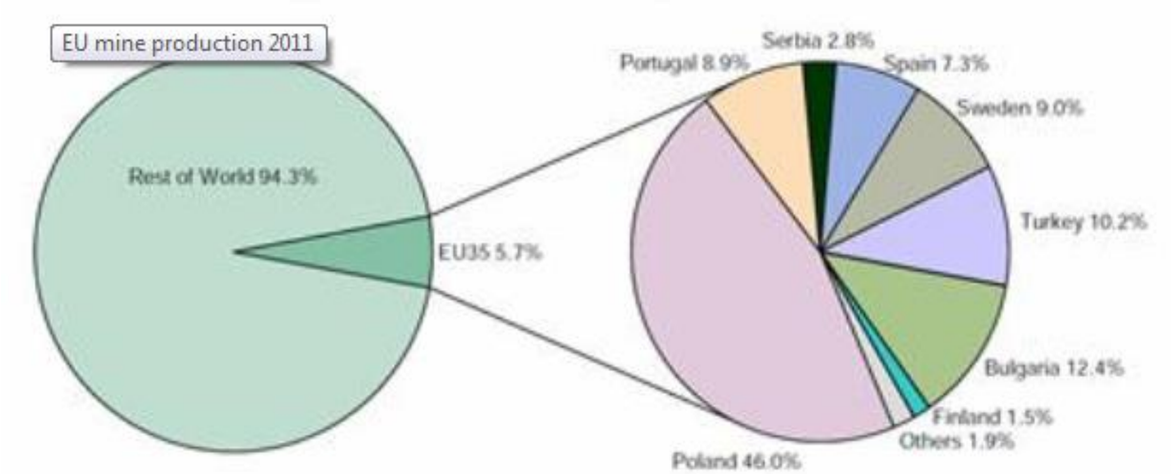

Figure 2-5: EU35 Mine production of copper 2011[36]

Cable manufacturers are grouped in the 'Europacable' association. Some of the main manufacturers of power cables are listed below, by alphabetical order:

- Acome – www.acome.com, France
- Brugg Cables, www.bruggcables.com, Switzerland
- General Cable, www.generalcable.es, Spain
- Hellenic Cables, www.cablel.com, Greece
- Italian Cable Company, www.icc.it, Italy
- Kabelwerk Eupen, www.eupen.com, Belgium
- Leoni, www.leoni.com, Germany
- Nexans, www.nexans.com, France
- Nkt cables, www.nktcables.com, Denmark
- Plastelec - http://www.plastelec.com/, France
- Prysmian Group, www.prysmiangroup.com, Italy
- Reka Cables, www.reka.fi, Finland
- SKB Gruppe, www.skb-gruppe.at, Austria
- TELE-FONIKA Kable, www.tfkable.com, Poland
- TKF, www.tkf.nl, Netherlands
- Tratos Cavi, www.tratos.eu, Italy
- Waskönig+Walter, www.waskoenig.de, Germany

Aluminium conductors are still used for bulk power distribution and large feeder circuits, but not as such in buildings. They are seldom used indoor, because connections are

[35] Glöser, Simon; Soulier, Marcel; Tercero Espinoza, Luis A. (2013): Dynamic Analysis of Global Copper Flows. Global Stocks, Postconsumer Material Flows, Recycling Indicators, and Uncertainty Evaluation. In Environ. Sci. Technol. 47 (12), pp. 6564–6572.
[36] Britisch Geological Survey, 2013, European Mineral Statistics 2007-11 A product of the World Mineral Statistics database

more difficult to avoid cold-flow under pressure which causes screw clamped connections may get loose over time. Also aluminium forms an insulating oxide layer on the surface and therefore needs an antioxidant paste at joints.

Depending on their final application, the power cables are sold to the end user through variety of channels such as directly from manufacturers, via wholesalers, via distributors or via installers. The product distribution channels of power cables are mostly business-to-business, as these products usually need professional installation (mainly due to safety hazards). Cables are installed by electrical contractors, e.g. those represented by European Association of Electrical Contractors (www.aie.org). A fraction of the sales is distributed via retail and is mainly installed in the residential sector.

2.3.2 General trends in product design and product features; feedback from consumer associations

Power cables are a mature product and available in standardized sizes.
There is a trend to use low smoke halogen free cables in buildings.

2.4 Consumer expenditure base data

The cable price is proportional to the copper price and therefore the cable price can be expressed in €/ (CSA [mm²] x l [m] x N) wherein CSA means Cross-Sectional-Area, l means Length and N means number of cores. Hence, the product unit is (CSA [mm²] x l [m] x N).

2.4.1 Purchase price

Europe studied and defined a list of 'critical raw materials'[37]. Neither copper nor aluminium are included in this list and impact thereof will therefore not be taken into account.

The European Copper Institute confirmed that copper is **not** becoming a scarce resource. See paragraph 2.4.1.1 on long-term availability of copper. However according to Europacable[38], referring to a JRC study[39], copper is becoming a scarce resource.

The price of cable can be calculated as[40] :

$$NDP = K'_1(\text{cable type}) \times CP \times CM + K'_2(\text{cable type})$$

Where:

NDP: Not discounted cable sales price
CP: conductor material price per kg

[37] http://ec.europa.eu/enterprise/policies/raw-materials/critical/index_en.htm
[38] Comment 22 of Europacable – second stakeholder meeting http://www.erp4cables.net/sites/erp4cables.net/files/attachments/Europacable%20Comments%20Task%20123.pdf
[39] JRC study "Integration of resource efficiency and waste management criteria in European product policies – Second phase report N°2 (Report EUR 25667 EN)", http://sa.jrc.ec.europa.eu/uploads/ecodesign-Application-of-the-projects-methods-to-three-product-groups-final.pdf
[40] Comments of Europacable – first stakeholder meeting

CM: amount of conductor material in kg
K'_1: constant in function of cable type, reflecting the cost of the conductor material
K'_2: constant, in function of cable type, reflecting the plastics, labour costs and other added values

It is common practice in various sectors to use catalogue prices as an approach to price an installation. Sometimes the price of the equipment at catalogue price (which is higher than the cost paid by the installer to the manufacturer or distributor) allows enough margin to include the labour and auxiliaries costs.
Installers actually buy at discounted prices. Then, on top of that, the labour cost plus the auxiliaries are to be added to the offer.
The "LV Power Cable Market Prices" study[41], based on the analysis of data of 13948 cables from 7 European manufacturers of different sizes, indicates for the category BB (=multi or single core cables without any special characteristic) that an average not discounted price of 0.21588 €/ (mm²x m) is applicable.
The prices in this study refer to:

- 1 m cable, per mm² section;
- July 2014;
- standard packages;
- prices for the final professional customer;
- in case of single core cables or wires, the total section is the rated section of the cable. In case of multicore cables the total section has been calculated summing the sections of all the cores;

and do not include:

- the costs of cable installation and cable transportation to the building site;
- discounts (see further on);
- VAT.

Like for many other products also cable and wire prices are subjected to typical discount policies. According the study[41], power cables of category BB are subjected to discount class A (typical discount is 45+8+5) or class B (typical discount is 50+8+5).
Where the discount is A+B+C, the final discounted price is calculated by following formula:

$$DP = NDP \times (1-A/100) \times (1-B/100) \times (1-C/100)$$

Where:
DP: Discounted cable sales price
NDP: Not discounted cable sales price
A, B, C: discounts

The ECD study[41] lists for cables of category BB an average discounted cable price of 0.09434 €/ (mm². m).

[41] "LV power cable market prices" study by ECD (Engineering, Consulting and Design) for European Copper Institute, August 2014

Table 2-33 lists the prices, obtained from 2 sources, for the cables mentioned in the Bill Of Materials table in Task 4. The average discounted cable price of 0.1 €/ (mm². m) for this cable type matches well with the 0.09434 €/ (mm². m) mentioned in the study[41].

The cost of cable can be calculated as[42]:

$$CC = K_1(\text{cable type}) \times CP \times CM + K_2(\text{cable type})$$

Where:

- CC: cable cost
- CP: conductor material price per kg
- CM: amount of conductor material in kg
- K_1: constant in function of cable type, reflecting the cost of the conductor material
- K_2: constant in function of cable type, reflecting the plastics, labour costs and other added values

Note that the values K_1 and K_2 depend on the type of cable.

Table 2-24: conductor cost based upon conductor material price

Conductor material	Price LME 10 October 2013	density ρ	Volume V (1 m at 1 mm²)	Weight of V	Price
Unit	€/100kg	kg/m³	m³	Kg	€/mm².m
Cu core	535	8900	0.000001	0.0089	0.047615
Al core	183	2700	0.000001	0.0027	0.004941

For similar aluminium cables, the price of copper cables is used as a starting point, except that the price of the copper material is subtracted of the product price and the price of aluminium material is added to the product price. In Task 4 this price is verified with some commercial offers.

Conductor prices are very volatile[43], therefore it is common to correct cable prices with a surcharge[44] depending on the market price.

[42] See comments of Europacable – first stakeholder meeting
[43] http://www.ems-power.com/ems-metallkurse/ems-metallkurse.de.shtml
[44] http://www.igus.de/_Product_Files/Download/pdf/copper_en.pdf

Figure 2-6 example of cable connector

In the calculation of the base case product price in later tasks, the connector price will be included, because altering the cable size can have an impact on the price of the used connectors (example see Figure 2-6). The price of connectors is shown in Table 2-25. This price is based upon several offers.

Table 2-25 connector prices

Minimum wire size	Maximum wire size	CSA	Connector price	Discounted connector price
mm^2	mm^2	mm^2	€	€
0.14	4	1	0.87	0.54
0.14	4	1.5	0.87	0.54
0.14	4	2.5	0.87	0.54
0.14	4	4	0.87	0.54
0.2	10	6	1.61	0.97
0.2	10	10	1.61	0.97
0.5	16	16	2.11	1.25
1.5	25	25	2.11	1.07
1.5	50	35	4.85	2.84
1.5	50	50	4.85	2.84
16	70	70	11.79	7.31
25	95	95	22.11	13.71
35	150	120	28.96	17.96
35	150	150	28.96	17.96
70	240	185	35.36	21.92
70	240	240	35.36	21.92
		300	44.20	27.40
		400	58.93	36.53
		500	73.67	45.67
		630	92.82	57.54

2.4.1.1 Copper long-term availability

The future availability of minerals is based on the concept of reserves and resources. Reserves are deposits that have been discovered, evaluated and assessed to be profitable. Resources are far larger and include reserves, discovered and potentially profitable deposits, and undiscovered deposits predicted based on preliminary geological surveys. Copper is naturally present in the Earth's crust. According to the US Geological Survey (USGS, 2014), the copper reserves amount to 690 million tonnes and the copper resources are estimated to exceed 3,500 million tonnes. The number does not include vast copper deposits found in deep sea nodules and submarine massive sulphides. Current and future exploration opportunities will increase both for reserves and known resources. According to USGS data, since 1950 there has always been, on average, 40 years of copper reserves and over 200 years of resources left (see Figure 2-7).[45, 46]

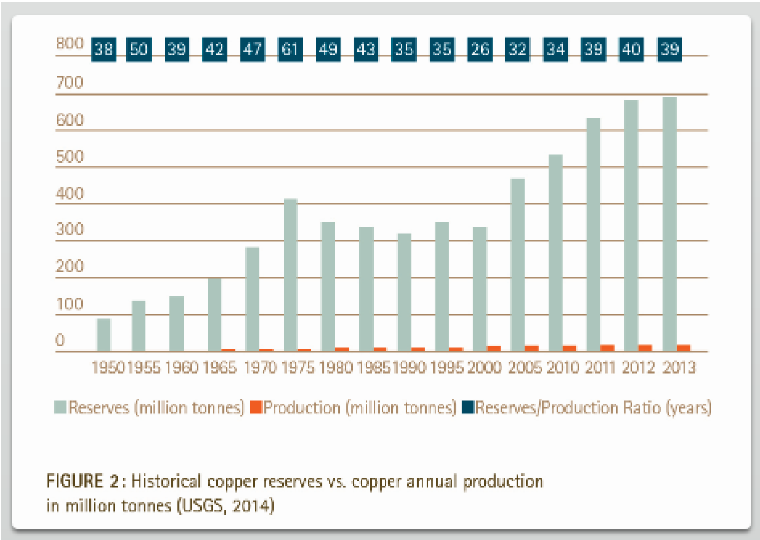

FIGURE 2: Historical copper reserves vs. copper annual production in million tonnes (USGS, 2014)

Figure 2-7 Historical copper reserves vs. annual copper production (USGS, 2014)

2.4.2 Installation costs

Cable installation time and installation costs depend on the length of the cable, the CSA of the cable and the difficulty for installation (accessibility). The cable installation time does not take into account the installation of the cable fixing system (cable tray, cable ladder, etc.) to which the cable is mounted. The calculation of the installation time is based on a normal accessibility to the cable fixing system (normal working height, no obstacles, etc.). The installation time of a cable with section CSA, length L is calculated with formula below.

$$T_{CSA} = Tm_{CSA} \cdot L + Te_{CSA}$$

Where

T_{CSA} = time to install a cable with section CSA and length L
Tm_{CSA} = time to install one meter cable with section CSA without connecting it
L = length of the cable to install
Te_{CSA} = time to connect the ends of a cable of section CSA

[45] See comment 2 of ECI comments – second stakeholder meeting http://www.erp4cables.net/sites/erp4cables.net/files/attachments/ECI%20comments%20to%20Task%20123.pdf

[46] http://copperalliance.org/core-initiatives/sd/availability/

The average hourly rates in the EU28 are shown in Table 2-26 and are used as the installer's hourly rate. Installation times for copper based cables are listed per cable section in Table 2-27. Installation times for aluminium based cables are listed per cable section in Table 2-28.

Table 2-26 hourly rates in EU-28[47]

	2008	2010	2011	2012	2013	Non-wage costs (% of total), 2013	Change 2013/2008, %
EA17	25.7	26.9	27.5	28	28.4	25.90%	10.40%
EA18	25.5	26.7	27.3	27.8	28.2	25.90%	10.40%
EU28	21.5	22.4	22.9	23.4	23.7	23.70%	10.20%
Belgium	32.9	35.3	36.3	37.2	38	27.40%	15.40%
Bulgaria	2.6	3.1	3.3	3.6	3.7	15.80%	44.10%
Czech Republic	9.2	9.8	10.5	10.5	10.3	26.80%	12.40%
Denmark	34.4	36.7	37.3	38	38.4	12.40%	11.70%
Germany	27.9	28.8	29.6	30.5	31.3	21.80%	12.20%
Estonia	7.8	7.6	7.9	8.4	9	26.70%	15.20%
Ireland	28.9	28.9	28.7	29	29	13.80%	0.50%
Greece	16.7	17	16.2	15	13.6	19.10%	-18.60%
Spain	19.4	20.7	21.2	21	21.1	26.60%	8.70%
France	31.2	32.6	33.6	34.3	34.3	32.40%	9.90%
Croatia	9.2	8.6	8.7	8.7	8.8	15.40%	-4.00%
Italy	25.2	26.8	27.2	27.6	28.1	28.10%	11.40%
Cyprus	16.7	17.7	18	18	17.2	16.60%	2.60%
Latvia	5.9	5.5	5.7	6	6.3	20.60%	7.10%
Lithuania	5.9	5.4	5.5	5.8	6.2	28.50%	5.00%
Luxembourg	31	32.9	33.9	34.7	35.7	13.40%	15.40%
Hungary	7.8	7	7.3	7.5	7.4	24.60%	-5.20%
Malta	11.3	11.9	12.2	12.5	12.8	8.00%	13.90%
Netherlands	29.8	31.1	31.6	32.3	33.2	24.70%	11.70%
Austria	26.4	28	29	30.5	31.4	26.70%	18.90%
Poland	7.6	7.2	7.3	7.4	7.6	16.70%	0.10%
Portugal	12.2	12.6	12.6	11.6	11.6	19.30%	-5.10%
Romania	4.2	4.1	4.2	4.1	4.6	23.20%	10.60%
Slovenia	13.9	14.6	14.9	14.9	14.6	14.70%	4.90%
Slovakia	7.3	7.7	8	8.3	8.5	27.40%	17.00%
Finland	27.1	28.8	29.5	30.8	31.4	22.10%	15.90%
Sweden	31.6	33.6	36.4	39.2	40.1	33.30%	26.90%
United Kingdom	20.9	20	20.1	21.6	20.9	15.30%	-0.30%
Norway	37.8	41.6	44.5	48.5	48.5	18.90%	28.20%

[47] Labour costs in the EU28, Eurostat news release 49/2014, 27 March 2014

Table 2-27 installation times for Cu based cables[48]

Cu based cables		
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

[48] EUROPEAN COPPER INSTITUTE, UTILISATION RATIONNELLE DES ENERGIES APPLIQUEE AU DIMENSIONNEMENT DES NOUVELLES INSTALLATIONS ELECTRIQUES

Table 2-28 installation times for Al based cables[48]

Al based cables		
Mono	**Installation time per meter**	**Installation time for the cable ends**
Min	Min/mm2	Min/mm2
1	1.66	4.75
1.5	2.33	6.65
2.5	2.99	8.55
4	3.66	11.4
6	4.99	11.4
10	5.65	14.25
16	6.65	16.15
25	8.31	19.38
35	9.31	24.23
50	9.97	29.07
70	11.3	34.2
95	11.97	42.75
120	13.3	42.75
150	14.96	57
185	16.63	57
240	19.95	80.75
300	23.27	114
400	26.6	190
500	33.25	342
630	39.9	456

The installation cost is composed of a cost to design (and verify or certify) the circuit plus the cost to install the cable. This is modelled with formula 2.2:

$$C_I = C_E + T_{CSA} \cdot hr \qquad \text{(formula 2.2)}$$

Where

C_I = installation cost (EURO)
C_E= engineering/design/certification cost (EURO)
T_{CSA} = time to install a cable with section CSA and length L
hr = hourly rate (EURO/hour)

Unless impacted by a measure proposed in later tasks C_E will be set tot 0.

2.4.3 Repair and Maintenance costs

Neither repair, nor maintenance costs are applicable to power cables. Once installed, a power cable is unlikely to become faulty, unless inappropriate use or damage by external factors (third party damages the cable) is the cause.

2.4.4 Disposal costs/benefits

For methods on recycling see Task 3.

As power cables have positive scrap value, it is an advantage for a company to send the old power cables for scrap and avoid disposal costs. It is assumed that there is no disposal cost required for the handling of power cables at their end-of-life.

The positive scrap value for the owner of the cable should be about 70% of the copper price (fluctuates). For instance, calculation of the positive scrap value based upon May 2014th figures results in €3500/ton / €5300/ton = 66%.

Copper price – scrap: ~ € 3500/ton[49] (05/2014)
Primary Copper price: ~€ 5300/ton[50] (05/2014)

2.4.5 Energy rates

Table 2-29 presents the average financial rates in the EU27 suggested in the MEErP 2011 Methodology. These rates will be used in this preparatory study according the MEErP methodology[51]. The calculated rates per year (reference year = 2011) are listed in Table 2-31. This table shows the calculated annual electricity rates for the domestic and non-domestic sector, based upon the figures in Table 2 29 (reference year 2011).

Table 2-29 Generic energy rates in EU-27 (1.1.2011)[51]

	Unit	domestic incl.VAT	Long term growth per yr	non-domestic excl. VAT
Electricity	€ / kWh	0.18	5%	0.11
Energy escalation rate*	%		4%	
**= real (inflation-corrected) increase*				

For the calculation in this study all non-residential prices are VAT exclusive.

2.4.6 Financial rates

Table 2-30 presents the average financial rates in the EU27 suggested in the MEErP 2011 Methodology.

[49] http://www.scrapmonster.com/european-scrap-prices
[50] http://www.cablebel.be/index-site.php
[51] VHK, MEErP 2011 METHODOLOGY PART 1.

Table 2-30 Generic financial rates in EU-27[52]

	Unit	domestic incl.VAT	non-domestic excl. VAT
Interest	%	7.7%	6.5%
Inflation rate	%	2.1%	
Discount rate (EU default)	%	4%	
VAT	%	20%	

ANNEX 2-A

Table 2-31 shows the calculated annual electricity rates for the domestic and non-domestic sector, based upon the figures in Table 2-29 (reference year 2011).

Table 2-31 Annual electricity rates per year for domestic and non-domestic sector

year	Electricity rate domestic incl. VAT (€/kWh)	Electricity rate non-domestic incl. VAT (€/kWh)
1990	0.08	0.05
1991	0.08	0.05
1992	0.09	0.05
1993	0.09	0.05
1994	0.09	0.06
1995	0.10	0.06
1996	0.10	0.06
1997	0.10	0.06
1998	0.11	0.07
1999	0.11	0.07
2000	0.12	0.07
2001	0.12	0.07
2002	0.13	0.08
2003	0.13	0.08
2004	0.14	0.08
2005	0.14	0.09
2006	0.15	0.09
2007	0.15	0.09
2008	0.16	0.10
2009	0.17	0.10
2010	0.17	0.11
2011	0.18	0.11
2012	0.19	0.11
2013	0.19	0.12
2014	0.20	0.12
2015	0.21	0.13
2016	0.22	0.13
2017	0.23	0.14
2018	0.24	0.14
2019	0.25	0.15
2020	0.26	0.16
2021	0.27	0.16
2022	0.28	0.17
2023	0.29	0.18
2024	0.30	0.18
2025	0.31	0.19
2026	0.32	0.20
2027	0.34	0.21
2028	0.35	0.21
2029	0.36	0.22
2030	0.38	0.23

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Table 2-32 shows the calculated stock and sales in absolute values based upon the rates figures in Table 2-22.

Table 2-32 Stock and sales per year and sector

	Residential					Services					Industry				
	Stock	Stock growth	Replacement sales	New sales	Total sales	Stock	Stock growth	Replacement sales	New sales	Total sales	Stock	Stock growth	Replacement sales	New sales	Total sales
Year	kTon Cu	kTon Cu	kTon Cu	kTon Cu	kTon Cu	kTon Cu	kTon Cu	kTon Cu	kTon Cu	kTon Cu	kTon Cu	kTon Cu	kTon Cu	kTon Cu	kTon Cu
1990	4381	39	51	39	90	2230	42	70	42	112	2159	61	59	61	120
1991	4421	39	52	39	91	2273	42	71	42	114	2222	63	60	63	123
1992	4460	40	52	40	92	2316	43	73	43	116	2286	64	62	64	127
1993	4501	40	53	40	93	2360	44	74	44	118	2353	66	64	66	130
1994	4541	41	53	41	94	2405	45	76	45	120	2421	68	66	68	134
1995	4582	41	54	41	94	2451	46	77	46	123	2491	70	68	70	138
1996	4623	41	54	41	95	2497	47	78	47	125	2563	72	70	72	142
1997	4665	42	55	42	96	2545	47	80	47	127	2638	74	72	74	146
1998	4707	42	55	42	97	2593	48	81	48	130	2714	76	74	76	150
1999	4749	42	56	42	98	2642	49	83	49	132	2793	79	76	79	155
2000	4792	43	56	43	99	2692	50	85	50	135	2874	81	78	81	159
2001	4835	43	57	43	100	2744	51	86	51	137	2957	83	80	83	164
2002	4878	44	57	44	101	2796	52	88	52	140	3043	86	83	86	169
2003	4922	44	58	44	101	2849	53	89	53	143	3131	88	85	88	173
2004	4967	44	58	44	102	2903	54	91	54	145	3222	91	88	91	178
2005	5011	45	59	45	103	2958	55	93	55	148	3316	93	90	93	184
2006	5056	45	59	45	104	3014	56	95	56	151	3412	96	93	96	189
2007	5102	46	60	46	105	3072	57	96	57	154	3511	99	96	99	194
2008	5148	46	60	46	106	3130	58	98	58	157	3612	102	98	102	200
2009	5194	46	61	46	107	3189	59	100	59	160	3717	105	101	105	206
2010	**5241**	**47**	**61**	**47**	**108**	**3250**	**61**	**102**	**61**	**163**	**3825**	**108**	**104**	**108**	**212**
2011	5288	47	62	47	109	3312	62	104	62	166	3936	111	107	111	218
2012	5336	48	62	48	110	3375	63	106	63	169	4050	114	110	114	224
2013	5384	48	63	48	111	3439	64	108	64	172	4168	117	113	117	231
2014	5432	48	64	48	112	3504	65	110	65	175	4288	121	117	121	238
2015	5481	49	64	49	113	3571	67	112	67	179	4413	124	120	124	244
2016	5530	49	65	49	114	3639	68	114	68	182	4541	128	124	128	252
2017	5580	50	65	50	115	3708	69	116	69	186	4672	132	127	132	259
2018	5630	50	66	50	116	3778	70	119	70	189	4808	135	131	135	266
2019	5681	51	66	51	117	3850	72	121	72	193	4947	139	135	139	274
2020	5732	51	67	51	118	3923	73	123	73	196	5091	143	139	143	282
2021	5784	52	68	52	119	3998	75	126	75	200	5238	148	143	148	290
2022	5836	52	68	52	120	4074	76	128	76	204	5390	152	147	152	299
2023	5888	53	69	53	121	4151	77	130	77	208	5547	156	151	156	307
2024	5941	53	69	53	122	4230	79	133	79	212	5708	161	155	161	316
2025	5995	53	70	53	124	4310	80	135	80	216	5873	166	160	166	325
2026	6049	54	71	54	125	4392	82	138	82	220	6043	170	164	170	335
2027	6103	54	71	54	126	4476	83	141	83	224	6219	175	169	175	344
2028	6158	55	72	55	127	4561	85	143	85	228	6399	180	174	180	354
2029	6214	55	73	55	128	4647	87	146	87	233	6585	186	179	186	365
2030	6270	56	73	56	129	4736	88	149	88	237	6775	191	184	191	375

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Table 2-33 shows some prices (2 sources) for copper cables (cable type is specified in detail in Bill Of Material in Task 4). It is only used to verify the average cable price mentioned in this document. The discounted price mentioned in this table is a little bit higher than the average price mentioned in this document (5% to 15% depending on the section).

Table 2-33 Prices of copper cable per section (based upon Bill Of Materials in Task 4)

Cable type	5x1,5mm²	5x2,5m²	5x4mm²	5x6mm²	5x10mm²	5x16mm²	5x25mm²	5x35mm²	5x50mm²	5x70mm²	5x95mm²	5x120mm²	5x150mm²	5x185mm²	5x240mm²	4x300mm²	4x400mm²	1x500mm²	1x630mm²
CSA (mm²)	1.5	2.5	4	6	10	16	25	35	50	70	95	120	150	185	240	300	400	500	630
Conductors	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4	4	1	1
Conductor form	Round	Round	Round	Round	Round	Round	Round	Round	Round	Round	Round	Round	Round	Round	Round	Sectorial	Sectorial	Round	Round
Class	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
PE included	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No
Sales Price - DM light (€/m)	0.99	1.44	2.71	3.77	6.11	10.11	14.86	18.1				58.225				116.45			
Discounted Sales Price - Rexel (06/2014)(€/m)	0.8332	1.22	2.12	3.24	5.26	7.96	12.8	17.7	25.575	34.6	46.5875	58.9	73.95	92.9375	119.5625	119.5625	159.4167	49.46667	62.328
Sales Price - Rexel (06/2014)(€/m)	1.4	2.05	3.52	4.92	8	13.22	19.46	25.8	37.2875	50.425	67.9125	85.8625	107.8	135.475	174.2875	174.2875	232.3833	72.10807	90.85617
Cu (€/kg) - avg 06/2014 (www.cablebel.be)	5.1876																		
Cu cost (€/m)	0.346	0.576	0.922	1.384	2.306	3.689	5.765	8.071	11.529	16.141	21.906	27.671	34.588	42.659	55.341	55.341	73.788	23.059	29.054
Sales Price - DM light (€/mm².m)	0.132	0.115	0.136	0.126	0.122	0.126	0.119	0.103				0.097				0.097			
Discounted Sales Price - Rexel (06/2014)(€/mm².m)	0.111	0.098	0.106	0.108	0.105	0.100	0.102	0.101	0.102	0.099	0.098	0.098	0.099	0.100	0.100	0.100	0.100	0.099	0.099
Sales Price - Rexel (06/2014)(€/mm².m)	0.187	0.164	0.176	0.164	0.160	0.165	0.156	0.147	0.149	0.144	0.143	0.143	0.144	0.146	0.145	0.145	0.145	0.144	0.144
Cu cost/Sales Price - DM light	35%	40%	34%	37%	38%	36%	39%	45%				48%				48%			
Cu cost/Discounted Sales Price - Rexel (06/2014)	16%	47%	44%	43%	44%	46%	45%	46%	45%	47%	47%	47%	47%	46%	46%	46%	46%	47%	47%
Cu cost/ Sales Price - Rexel (06/2014)	8%	28%	26%	28%	29%	28%	30%	31%	31%	32%	32%	32%	32%	31%	32%	32%	32%	32%	32%