Europacable

Guidance Document on the Issuing Of Environmental Information

Version 2 dated 21st June 2005

Contains editorial changes only to Version 1 dated 15th March 2005

These guidelines were accepted by the Council on 15th March 2005 and are recommended for use by all members of Europacable

Europacable Guidance Document on the Issuing Of Environmental Information

CONTENTS

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PART 1 GENERAL

1.1 Introduction

All manufacturers are currently faced with increased requests for environmental information on their products, whether in order to comply with existing legislation, or merely for the information of the end customer.

The Council of Europacable, recognising that this trend could lead to significant differences in approach by the industry, requested that the Europacable Environmental Committee provide a set of guidelines to assist members both in understanding the issues involved and providing an industry standard to which all members would be invited to adopt.

1.2 Environmental Information

There are two basic voluntary means of providing environmental information:

a) Information concerning the Environmental Management System implemented by the organisation, such as ISO 14001 or EMAS or information regarding the product management system, if any, such as a “Design for Environment” system organised according to ISO/TR 14062.

b) Direct information on the product itself (EPD, ISO 14040 on LCA)

Use of a) above is usually undertaken to demonstrate management competence and is more of a public relations exercise. It also does not usually supply the relevant direct information on individual products.

Use of b) above is, in many instances, the only means of facing the more demanding questions asked by customers and stakeholders in general, concerning product environmental information. This guidance document concerns itself therefore with standardising the type of information that should be given.

1.3 Direct Information

When a request is made for product environmental information, then consideration should be given to two choices. (See Fig 1.1)

The first choice, and simplest, is the provision of a “ECO Declaration” and this should be offered wherever possible. Details of this are given in Part 2 of the Document.

The second choice and more complex is the provision of Life Cycle Analysis (LCA) data. Sometimes this will be the only option acceptable. For example, this technique is a prime requirement to meet the essential requirements of the EUP Directive. Details of this are given Part 3 of the document.

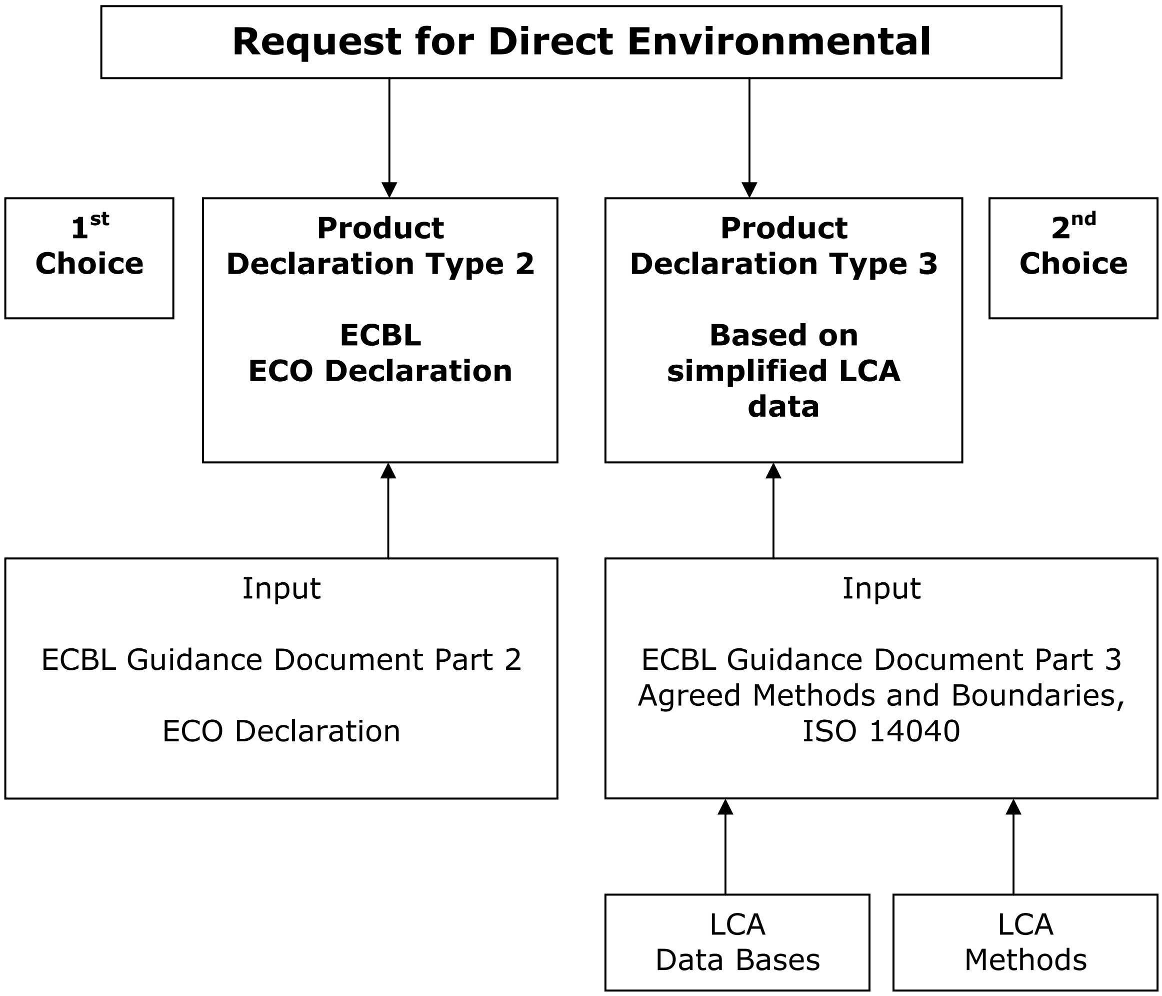
Request for Direct Environmental
1st Choice
Product Declaration Type 2
ECBL ECO Declaration
Product Declaration Type 3
Based on simplified LCA data
2nd Choice
Input
ECBL Guidance Document Part 2
ECO Declaration
Input
ECBL Guidance Document Part 3 Agreed Methods and Boundaries, ISO 14040
LCA Data Bases
LCA Methods

FIG 1.1

ECBL Guidance Document on the Issuing Of Environmental Information

PART 2 ECO DECLARATION

2.1 Introduction

The simplest and most convenient way of transmitting environmental information on products is to issue an "ECO Declaration" which lists in a logical way the basic information on environmental issues of the materials used in the product and other factors such as packaging.

The scope and purpose of this declaration is intended to satisfy the requirements of Type 2 product declarations. It is hoped that by every company adopting this standard format, this will prevent comparative and commercial reactions by users.

This part shows the format of the sheet (Fig 2.1), gives guidance to complete the sheet for any product (fig 2.2) and a worked example (Fig 2.3) for illustration only.

Fig 2.1

Blank Format

Logo	ECO DECLARATION						
Cable Type							
Supplier							
Environmental Management Systems							
We declare that the Product Conforms to the Environmental Specifications, as listed in the Ecodeclaration below							
Product Name							
Specification							
Reference							
Weights and Dimensions (approx values)	Total Weight			kg/m			
	Metal Weight			kg/m			
	Outer Diameter			mm			
Energy Losses at				W/m			
Operating Voltage			V				
Spec Max Current			A				
Other Components							
Materials							
Electromagnetic Compatibility							
Chemical Emissions							
Other Environmental Aspects							
Re - use							
End of life							
Packing	Type						
	Composition						
	Regulation						
Ref No		Edition		Written By / Position		Date	

FIG 2.2

Guidance on Completing ECO Declaration

Logo	ECODECLARATION

Insert Company Logo here if desired

Cable Type	

It is intended that there should be one declaration per product family, e.g. 1 kV Energy Cable. Two sheets should only be necessary with major differences in the cable e.g. Cu or Al

Supplier	

Insert the Name of the Company and the Manufacturing address

Environmental Management System	

Place in here any details of management systems used and certifications held e.g. ISO 14001/AO/Ref xxxxx

We declare that the Product Conforms to the Environmental Specifications, as listed in the eco declaration below

Product Name	

Insert the name of the product or the name of the family of product e.g. PVC flexible cord

Specification	

Insert any reference to directives and any reference number of specifications, public or client e.g. LVD/ IEC 60228

Reference			

In any one product it is not necessary to give details for all combinations of cores/sizes. It is recommended that a small combination, a medium combination and a large combination only are given. Insert therefore the reference to the type of product

e.g. 2 x 0,5sq.mm, 3 x 1,5 sq mm 5 x 4,0 sq mm

Weights and Dimensions (approx values)	**Total Weight**		**kg/m**			
	Metal Weight		**kg/m**			
	Outer Diameter		**mm**			

Metal weight should include the individual weights of each metal in the product e.g. copper, aluminium, lead, steel

Give the outer diameter of the product for information purposes only

Total weight is the total weight of the product in kg per metre length

Energy Losses at			W/m			
Operating Voltage		V				
Spec. Max. current		A				

Data given should be the losses based on the operating voltage of the system and the specified maximum current that the product can carry. It is primarily intended to cover only conductor losses.

Other Components	

Insert the main non metallic constituents of the product. As guidance, it is suggested that only components greater than 5% of the total weight of the cable are included but at least the insulation and sheathing (if applicable) materials.

Materials	This product contains no prohibited hazardous materials affecting health or the environment

This entry is made on the assumption that the product contains no prohibited hazardous materials in accordance with current EU/National legislation

If it does then replace the wording with

This product contains XXX which is hazardous to the environment.

As a guide one should follow the advice in IEC Guide 113 which categorises hazards to health as 1) Carcinogens, Mutagenic, Toxic for reproduction (CMR) 2) Acutely or chronically toxic 3) Easily transformed into CMR or toxic substances 4) Causes sensitization 5) Radioactive

Hazards to the environment are classified as 1) Water polluting 2) Persistent and bioaccumulative 3) Contributes to global warming 4) Ozone depleting 5) Leading to acidification 6) Leading to soil contamination

Electromagnetic Compatibility	**Not Applicable**

A standard response of not applicable has been entered. However if applicable, put in the regulation and/or standards covering the product, e.g. complies with EN 55022. Do not leave blank.

Chemical Emissions	**During normal operation, there are no significant chemical emissions hazardous to health or the environment.**

Use the statement already included, unless there is a hazard.

Other Environmental Aspects	**In case of fire, the principally formed substances are soot, carbon oxides, water and corrosive gases (e.g. hydrochloric acid) together with other halogenated residues**

This wording has been included for products where the principle non metallic constituent is halogenated. Where this constituent is non halogenated then insert this text.

In case of fire, the principally formed substances are soot, carbon oxides and water

Re Use	**It is not recommended that cables are re-used after dismantling or at the end of life due to safety or performance implications.**

The general statement given is intended to cover any cable product

End of life	**Metal components of this product are totally recoverable. All the other materials used in this product may be recycled by mechanical or chemical processes or incinerated for energy recovery.**

Use this general statement.

Packaging	**Type**	
	Composition	
	Regulation	

In type, insert type and whether or not it is returnable e.g. bobbin, box, pallet, drum

In composition, indicate the main material e.g. cardboard, plastic, steel or wood. In the case of wood indicate whether it is treated or not.

In regulation, indicate any regulation, standard or registration applicable e.g. Packaging Directive is Reference Directive 94/62/EEC

<table>
<tr><td rowspan="2">Ref No</td><td rowspan="2"></td><td rowspan="2">Edition</td><td rowspan="2"></td><td>Written By</td><td></td><td rowspan="2">Date</td><td rowspan="2"></td></tr>
<tr><td>Position</td><td></td></tr>
</table>

Fig 2.3

Worked Example

Logo	**ECO DECLARATION**				
Cable Type	**Data Cable**				
Supplier	**Company XYZ**				
Environmental Management Systems	**ISO 14001 Ref xxxx No ENV/2000/14387**				
We declare that the Product Conforms to the Environmental Specifications, as listed in the Ecodeclaration below					
Product Name	**4P 24 AWG FTP cable, 100 ohms Cat.5**				
Specification	**ISO/IEC 11801 EN 50167 EN 50168 EN 50169 EN 50173**				
Reference			**M0383**		
Weights and Dimensions (approx values)	**Total Weight**	**g/m**	**0,0364**		
	Metal Weight	**g/m**	**0,018**		
	Outer Diameter	**mm**	**6,0**		
Energy Losses at		**W/m**	**0,01**		
Operating Voltage	**V**				
Spec Max Current	**A**				
Other Components	**PVC**				
Materials	**This product contains no legally restricted materials. It contains no prohibited hazardous materials affecting health or the environment**				
Electromagnetic Compatibility	**Complies with EN 55022**				
Chemical Emissions	**During normal operation, there are no significant chemical emissions hazardous to health or the environment.**				
Other Environmental Aspects	**In case of fire, the principally formed substances are soot, carbon oxides, water and corrosive gases (hydrochloric acid) together with other chlorinated residues**				
Re - use	**It is not recommended that cables are re-used after dismantling or at the end of life due to safety or performance implications**				
End of life	**Metal components of this product are totally recoverable. All the other materials used in this product may be recycled by mechanical or chemical processes or incinerated for energy recovery.**				
Packing – **Type**	**Disposable Drums**				
Packing – **Composition**	**Non treated Wood or Cardboard**				
Packing – **Regulation**	**Directive 94/62/EEC**				
Ref No **1**	**Edition** **1**	**Written By**	**Anon**	**Date**	**26.11.2002**
		Position	**Env Manager**		

ECBL Guidance Document on the Issuing Of Environmental Information

PART 3 USE OF LIFE CYCLE ANALYSIS

3.1 Objective

The purpose of producing these guidelines on Life Cycle Analysis (LCA) is to:

a) To meet impending legislation centred around the Commissions "cradle to grave" accountability of any product as seen, for example, in the EUP Directive. National Governments and Regulators also expect to see a professional approach which will allow the industry to propose self regulation in relevant areas.

b) To meet the increasing demand for product declarations based on LCA work from major customers, many of our customers are well advanced in the use of LCA and expect no less competence from the suppliers of cables.

c) To provide a common industry position so that competitive statements will have credibility in the market and with our customers.

3.2 Introduction

Carrying out LCA involves many common industry approaches. In order to have credibility and a valid approach it is essential that the methods and boundaries are reputable and wherever possible in accordance with international standards.

It is imperative that all steps in a study and its methods are transparent and intelligible so that the user of a LCA will obtain sound evidence which then can be used as arguments.

The ISO 14040 series of international standards takes account of these key requirements by laying down internationally applicable rules, ranging from the definition of the goal for the study to data collection and the analysis of various environmental issues.

3.3 Approach

In case of work on LCA the ISO 14040 series of standards shall be used.

The purpose of referring to the ISO standards is to secure transparency and openness in all results. Europacable members will promote simplicity when applying the LCA technique. Making an LCA involves time, money and expertise. It also requires an analytical and data infrastructure that includes; a methodology, a vast amount of data and appropriate software with which to manipulate the data. LCA is typically an iterative process in that the assessment is repeated several times - each time in more detail. It is important to know what level of sophistication is appropriate depending on the purpose of the LCA.

3.4 LCA software tools and databases

The purpose of the software tool is to support the process of producing a LCA. It consists of a database, a calculation tool and a tool to evaluate the environmental impact, impact assessment. There are several different tools in use among ECBL members and a lot of resources, time and money, have been invested to establish the tools, it is therefore not realistic to recommend a single method to be used. A summary of the tools and databases used or experienced by ECBL members is attached. (Annex 2)

ECBL should review the status of the software tools and databases used by its members, exchange information and keep this information up to date.

3.5 Basic concept of the ISO 14040 series

There are four different phases in an LCA according to ISO 14040 (See Figure 3.1):

- Goal and Scope Definition
- Life Cycle Inventory analysis
- Life Cycle Impact Assessment
- Life Cycle Interpretation.

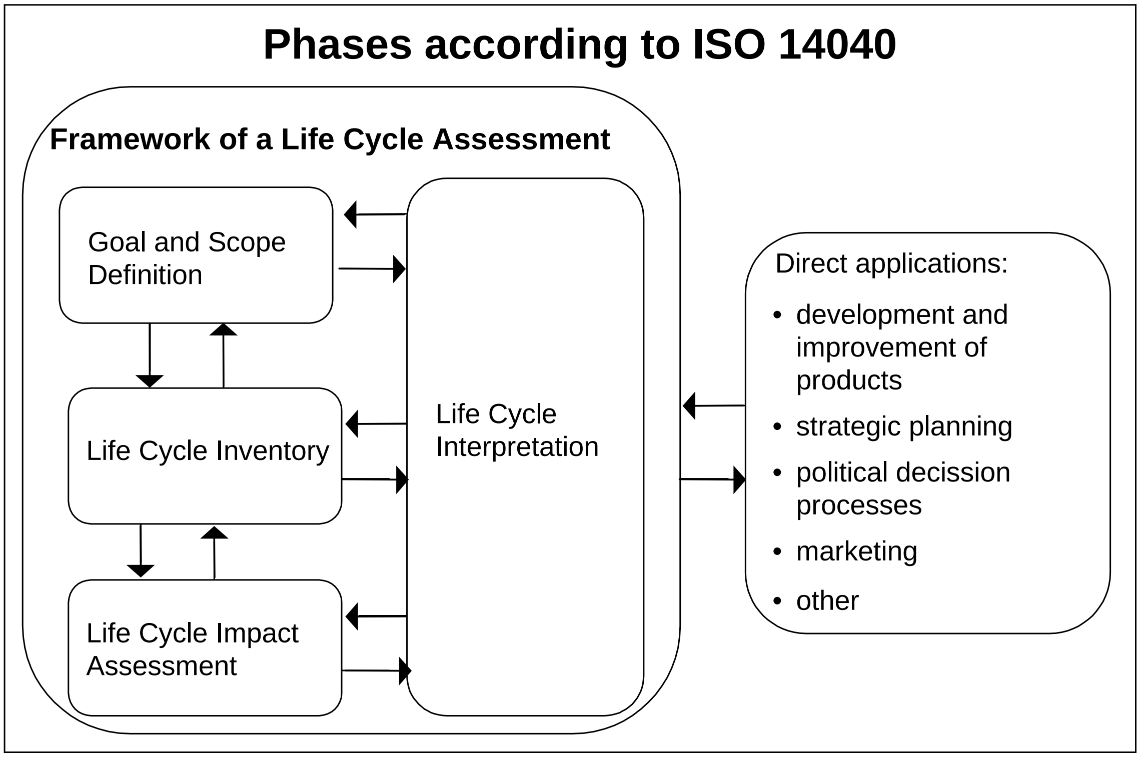

Figure 3.1 ISO Standard on Life Cycle Assessments

3.5.1 Goal and scope

3.5.1.1 Functions of the product system and functional unit

Describe the functions of the product or system to be studied. The function should be as clearly specified as possible since the functional unit to be used as an allocation basis for all further calculations is based on the function of the product. The functional unit is often best described from the customer point of view, i.e. relate to the performance of the product or system.

Proposal for functional unit:

1 metre of cable.

Other definitions could be possible by different Business Sectors, (telecom-, power, data cable, etc.)

3.5.1.2 The product system boundaries

There are the following basic steps in the “cradle to grave” concept for a cable (See Fig 3.2):

Production of raw materials, manufacturing of cables, installation, product use, end of life - scrapping of cables and transport in between all steps.

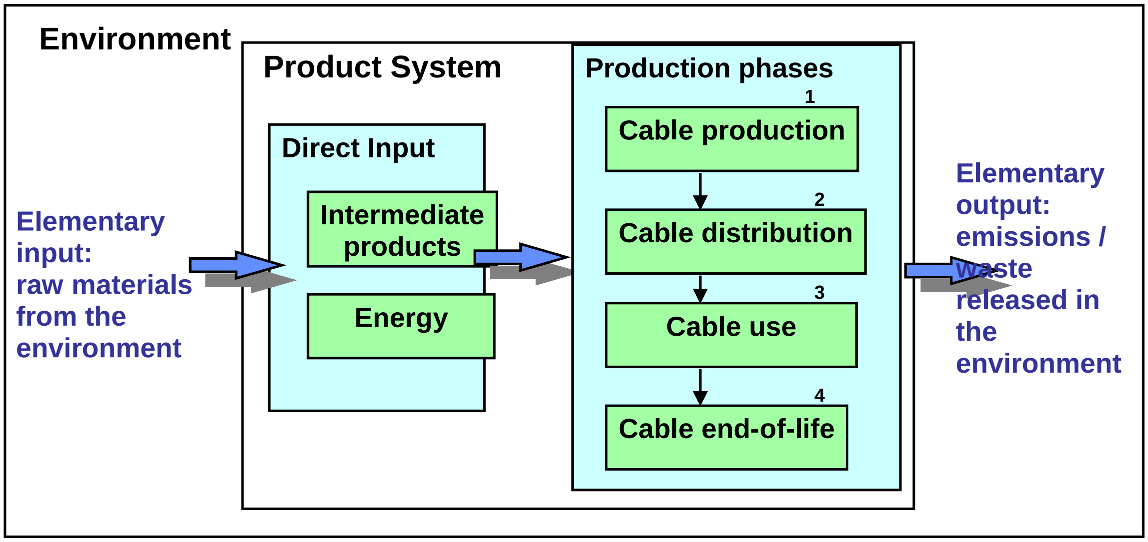

FIG 3.2

Life Cycle Phases and Associated Input/Output

For the cable industry, it is necessary to provide as much information as possible but a very pragmatic approach must be made. In some products, it can be anticipated that the principle environmental impact over the lifetime of the product would be usage rather than raw materials and production. e.g. power cables where losses over lifetime would be significant.

Basic recommendation for system boundaries:

Raw material production, manufacturing of products, end of life.

Details of transport, installation and usage are too variable to be able to form a common view. However, different Business Sectors may wish to consider whether for their individual products, further harmonization is possible

3.5.1.3 Allocation procedures

If data is collected from a manufacturing site producing different products the environmental aspects, e.g. emissions and waste, must be allocated to the functional unit of the studied product in a consistent way. Allocation on weight basis is common, but it could also be relevant with other allocation basis, like length, number of products or economical values. Allocation decisions can also be relevant in other phases of the LCA, for example in the end of life phase when you have several options how to take care of the product. The LCA methodology as such can not help with this decision; it has to be decided and specified for each production site.

Recommendation:

For transparency the allocation principles should be reported in the LCA study.

3.5.2 Life Cycle Inventory

The inventory phase is mostly very time consuming. Focus on the materials and processes that are most important for the system.

The inventory represents the sum of elementary flows from all processes included in the studied product system. The elementary flow (see fig. 3.2) is represented by: raw materials from the environment and output to environment – airborne and waterborne emissions, solid waste, other (such as radioactivity, etc.).
Therefore, in order to calculate the product LCA inventory, inventory data of single materials / processes are to be defined and summed up.

Using a software tool with databases saves a lot of time in this phase. For important materials and processes, collection of site specific data may be required.

3.5.2.1 Collection of data

The type of data that should be collected depends on the type of product and the goal and scope definition but some general advice can be given:

- **Types and amounts of materials in the product and its components.**

  Make an inventory of type and amount of materials in your product. Sometimes the needed specific material in the database can not be found then own data has to be collected from suppliers or as an approximation use data for some similar materials.

- **Manufacturing processes.**

  The data you need are the used amounts of energy (electricity and different types of fossil or maybe renewable fuels) per functional unit, data for emissions to air and water, and waste/recycled materials. More often than not, allocation of the emissions, energy, waste etc. to the functional unit must be performed

- **Transports. (Optional)**

  Data for distances and types of transports have to be collected. The scope should be transports under the whole life cycle, however some of these are more uncertain than others so you have to do assumptions, for example how far will the product be transported to the customer, and by what transportation mode?

- **Installation, operation and use of the product. (excluded)**

  For electrical cables the operation phase often means energy losses. It is then important to estimate losses of energy under the life cycle phase. An option is to select different alternative use scenarios. A common allocation basis is to study the losses per functional unit under this phase. It is also necessary to estimate the lifetime of the product, and consider if some maintenance materials are needed under this phase.

- **End of life data.**

  This is often the most difficult part of the inventory analysis. It includes a best estimation on how the studied product will be treated in the end of life phase. As a minimum requirement it is estimated how all different materials will be treated, by quantifying the fractions of each material estimated to be recycled, incinerated or put to a landfill. This step can be very difficult to estimate since it is not know what technology will be used for future scrapping of the product, especially for products with very long lifetimes.

  Furthermore, since the forecast of how the cable will be treated at its end-of-life is very difficult, in many cases several scenarios are to be analysed such as:
  - Cable abandon
  - Cable recovery and disposal
  - Cable recovery and materials reclaiming, regeneration and use as recycled raw material for other products

  When recycling is a sensible hypothesis, the so-called "avoided impact", due to the use of recycled materials instead of virgin materials, is to be calculated, consistently with the "System borders" previously defined

  For most electrical cables the metal content will give a positive contribution to the end of life phase.

3.6 Evaluation and Presentation of the results

Results can be evaluated on three levels:

- **The technical system** (called *inventory analysis* in ISO 14040) showing summarized inventory values in units as kg or MJ. As example "The studied product releases 40.000 kg CO2 during its life cycle", etc for other emissions and resource uses. This is an objective way to present the results on the other hand, there is often a problem connected to this presentation since the results consist of a long list of emissions and resource uses.

- **The environmental system** (called *characterization* in ISO 14040), showing the results in different environmental impact categories. GWP, Global Warming Potential, and AP, Acidification Potential are two of the categories. This is the conversion of the total figures obtained in the calculation of emission and resource usage into a common format which looks at the main identified parameters likely to affect the environment. These parameters could be Global warming, GWP, (CO_2), ozone depleting potential, ODP, or acidification potential, AP.

- **The social system** (called *weighting* in ISO 14040), showing the results aggregated into one single score. This is an optional part of an LCA and should always be used with care. This method to present results is not recommended as it includes a high degree of subjectivity.

Recommendation:

Resource use and emissions are calculated for raw materials production, manufacturing of cables and end of life, by using the tools and databases shown in Annex 1 and Annex 2.

It is recommended to present data as an inventory analysis and in corresponding impact categories.

Details of transport, installation and usage are too variable to be able to form a common view. However, different Business Sectors may wish to consider whether for their individual products, further harmonisation is possible.

LCA Tools Recommended for Usage

Tool	Supplier	Experience By
Sima Pro 4.0	Pre Consultants www.pre.nl	Draka NL Pirelli R & D
Eco Lab	Nordic Port www.port.se	ABB Draka SE
EDIP	LCA Center www.lca-center.dk	NKT
TEAM	Ecobilan	
EIME	CODDE www.codde.fr	Nexans
CHAMP	University of Surrey	Brand Rex Corning

LCA Data Bases recommended for usage

Database	Supplier	Sources
Pre 4	Pre Consultants	APME, BUWAL 132, ETH, SPIN, CPM (Chalmers)
IVAM 2.0	IVAM Env. Resaerch NL	Data collected by IVAM Env. Resrearch
IDEMAT	Delft Tech University	Various sources
CPM	CPM, Chalmers Univ, SE	APME, various
EDIP	LCA Center	SPOLD LCA format, various
DEAM	Ecobilan	BUWAL 250&350, AP{ME, ETH, Ecobilan data collection
ETH		
BUWAL		
EPS		
APME		
BOUSTEAD	Boustead Consulting Ltd, Great Britain www.boustead-consulting.co.uk	

Annex 3

Worked Example
With kind permission of Pirelli Cables

LIFE CYCLE INVENTORY OF A POWER SUBMARINE CABLE

"CRADLE TO GATE" PRODUCTION AND DISTRIBUTION

Pirelli Corporate Health, Safety, Environment

TABLE OF CONTENT

Title

Life Cycle Assessment of power submarine cable ABC 132 kV.

Subtitle

Life Cycle Assessment of the high voltage cable ABC 132 kV (760 mm^2, 3 core XLPE, lead sheathed, polyethylene core jacket, polypropylene bedding, stainless steel (with spacer rods) wire armoured, polypropylene served Submarine Cable (with interstitial optical unit).

1. General information

1.1 Study goal and approach

This is a life cycle inventory "***from cradle to gate***" of the cable ABC 132 kV, developed to satisfy Pirelli client need, who has been requested to deliver this study to Danish Environmental Authority, as a contribution to assess the environmental impact of a "wind farm". In fact, the cable ABC 132 kV should be used to connect an off shore "wind farm" under construction in Denmark and the local Authority wants to verify that this plant has a lower environmental impact than a conventional power station. According with this need, the results of this study are developed in a suitable manner to be integrated in a wider LCA study to make comparison between a wind farm and a conventional power station.

The quantification of environmental burden is developed with reference to all processes carried out to produce the cable and all its intermediate product, up to raw material extraction. The result of this study is represented by the ***inventory*** of the environmental data (resources consumption and emissions).

As to the ***distribution phase*** (the life cycle step immediately after the production), see ***annex 1***.

The study does not include the ***"use"*** and ***"end-of-life"*** phases, but a brief explanation is included in ***annex 2.***
.

1.2 Requesting party

Pirelli client.

1.3 Executor

Stefano Luciano
Environmental Reporting and Product Environmental Analysis
Corporate Health, Safety and Environment department

1.4 Reviewers

A peer review has not been carried out.

2. Functional unit

The environmental impact results are referenced to 1 km of cable

3. Scope

3.1 System boundaries

This is a “cradle to gate” study. This means that the environmental impact is analysed of all the activities occurring from the raw materials extraction to cable production.

You can imagine how many processes occur throughout the entire life span of the product. We must make some choices to make the study possible.

Due to this, following activities / processes / products have not been taken into consideration:

- capital goods production;
- plants and premises lighting system;
- heating;
- hygienic purpose consumption;
- detergent consumption for maintenance;
- other plant maintenance activities;
- laboratory activities (research and development);
- offices consumption (paper, electrical power, etc.);
- internal transport;
- ancillary materials
- all cable materials forming the cable functional unit weight for less than 1% (with the exception of optical fibre, all included).

3.2 Study phases

Consistently with the ISO14040/1/2 rules, the study has been implemented as follows:

1. definition of study boundaries: what is to be studied and what’s not to be studied (see previous paragraph 3.1).

2. inventory of environmental data (such as raw materials and energy consumption, emissions, etc)

- description of cables materials: it is the description of the cable components, their respective materials and quantities per functional unit
- environmental data collection: it is the collection of the environmental data related to all the cables materials
- data assembling: it is the sum of all environmental data, in order to have the environmental balance of the entire product.

This study also does not include the ***environmental assessment*** of the inventory, which would be an evaluation of the impact produced by all inventory data (such as airborne and waterborne emissions) on different environmental impact categories, to be calculated by using proper conversion factors which turn the value of each inventory data into an index quantifying the environmental impact.

4 Inventory

4.1 Data categories glossary

To make easy the understanding of the study, following terms are used:

Input: material or energy which enters a unit process (ISO 14040 – 3.6)

Output: material or energy which leaves a unit process (ISO 14040 – 3.13)

Direct input: the inputs directly necessary for cable production. They are represented by materials and energy consumption

Direct output: the output directly released by cable production.

Elementary input: material or energy entering the system being studied, which has been drawn from the environment without previous human transformation (ISO 14040 – 3.3)

Elementary output: material or energy leaving the system being studied, which is discarded into the environment without subsequent human transformation (ISO 14040 – 3.3)

Elementary flows: this term is used to define both elementary input and output

Direct elementary input: material or energy entering the system being studied, which has been drawn from the environment without previous human transformation, when the "entering point" is represented by cable production (elementary inputs needed directly for cable production, such as water consumed by cable production plant)

Direct elementary outputs: material or energy leaving the system being studied, which is discarded into the environment without subsequent human transformation, when the "exit point" is represented by cable production (elementary outputs directly released by cable production, such as waste from cable production plant)

Primary data: data collected "on field", by analysing directly the production process / activities

Secondary data: data collected from public databases or other kind of bibliography

4.2 Used data

Data collection has been carried out as follows:

Primary data

It has been possible to collect primary data for some parameters related to cable production in Pirelli plant of Erith, precisely :

electricity consumption per km of cable
gas consumption per km of cable
water consumption per km of cable
waste water per km of cable

Secondary data

All the data about intermediate product and processes out of Pirelli gate were collected from international data banks (see table 1 – page 9)

Following is, for each input or group of inputs, the list of the chosen databanks, with the motivation of the choice itself.

<u>Metals and glass fibre</u>

- Chosen Databank: Idemat - Delft University
- Reason of the choice: no other available database about pure copper.

<u>Polymers</u>

- Chosen databank: APME 2000
- Reason of the choice:
  1. it is very used and referenced database;
  2. it encompasses all the plastics and their main chemicals / raw materials.

Electrical energy - Great Britain

- Chosen databank: BUWAL 250
- Reason of the choice:
  1. it is a very referenced database;
  2. consumption and releases figures are, in many cases, an average of the ones indicated by other sources, whose values, for each single consumption or release item, record more numerous and bigger reciprocal differences.
  3. some values are very similar to the ones from other sources with no reciprocal correlation;
  4. other sources have problem, such as;
     - incompleteness;
     - data referred not only to electricity production, but also to plants and machinery production;
     - interpretation problem about the kind of emissions.

Electricity energetic mix

Since most analysed activities are carried out in Great Britain, the ecobalance of 1 MJ of electrical energy produced in Great Britain has been used, composed by following energy sources

1. energetic sources:	UK	power efficiency
• oil	8,2%	55%
• natural gas	3,2 %	60%
• coal	59%	45%
• hydro	2,9%	90%
• uranium	26,4%	27%

5 Functional unit calculation procedure

5.1 Calculation procedure for on-field collected data

The Erith production process environmental data have been referenced to the functional unit by following steps:

1) calculation of the environmental burden per kg of product. It was obtained by dividing the total plant yearly amount of the data per the total amount of the plant production expressed in tonnes. This means that the assumption has been used that all the plant products (expressed in weight) has the same environmental burden.

2) Multiplication of the environmental burden per kg of product per the total kgs of 1 functional unit (1 km)

5.2 Calculation procedure for data collected from databanks

As mentioned, elementary flows of activities outside Pirelli plant have been collected from data banks.

Specifically, databanks have been used of the materials / energy sources listed in table 1 – page 31

6 Direct input (1)

TAB. 1 - CABLE MATERIALS AND RESPECTIVE DATA SOURCE FOR 1 km OF CABLE				
Cable component	**Component material**	**quantity kg / km**	**%**	**Source of inventory ecobalance**
Wire	Copper	10000	18,1	Copper production: database Idemat; Copper drawing: Milano plant
Filler Compound	YV4 70316	400	0,7	Cut off (<1%) - see report page
Barrier	unknown	100	0,2	Cut off (<1%) - see report page
semi-conductor screen	BES3108	300	0,5	Cut off (<1%) - see report page
insulation	LE4201 - XLPE	5000	9,0	Database APME 2000
semi-conductor screen	BES3108	150	0,3	Cut off (<1%) - see report page
water blocking	unknown	250	0,5	Cut off (<1%) - see report page
sheath	lead	7000	12,6	Database Idemat 96
anti corrosion sheath	DFDG 6059 LLDPE	5500	9,9	Database APME 2000
optical fibre core	optical fibre + unknown	300	0,5	see detail table 2
rope fillers	PP	7000	12,6	Database APME 2000
filler yarn	PP	4500	8,1	Database APME 2000
tape	polyesther	200	0,4	Cut off (<1%) - see report page
string bedding	PP	3000	5,4	Database APME 2000
armouring	steel stainless	5500	9,9	Database Idemat 96
spacer rods	HDPE	2500	4,5	Database APME 2000
filling	bitumen	2000	3,6	Database APME 2000 (naphta)
filling	T3214 oil	150	0,3	Cut off (<1%) - see report page
strings	PP	1500	2,7	Database APME 2000
total		**55350**	**100**	

TAB. 2- OPTICAL MATERIALS FOR 1 km OF CABLE AND RESPECTIVE DATA SOURCES				
Optical core component	**Material**	**Quantity kg / km**	**%**	**Source of inventory ecobalance**
central strenght member	steel	30	10,0	Database Idemat 96
optical slot	PPL	1	0,3	Database APME 2000
optical fibre	glass fibre	2	0,7	Database Idemat 96
filling	silicon	3	1,0	Database Idemat 96
synthetic tape	polyester	2	0,7	Database APME 2000
plastic sheath	PPL	59	19,7	Database APME 2000
water protection barrier	copper	200	66,7	Database Idemat 96
anticorrosion protection	bitumen	2	0,7	Database APME 2000 (assumed naphta)
outer sheath	PE	1	0,3	Database APME 2000
total		**300**	100,0	

TAB. 3- CABLE PRODUCTION DIRECT ENERGY (ERITH PLANT) FOR 1 km OF CABLE				
Energy Source	**Unit**	**Quantity**	**%**	**Source of inventory ecobalance**
electricity	kWh	7000	78	database BUWAL 250 (dust: BUWAL 132)
gas	kWh	2000,0	22	Database APME 2000
total	**kWh**	**9000**	**100**	

7 Direct elementary input and output (1)

TAB. 4 - CABLE PRODUCTION DIRECT ELEMENTARY FLOWS (ERITH PLANT) FOR 1 km OF CABLE			
Type	**Unit**	**Quantity**	**Source**
water	kg	500	production plant
waste water	m3	400	production plant
hazardous solid waste	kg	300	production plant
non hazardous solid waste	kg	200	production plant

(1) Warning: these numbers are not representative of a real situation, they are listed just as an example

8 Elementary inputs

TAB. 5 - INPUTS		
Substance	**Unit**	**Quantity**
natural gas ETH	m3	1,00E+02
water	kg	150,0
coal ETH	kg	300,0
crude oil IDEMAT	kg	400,0
copper (ore)	kg	250,0
coal	kg	300,0
Pb lead (ore)	kg	500,0
crude oil ETH	kg	390,0
natural gas	kg	200,0
Fe iron (ore)	kg	300,0
barrage water	kg	400,0
air	kg	500,0
chromium (ore)	kg	550,0
lignite ETH	kg	450,0
N2 nitrogen	kg	150,0
wood	kg	200,0
nickel (ore)	kg	470,0
water (surface, for process.)	kg	370,0
sodium chloride NaCl	kg	470,0
bauxite	kg	100,0
silicon	kg	250,0
manganese (ore)	kg	350,0
water (well, for cooling)	kg	450,0
limestone	kg	470,0
lignite	kg	23,0
Fe iron (in ore)	kg	35,0
sand	kg	37,0
crude oil	kg	200,0
uranium (in ore)	kg	100,0
S sulphur (elemental)	kg	23,0
fluorspar	g	24,0
granite	g	25,0
bentonite	g	26,0
water (well, for processing)	g	27,0
uranium (ore)	g	28,0
O2 oxygen	g	29,0
S sulphur (bonded)	g	30,0
clay minerals	g	32,0
shale	g	33,0
NaOH	g	34,0
zinc (in ore)	g	43,0
dolomite	g	44,0
calcium sulphate	g	45,0
feldspar	g	21,0
olivine	g	22,0
potassium chloride KCl	g	21,0
gravel	g	21,0
phosphate (as P2O5)	g	21,0
Pb lead (in ore)	g	21,0
ferromanganese	g	23,0
baryte	g	23,0
chromium (in ore)	µg	24,0
nickel (in ore)	µg	25,0
rutile	pg	26,0
chalk	pg	300,0
energy from oil	MWh	500,0
energy from natural gas	MWh	200,0
energy from hydro power	MWh	100,0
energy from uranium	MWh	100,0
energy from coal	MWh	150,0
pot. energy hydropower	MWh	100,0
energy recovered	MWh	100,0
energy (undef.)	GJ	100,0
energy from hydrogen	GJ	50,0
energy from lignite	GJ	50,0
energy from biomass	MJ	50,0
energy from peat	MJ	50,0
energy from sulphur	MJ	30,0
energy from wood	kJ	50,0

Remark:
Some energy non-renewable resources , such as oil, coal or gas, are expressed partly in weight or volume, partly in energy unit measure (energy from coal, from oil, from gas). This is due to the different data sources used (APME, ETH, Idemat). They are not doubled, you must add them to have the total value of resource consumption. In order to calculate a unique value for each resource, you can use following coefficients:
1kg coal = 29 MJ energy from coal
1 kg oil = 41,8 MJ energy from oil
1 m3 natural gas = 36 MJ energy from gas

Warning: these numbers are not representative of a real situation, they are listed just as an example

9 Elementary outputs

TAB. 6 - AIRBORNE EMISSIONS		
Substance	**Unit**	**Quantity**
CO2	kg	20000
SO2	kg	2000
NOx	kg	1000
SOx	kg	500
methane	kg	200
CO	kg	300
non methane VOC	kg	300
NO2	kg	200
hydrocarbons CxHy	kg	300
dust (SPM)	kg	400
Soot	kg	50
HCl	kg	50
dust	kg	200
metals	kg	300
Cl2	kg	20
HF	kg	20
aromatic CxHy	kg	20
N2O	kg	20
hydrogen H2	kg	30
benzene	kg	40
ammonia	g	50
H2S	g	20
VOC	g	40
other org. organic substances	g	30
Ni	g	10
toluene	g	10
Zn	g	10
lead Pb	g	1
aldehydes	g	10
CxHy aliphatic	g	10
CFC (soft)	g	10
F2	g	15
pentane	g	15
Mn	g	10
coal dust	g	10
Cu	g	40
mercury Hg	g	10
PAH's	g	5
Al	g	5
formaldehyde	g	3
ethylbenzene	g	10
Cd	g	20
fluoranthene	g	30
HALON-1301	g	3
benzo(a)pyrene	g	10
naphthalene	mg	20
Cr	mg	30
As	mg	3
mercaptans	mg	10
organo Cl CxHy chloro	mg	20
phenol	mg	30
CS2	µg	3
dioxin (TEQ)	µg	10
H2SO4	µg	20
1,2-dichloroethane	µg	30
vinyl chloride	µg	32
HCN	pg	23

Warning: these numbers are not representative of a real situation, they are listed just as an example

TAB. 7 - WATERBORNE EMISSIONS		
Substance	**Unit**	**Quantity**
waste water (vol)	m3	15000
inorganic general	tn	300
Cl-	tn	200
SO4-- sulphate	kg	100
anorg. dissolved subst.	kg	50
Al	kg	150
suspended substances	kg	170
Fe	kg	53
TOC	kg	300
oil	kg	200
metallic ions	kg	100
Ba	kg	50
COD	kg	150
phosphate	kg	170
suspended solids	kg	53
other metals metallic ions	kg	300
Na	kg	200
NO3- nitrate	kg	100
dissolved solids	kg	50
detergent/oil	kg	150
Kjeldahl-N	kg	170
BOD	kg	53
NH4+	kg	300
Zn	kg	200
Cr	kg	100
Acid as H+	kg	50
S	kg	150
other nitrogen N-tot	g	170
hydrocarbon CxHy	g	53
dissolved organics	g	300
CO3-- carbonate	g	200
Pb	g	100
Ni	g	50
Cu	g	150
CxHy aromatic	g	170
DOC	g	53
arsenic As	g	300
sulphur/sulphide	g	200
phenols	g	100
toluene	g	50
P2O5	g	150
other organics	g	170
phenol	g	53
H2	g	300
Ca	g	200
crude oil	g	100
F- fluoride ions	g	50
dissolved substances	g	150
sulphide	g	170
PAH's	g	53
Cd	g	300
CN- cyanide	g	200
sulphates	g	100
Mg	g	50
AOX	g	150
F2	mg	170
organo chlorine CxHy chloro	mg	53
Hg	mg	55
NH3	mg	75
K	mg	78
dissolved Cl2	mg	79
CrO3- chromate	µg	32

Warning: these numbers are not representative of a real situation; they are listed just as an example

TAB. 8 - SOLID WASTE		
Substance	**Unit**	**Quantity**
high active nuclear waste	cm3	150
low,med. act. nucl. waste	mm3	170
inorganic general	kton	53
mineral waste	kg	300
industrial waste	kg	200
regulated chemical waste	kg	100
slags/ash	kg	50
oil	kg	150
non hazardous waste	kg	150
inert chemical waste (inert)	kg	170
unspecified	kg	53
to incinerator	kg	300
dust - not specified	kg	200
produc. waste (not inert)	kg	100
construction waste	kg	50
hazardous waste	kg	150
slag	kg	150
final waste (inert)	kg	170
metal scrap	g	53
plastics packaging	g	300
to recycling	g	200
wood packaging	mg	100
paper/board packaging	mg	50

Warning: these numbers are not representative of a real situation; they are listed just as an example

10 Assumptions / limitations

For transparency purposes, the assumptions and the limitations of the study are hereunder listed

10.1 Assumptions

1. DFDG 6059: assumption that carbon black is grade N550.
2. Copper wire process: data from Milan plant: 3,55-4 mm wire (it is the most similar dimension of all available wire processing data)
3. Optical fibre: assumed all glass fibre
4. Bitumen ecoprofile assumed to naphta ecoprofile
5. Fibre unit outer sheath: material: PE: assumed: LDPE
6. Stainless steel: Steel 67,6%, Scrap: 20%, Mn: 0,4%, Si 0,8%, Cr: 10,4%, Ni: 0,8%
7. Electricity mix = Electricity UK, because 70% of the products (% on total weight) are produced in UK and copper rod is produced in UK

10.2 Missing data

1. Copper ribbon manufacture process
2. Pirelli plant air emissions and ancillary materials consumption per km of cable – their contribution to the total impact is expected to be negligible.

10.3 Cut off

The activities / processes / materials not taken into consideration are listed in par. 3.1 and tab. 1.

11 Main results emerging from inventory analysis

Energy consumption: it is mostly due to cable materials production, secondly to the electrical energy necessary to produce the cable, whilst the energy of installation is the less consuming process.

In the context of ***cable materials***, copper is the most impacting, according to the used databases. As a matter of fact, emissions of CO_2, SO_2 and NOx is mostly due to this.

As to ***carcinogenetic released substances*** (benzene, fluoranthene, benzo(a)pyrene, etc.), the major contribution emerges from energy usage, both for cable production and for material production (for example: transport operation in the steel production process).

ANNEX 1 – DISTRIBUTION PHASE (TRANSPORT AND INSTALLATION)

In this annex the results of "distribution" phase are presented. Distribution is the life cycle phase which immediately takes place after cable production, which has been analysed in the previous part of this report. Distribution phase encompasses:

- cable transport
- cable installation

The criteria used are the same used for the previous part of the study.

I Data categories glossary

Data category glossary is the same as the one presented at page 28, simply, but referred (if necessary) to cable distribution:

Input: material or energy which enters a unit process (ISO 14040 – 3.6)

Output: material or energy which leaves a unit process (ISO 14040 – 3.13)

Direct input: the inputs directly necessary for cable distribution. They are represented by materials and energy consumption

Direct output: the output directly released by cable distribution.

Elementary input: material or energy entering the system being studied, which has been drawn from the environment without previous human transformation (ISO 14040 – 3.3)

Elementary output: material or energy leaving the system being studied, which is discarded into the environment without subsequent human transformation (ISO 14040 – 3.3)

Elementary flows: this term is used to define both elementary input and output

Direct elementary input: material or energy entering the system being studied, which has been drawn from the environment without previous human transformation, when the "entering point" is represented by cable distribution (elementary inputs needed directly for cable distribution)

Direct elementary outputs: material or energy leaving the system being studied, which is discarded into the environment without subsequent human transformation, when the "exit point" is represented by cable distribution (elementary outputs directly released by cable distribution, such as waste from cable production plant)

Primary data: data collected "on field", by analysing directly the production process / activities

Secondary data: data collected from public databases or other kind of bibliography

II Data collected

Primary data

It has been possible to collect primary data for some parameters related to cable distribution from "ABC project", precisely:

- Fuel consumption per km of cable
- Lube oil consumption per km of cable
- Waste water per km of cable

Secondary data

Ecobalance data about fuel oil production and combustion were collected from BUWAL 250, because this is homogeneous with the other sources chosen for the rest of the study.

III Data inventories results

Direct inputs:

TAB. 9- TRANSPORT DIRECT INPUTS (FOR 1 km OF CABLE)

Energy Source	Unit	Quantity kg / km	%	Source of inventory ecobalance
fuel oil	kg	50	50,0	BUWAL 250
lube oil	kg	50	50,0	cut - off < 1%
total	**kg**	**100**	**100**	

TAB. 10 - INSTALLATION DIRECT INPUTS (FOR 1 km OF CABLE)

Type	Unit	Quantity kg / km		Source
fuel oil	kg	100	50,0	BUWAL 250
non hazardous solid waste	kg	100,0	50,0	cut - off < 1%
total	**kg**	**200**	**100**	

Direct elementary outputs

TAB. 11 - INSTALLATION ELEMENTARY OUTPUTS (FOR 1 km OF CABLE)

Type	Unit	Quantity	Source
non hazardous solid waste	kg	1000,0	SEAS Project
non hazardous scraps waste	kg	1000,0	SEAS Project

Warning: these numbers are not representative of a real situation, they are listed just as an example

Elementary inputs inventory

TAB. 12 - INPUTS		
Substance	**Unit**	**Quantity**
pot. energy hydropower	MJ	100
natural gas ETH	m3	200
coal ETH	kg	150
crude oil ETH	kg	300
lignite ETH	kg	50
uranium (in ore)	g	50
wood	g	50

Elementary outputs inventory

TAB. 13 - AIRBORNE EMISSIONS		
Substance	**Unit**	**Quantity**
CO2	kg	20000
NOx	kg	400
non methane VOC	kg	300
CO	kg	314
SOx	kg	50
methane	kg	40
dust (SPM)	kg	31
benzene	kg	3
N2O	g	134
aromatic CxHy	g	57
metals	g	57
HCl	g	50
Ni	g	40
Zn	g	31
HF	g	3
HALON-1301	g	134
lead Pb	g	50
ammonia	g	40
Cd	mg	31
PAH's	mg	3
mercury Hg	mg	40
Mn	mg	31
organo Cl CxHy chloro	µg	3

This emission values are calculated by using BUWAL 250 database.

According to “ABC project”, following values, for respective emissions, are calculated for 1 km of cable distribution:

- CO: 206,4 kg
- NOx: 547,2 kg
- PM10: 44,4 kg

Warning: these numbers are not representative of a real situation, they are listed just as an example

TAB. 14 - WATERBORNE EMISSIONS		
Substance	**Unit**	**Quantity**
Cl-	kg	321
anorg. dissolved subst.	kg	232
suspended substances	kg	34,3
oil	kg	16,1
SO4-- sulphate	kg	11,3
TOC	kg	5,54
other metals metallic ions	kg	3,7
COD	kg	1,77
Ba	kg	1,52
NH4+	kg	1,32
other nitrogen N-tot	kg	1,29
CxHy aromatic	g	513
NO3- nitrate	g	396
Fe	g	338
Kjeldahl-N	g	223
Al	g	159
phenols	g	79,7
toluene	g	71,4
BOD	g	54,2
sulphide	g	18,9
phosphate	g	15,6
PAH's	g	7,86
Zn	g	7,03
Cr	g	6,65
Ni	g	2,47
CN- cyanide	g	2,38
AOX	g	2,37
Cu	g	1,86
Pb	g	1,63
arsenic As	mg	788
Cd	mg	668
organo chlorine CxHy chloro	mg	527
DOC	mg	285
Hg	mg	5,94

TAB. 15 - SOLID WASTE		
Substance	**Unit**	**Quantity**
non hazardous waste	kg	3401

Warning: these numbers are not representative of a real situation, they are listed just as an example

IV Assumptions

In order to evaluate the “distribution phase” inventory, following assumptions have been done:

1) specific gravity of waste (table 7) = 0,5 (waste figure was given in m3)

2) Ecobalance of 1 kg of fuel oil = ecobalance of 41,7 MJ of “Heat Diesel” from database Buwal 250.

In other words: the ecobalance of heat energy from diesel in the Buwal 250 database states that, from 1 kg of fuel oil as raw material, 41,7 MJ of heat energy are obtained.

Consequently, the ecobalance of fuel oil (total quantity) is obtained by two steps:

- calculating the total energy obtained by total quantity of fuel oil used, by multiplying the total quantity of fuel oil expressed in “kg” for the 41,7 MJ)

- multiplying the total energy obtained, for the ecobalances values related to 1 MJ

ANNEX 2 – USE PHASE AND END-OF-LIFE PHASE

In this study, use and end-of-life phase is missing, but some an explanation is hereunder provided on how to manage these parts of the product life span.

What is the use phase?

The aim of this LCA phase study is to evaluate the impact of the cable when it is used by its purchaser, during the whole use-period (it could be 30 years for cables). In the case of the submarine cable, it refers to the impact of the cable during its stay in the sea.

What is the end-of-life phase?

The aim of this LCA phase study is to evaluate the impact of all the operations of the cable at its end-of.life. Since the forecast of how the cable will be treated at its end-of-life is very difficult, in many cases several scenarios are to be analysed, such as:

- Cable abandon
- Cable recovery and disposal
- Cable recovery and materials reclaiming, regenaration and use as recycled raw material for other products

In some case, more scenarios are needed. Regarding the submarine cable, no hypothesis has been done.

Procedure to follow to study the inventory of the use phase and end-of-life phase scenarios

When you have defined the end-of-life scenarios, you have to calculate the environmental impacts of them, and obviously also of use phase.

The procedure is the same followed for the production “cradle to gate” and “distribution” phase:

- definition of study boundaries: what is to be studied and what’s not to be studied.

- inventory of environmental data (such as raw materials and energy consumption, emissions, etc)
    - description of cables materials: it is the description of the cable components, their respective materials and quantities per functional unit
    - environmental data collection: it is the collection of the environmental data related to all the cables materials
    - data assembling: it is the sum of all environmental data, in order to have the environmental balance of the entire product.

The figures of the environmental inventory balance are to be referred, as usual, to the functional unit (obviously the same of the “cradle to gate”, since it must be the same for all the life cycle).