INTERNATIONAL TELECOMMUNICATION UNION

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

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SERIES L: CONSTRUCTION, INSTALLATION AND PROTECTION OF CABLES AND OTHER ELEMENTS OF OUTSIDE PLANT

Minimizing the effect on the environment from the outside plant in telecommunication networks

ITU-T Recommendation L.45

(Formerly CCITT Recommendation)

ITU-T Recommendation L.45

**Minimizing the effect on the environment from the outside plant
in telecommunication networks**

Summary

This Recommendation details the methodology adopted in order to minimize the effects (e.g. energy and CO_2) caused by the use of outside plant in the environment. This is based on life-cycle analysis, that is, *cradle to the grave* ownership of the products.

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications. The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

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As of the date of approval of this Recommendation, ITU had not received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementors are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database.

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considering

- that the energy consumption to maintain the continuous operation of data and telecommunication equipment for IT activities has a significant impact on the environment. For example 1% of the total power consumption of Stockholm is used to realize all telephone calls and to be able to transmit and receive all fax messages and data files on a 24-hour basis;

- that there is the potential for energy saving with effective telecommunication solutions;

- that the use of IT technology can be a possible way towards a more sustainable society with efficient use of energy and with a substantial reduction in the emission of "greenhouse" gases;

- that the global warming phenomenon causes disturbances in global weather conditions which result in storms, floods, erosion, malaria and changes in the sea currents in the oceans;

- that a life-cycle analysis of underground optical cables has been carried out in Sweden which shows it is applicable to other networks;

- that energy consumption changes continuously with the development of cable design, cable manufacture, installation methods, tools, machinery and vehicles;

- the existence of an Agenda 21, a comprehensive plan of action to be taken globally, nationally and locally by organizations of the United Nations, governments and major groups in every area in which humans impact on the environment;

- that there are instances where toxic waste is polluting the environment through ignorance or neglect,

it is recommended

- to contribute in all industrial activities to reduce the effects of global warming;

- to minimize energy consumption and reduce greenhouse gases in accordance with the technique of life-cycle analysis in ISO 14040;

- to use ISO 14020 and ISO 14025 as criteria for an environmental declaration on products and systems;

- that each organization involved should have an environmental policy and an environmental plan with measurable goals on how to improve products and methods for a reduction in the consumption of energy;

- to keep track of toxic and dangerous substances and to have a waste management system.

1   Life-cycle analysis

In an attempt to cover the whole life cycle using a "cradle to the grave" perspective for cables and equipment, the life cycle is divided into three phases (see Figure 1):

- manufacturing;
- usage;
- scrapping.
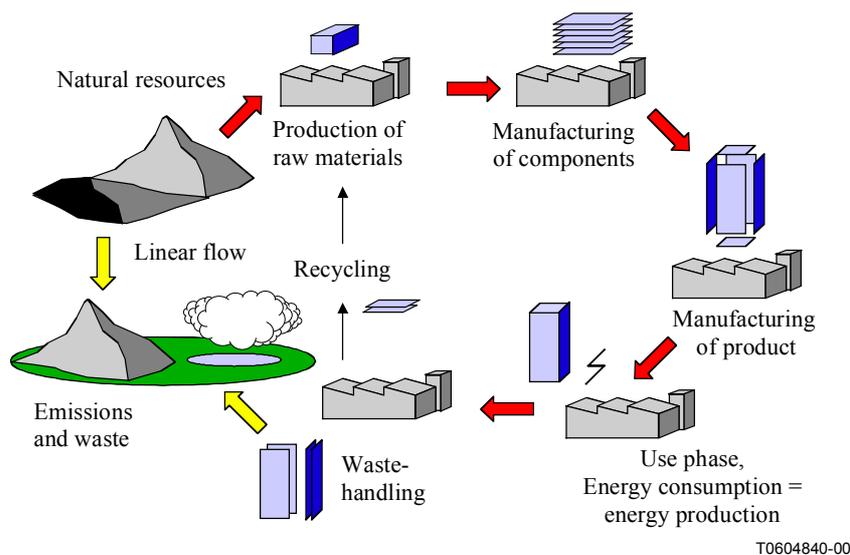
Figure 1/L.45 – Life cycle assessment

1.1 Manufacturing

The manufacturing phase includes raw material, transportation and production of a product. It is important to use materials with low impact on the environment and to follow the legislation in each country and the recommendations regarding banned materials.

1.2 Usage

The phase "usage" can be divided into installation, operation and maintenance. It is established that optical cables due to their light weight and improved installation capability technique give a lower usage of energy and CO_2 than copper cables.

During the installation phase of the cables it is also very important to organize transportation in an optimal way. This is done by using a fleet of well-maintained vehicles and machinery that causes minimal pollution, using suitable fuel and having catalyst exhaust fume cleaning systems.

1.3 Scrapping

Scrapping of cables is divided into disassembling and recycling/waste. Scrapping of optical cables is not common today. Scrapping of the optical cable ends (short cable pieces) is currently performed when splicing cables and the cable waste is disposed of in a similar way to that in the manufacturing process. Scrapping of old copper cables is industrialized in most parts of the world. The copper is recycled and the plastic materials are burned or disposed of as waste. If cables or batteries contain lead the recycling process should be carried out according to safety requirements. Scrapping of old telephone poles impregnated with preservatives also requires sound environmental practices.

1.3.1 Disassembling

Excluding the duct and poles, optical cables can be removed with the same technique with which they were installed (blowing, floating and pulling). Due to the ease of their removal there is the potential for reuse of the cable or recycling of the cable material. They can also be left in the duct (if permitted) as they cause no contamination in the ground environment.

1.3.2 Recycling/waste

Sheath materials from optical cables and fibres can easily be separated mechanically and most of the plastic materials recycled.

Where optical cables are metal free and only contain thermoplastic plus optical fibres the energy content in thermoplastic can be regained as heat when burnt in heating plants as its content is similar to petroleum oil.

For poles, attention should be paid to local legislation for their disposal or reuse.

<center>APPENDIX I</center>

<center>**Environmental issues for the outside plant – A "cradle to the grave" approach for environmental impact from a transmission line based on LCA**</center>

I.1 Life-cycle analysis (LCA) on an optical transmission media

I.1.1 Abstract

The study deals with the impact on the environment due to the use of optical fibre transmission media like optical fibres and optical cables.

I.1.2 Introduction

Ericsson, Telia and AT&T have jointly accomplished an extensive life cycle analysis investigating the environmental influence from different activities in the industrial sector in a western society. The analysis is based on figures from the cities of Stockholm in Sweden and Sacramento in California, United States. The study shows that the impact of the IT activities only counts for about 1% of the total energy consumption in society.

In further analyses Telia and Ericsson aim to put a transmission media into focus, namely optical fibres and fibre cable systems in a "cradle to grave" perspective. The major measurable factors are energy consumption and carbon dioxide release. These parameters are of high importance in order to reduce emissions due to the combustion of fossil-based fuels. According to the Kyoto agreement, reduced energy consumption and carbon dioxide release are vital in order to reduce the "global warming" phenomenon. The study is divided into three phases: manufacturing, usage and scrapping.

According to the study above the most significant environmental load from the IT-activities origins is the energy consumption needed to keep data and telecom equipment in continuous operation. In order to realize all telephone calls between fixed and mobile terminals and to be able to transmit and receive fax messages and data files only about 1% of Stockholm's total consumption of electrical energy is required. The potential for savings in energy consumption due to effective telecommunication solutions is therefore very promising. The use of IT-technology can be a possible way towards a more sustainable society with efficient use of energy and with a substantial reduction of the emission of "greenhouse" gases.

I.1.3 Scope – "Cradle to the grave" perspective on optical cables

In an attempt to cover the whole life cycle for optical fibre cables the life cycle is divided into three phases:
- manufacturing;
- usage (including installation);
- scrapping (including dismantling).

I.1.4   Conditions for the study

The analysis is based on underground optical cables for the long-distance network in Sweden. Submarine cables and indoor networks are not included in the study. Conditions for the study changes continuously as the development in the field of cable design, cable production, installation methods, tools, machinery and vehicles is proceeding. The study regards energy consumption and greenhouse gases.

I.2   Manufacturing

The manufacturing phase includes raw material, transportation and production of a product. It is important to use materials with low impact on the environment and to follow the legislation in each country and the recommendations regarding banned materials.

I.3   Usage

The phrase "usage" can be divided into installation, function and maintenance.

Installation

The transition from copper conductor cables to optical fibre cables has had and still has a significant influence on cable installation techniques. Modern optical cables are light in weight and suited to be installed with blowing or floating techniques in long lengths. Due to improved design of high-count fibre, cables are slim, lightweight and fast to splice. Today a 12-fibre ribbon unit only takes a couple of minutes to splice. The most resource consuming part of the installation is the placement of duct systems.

In the attachments one can see the CO_2 emissions during installation of a typical long-distance cable. The CO_2 emission is mainly derived from the usage of fossil fuel like petrol and gasoline that is used in vehicles for transportation, digging, ploughing equipment and compressors, etc. You might therefore set emissions of CO_2 equal to usage of fossil fuels. In Telia's fleet of vehicles it is today mandatory to use catalyst cleaning of the exhaust fumes but this does not influence the emissions of carbon dioxide.

See charts with calculated emission of CO_2.

Function

Early optical cable plants have been in function for more than 20 years without any significant degradation of the cable properties. There is no indication that the lifetime of an optical cable will be shorter than 20 years. Scrapping of "old" optical cables has so far not occurred due to their future-proofness. The energy consumption in optical cables is small in comparison with "electrical" telephone cable systems.

It is notable that the energy usage in a telecom network mainly derives from the terminal equipment and the switches (see charts with measured energy consumption from a videoconference system). The energy usage in transmission systems can normally be estimated as less than 10% of the total energy consumption.

The amount of transmitted signal energy is small and the attenuation in the fibres, especially single-mode fibres, permits long length transmission. Techniques like WDM further increase the bandwidth and the amount of information. The energy consumption during lifetime is located to the transmission equipment. The "footprint" of the electronics is getting smaller and smaller and the technical development in this area is very fast.

See charts with calculated emissions for different telecom traffic and services.

Maintenance

Maintenance costs have dropped significantly due to fast repair methods and due to the fact that optical cables are not damaged by lightning. Optical cables are not "sensitive" to moisture penetration to the same extent as copper cables. Most of its resource consumption is due to transportation of the maintenance personnel and working machines to access the cables.

I.4   Scrapping

Scrapping of optical cables can be divided into disassembling and recycling/waste. Scrapping of optical cables is not common today. Scrapping of optical cables is currently performed when splicing cables (short cable pieces) and to handle cable waste in connection with the manufacturing process. Scrapping of old copper cables is industrialized in Sweden. Figures presented in the chart are calculated based on scrapping of copper cables.

Disassembling/Dismantling

If excluding the duct, optical cables can be removed with the same technique with which they were installed (blowing, floating, and pulling). Due to the ease of removing optical cables there is a potential for reuse of the cable or recycling of the cable material.

They can also be left in the duct (if permitted by authorities and real estate owners) as they cause no known contamination in the ground environment. It is notable that the environmental impact from the dismantling process might be significant due to high emissions of CO_2.

See charts with calculated emission of CO_2.

Recycling/Waste

Sheath materials and fibres can easily be separated mechanically and most of the plastic material recycled.

As modern optical cables today are metal free (at least in Sweden) and only contain thermoplastic materials (mostly polyethylene) plus the optical fibres, therefore the energy content in optical cables can be regained as heat when burnt in heating plants as their content is similar to petroleum oil.

In our study we have calculated with recycling of sheath material.

I.5   Summary

LCA analyses of optical cables get a favourable position as an extremely efficient product in view of its small material content and its functionality. The installation and dismantling phase for an optical cable plant is the most resource consuming activity. It is important to even further improve installation methods, and this is possible to achieve by the use of key figures like greenhouse gas (CO_2) and energy (kWh or MJ) when designing new telecom networks.

Optical cables play an important role as the only transmission medium that can handle the increasing demand on telecommunications (Internet, broadband etc). Information is one of the important tools to handle the more and more complex global environmental situation.

Example of services: Emissions of greenhouse gas for operating a limited videoconference meeting (5 hours a week during one year) in Sweden based on a cradle to grave perspective. Installation/dismantling of the cable system is not included. (See Figures I.1, I.2 and I.3.)
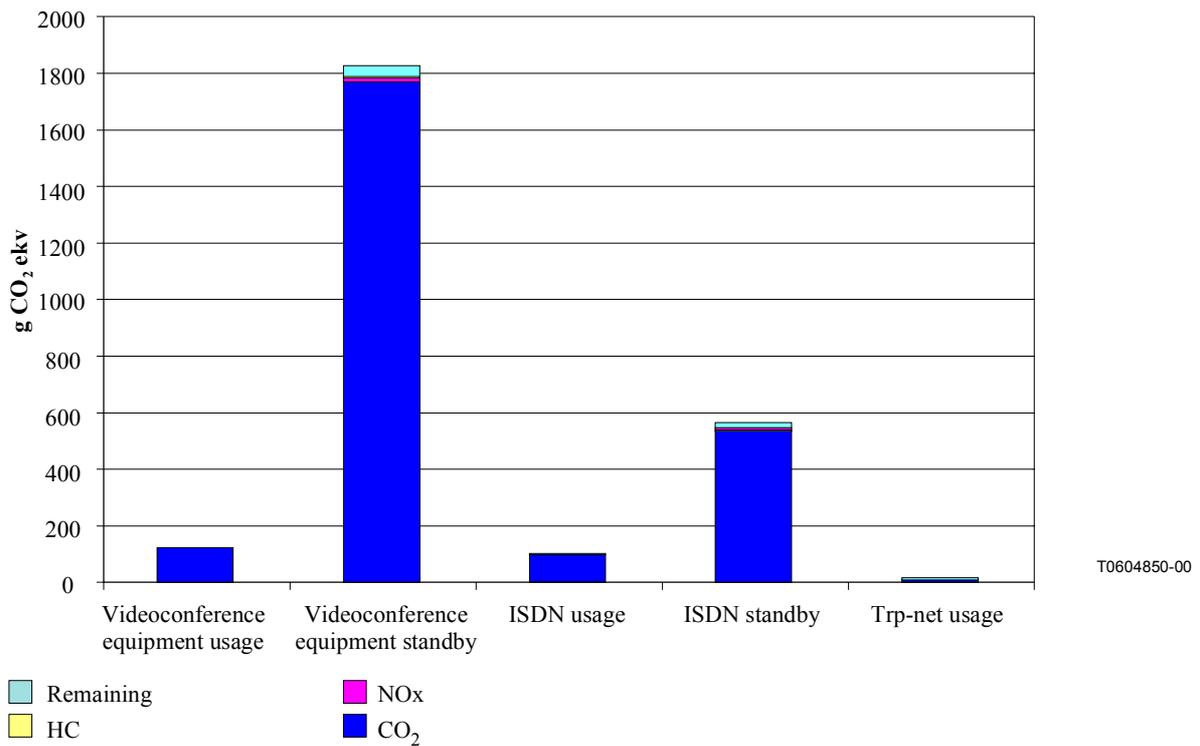
Figure I.1/L.45 – Global warming potential
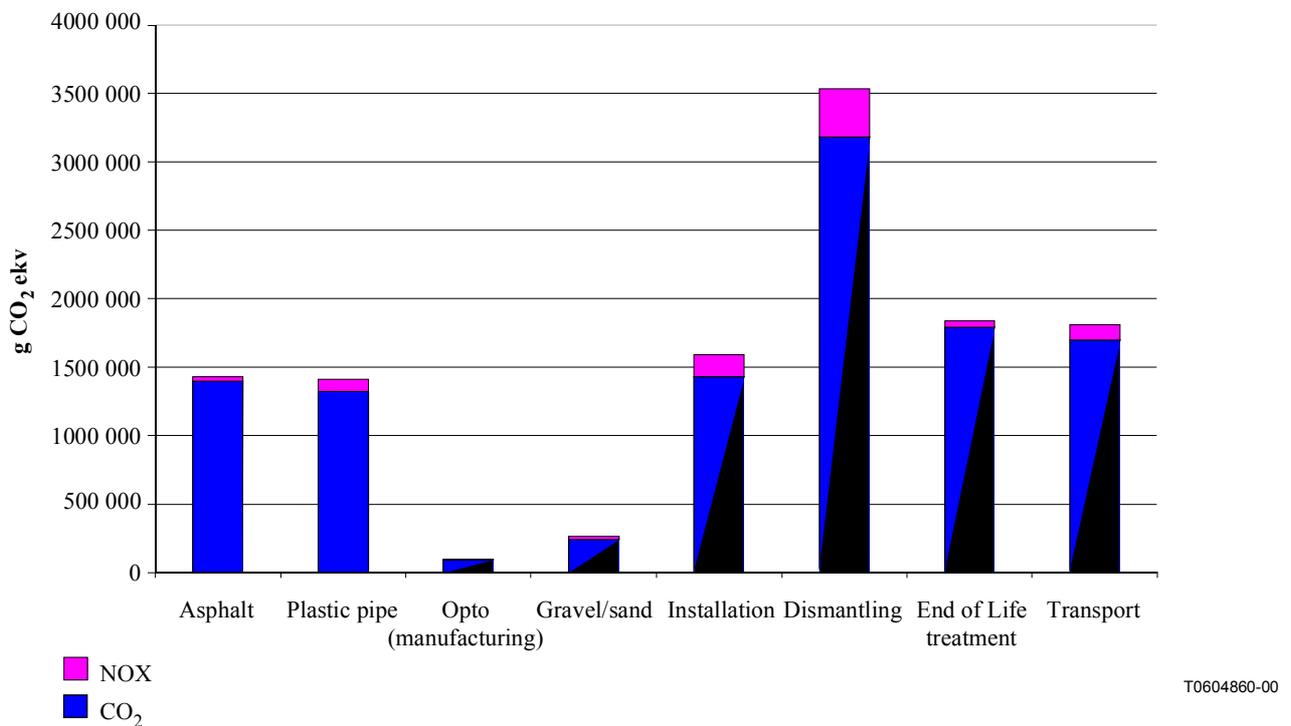
Figure I.2/L.45 – Example: Emissions of greenhouse gas for a major (> 450 km) cable system in Sweden based on a cradle to grave perspective
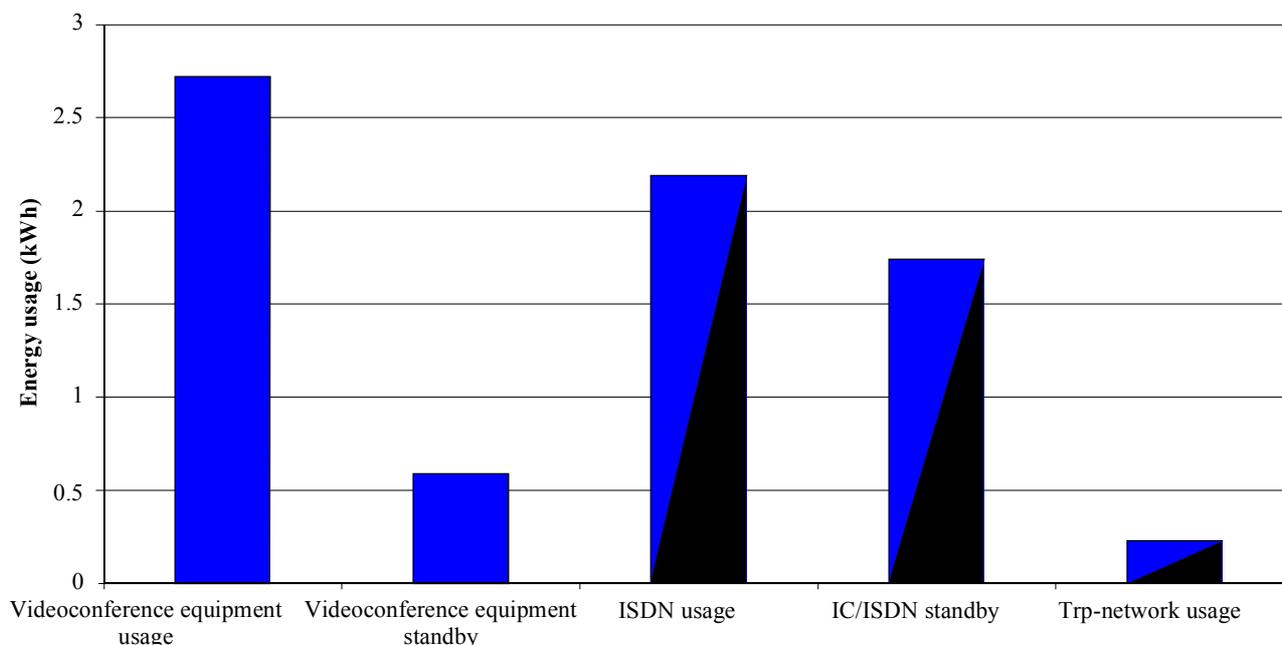
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Figure I.3/L.45 – Example of Services: Use of electrical energy to operate a limited videoconference meeting (30 h a week during one year) in Sweden based on a cradle-to-grave perspecitve. Installation/dismantling of the cable system is not included

References

–   ÖSTERMARK (U.), ERIKSSON (E.): Life Cycle Analysis of a videoconference (Livscykelanalys av bildkonferens), *Chalmers Industriteknik,* 1998.

–   TINGSTORP (S.), TELIA (N.): Life Cycle Analysis of the installation of a telecommunication cable (Livscykelanalys för anläggning av Telekabel), *Master thesis*, 1998.

Environmental product declarations for products used in outside plant

There is a need for standard information regarding the environmental impact from the products used in outside plant.

We suggest that telecom companies work with life-cycle analysis according to ISO standard 14040 and to present an environmental product declaration that could be certified by a third party if necessary. This will facilitate the installers in choosing products with the lowest possible environmental impact.

The Government of Sweden decided on 30 November 1997 that a national system for environmental product declarations should be created. The system is initiated and driven by the business sector. On 13 May 1998 the regulation for environmental product declarations was adopted.

Working groups are developing specific rules for the following product/service categories: flooring, sawn timber products, energy, pulp and paper, road transports of dairy products, passenger's cars and optical fibre cables. Initiatives to develop rules for other products have been taken.

Principles and properties of certified environmental product declaration in Sweden

Certified environmental product declarations shall provide opportunities for giving an objective, credible and quantitative description of the environmental properties of products and services viewed from a comprehensive life-cycle assessment perspective. Certified environmental product declarations are primarily intended for use by professional buyers in commerce, industry and public authorities as source information in conjunction with the requirements for factual-based and comparable environmental information in the procurement and purchase of products and services and as assistance for such buyers in making correct assessments of the product and services provided by suppliers, distributors and contractors. Certified environmental product declarations may also be used by private consumers as information of environmental performance of, e.g., capital goods.

Moreover, in conjunction with the introduction of environmental management systems in accordance with ISO 14001 and EMAS, the need has increased for quality assurance of the data and information required from suppliers, distributors and contractors, for which certified environmental product declarations may well come into use.

Certified environmental product declarations should be applicable to all products and services within clearly defined product and service groups to ensure *objectivity, comparability and credibility* in the assessments of their environmental properties. Certified environmental product declarations represent an open presentation of the environmental properties and are neutral, since no predetermined environmental performance levels are specified. Compared to environmental labelling Type I (Eco Labelling)*,* a certified environmental product declaration includes no valuation of the environmental properties of the product. It is up to the audience (industrial and private consumer) of a certified environmental product declaration to take a stand and make assessments on the basis of their own points of departure and the information on the environmental properties of the product, as stated in the declaration.

An additional point of departure that can be claimed in conjunction with a certified environmental product declaration is that the establishment of a national system for such declarations shall be based on existing ways of working for implementing environmental management systems (e.g. ISO 14001 and EMAS), and on open and established systems for certification and registration. This means that certified environmental product declarations can be introduced and maintained in a manner that is as cost-effective as possible, without unnecessary bureaucracy, which should lead to relatively low charges for certification and registration.

Some key properties that characterize a certified environmental product declaration can be summarized in the following way:

- Objective, due to a requirement that scientifically accepted and valid methods are used for lifecycle assessment (LCA) in accordance with ISO standards ISO 14040-14043 in order to identify and focus the environmental work on the most significant environmental aspects, leading towards continuous improvements.
- Environmental impact, oriented, due to the possibility to include assessments of potential environmental impact.
- Wide range, by being non-selective, i.e. applicable to all products and services on the market within well-defined product and services groups.
- Neutral, due to absence of valuations and predetermined environmental performance levels that must be met.
- Open, by easily accessible information available on the Internet.
- Competence enhancing, by access to explanations of key definitions and concepts, as well as general information on the environment being linked to the information of certified environmental product declarations on the Internet.
- Credible, due to requirements on inspection, review, approval and follow-up by an accredited independent and competent third party.

- Cost-effective, since certified environmental product declarations are based on existing ways of working with certification and registration in the environmental field based on open and established systems.
- Flexible, since the contents of certified environmental product declaration can be amended as necessary and as required by the company/importer after due external review and approval by an accredited certification body.

The environmental information

The system is based on specific requirements on the information that describes the environmental properties of products and services. This applies to the scientific source of information and the scope of the information that will be included in an environmental product declaration.

The scope of the information is thought to have a similar layout as material safety data sheets, MSDS, that contain standardized information on the health and safety aspects of chemicals and products. The information in an environmental declaration can be divided into five sections:

1) description of manufacturer/importer and of the product or service;
2) environmental performance declaration;
3) content declaration;
4) recycling declaration;
5) information from the certification body.

Definition of product-specific points of departure

Commerce and industry initiate the system for certified product declarations. It is principally industry, commerce and organizations that define the product and services groups to be included in the system. In conjunction with the so-called product-specific points of departure must be specified for the LCA calculations, so that these will be comparable between different certified environmental product declarations within a given product group, (i.e., telecom cables) or type of service. The product-specific points of departure can be revised as required, but should remain in force over reasonable periods of time in order to achieve stability on the market. Proposals for product-specific points of departure should be prepared in cooperation between interested parties, such as companies/importers, as well as industrial or interest organizations.

Telecom cables product-specific points:

The definition of product-specific points of departure shall include the following issues:

1) Choice and definition of product group and service (telecom cables).
2) Choice and definition of functional unit (100 m of cable).
3) Choice and description of system boundaries (from the cradle to the grave, raw material, transportation and production of cable).
4) Choice of possible product and service, specific so called cut-off criteria (transportation by the employed and packaging material).
5) Choice of allocation rules (energy, transportation of raw material).
6) Description of the type of information which is to be included in the phase of the declaration of environmental performance (transmission data, usage, health, life length, emissions, maintenance).
7) Choice of quantities and units in which the results are to be expressed (MJ/100 m, kg/m).

Environmental declaration optical fibre cables

As an example we present an environmental declaration on an optical fibre cable used indoors and partly outdoors.

COMPANY ADDRESS

THE PRODUCT

The environmental declaration applies to optical fibre cable type: xxx.

Delivery lengths are: x. Cable diameter: y. Weights: z.

CONTENTS DECLARATION

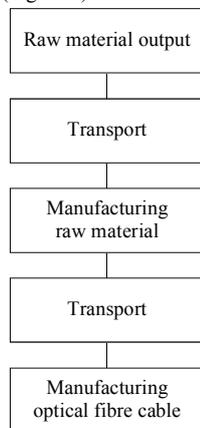|	% by weight
Strength member	10-12
Optical fibre	3-4
Swelling tape	2-3
Colour pigment	1-2
Marking ink	<0.1
Acrylate coating	2-4
Polyethylene	30-35
Polyethylene*	45-50

* non halogen flame retardant

MANUFACTURING

The optical fibre cable is manufactured at the factory: xxx.

The fibre is coated with layers of acrylate polymer which are cured by UV radiation.

The fibres are placed side by side and encapsulated with a further application of UV-curing acrylate to form a ribbon.

The ribbons are placed in slots around a strength member and the cable body sheathed with a non-halogen flame retardant polyethylene.

An inkjet printer is used to provide the cable identification. When the cable is ready it is wound onto drums and delivered to the customer.

Scrap from production is sorted and as far as possible recycled.

Discharge from production evolves from the cleaning of the implements used during the acrylate coating of the fibre and is in the form of solvents.

The packing used in connection with production consists of wood, polyethylene, steel and a small amount of aluminium.

ENVIRONMENTAL PERFORMANCE DECLARATION

Production

The environmental profile shown is based on a life cycle analysis (LCA) carried out at Ericsson Cables AB during 1998.

The profile refers to 100 m of cable. The assessment begins with the gathering of the resources and is concluded when the product leaves the factory (Figure 1).

Raw material output

Transport

Manufacturing raw material

Transport

Manufacturing optical fibre cable

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Figure 1

Resources, raw matr.	MJ/100 m
Feedstock oil	~ 260
	kg/100 m
Renewable	< 38
Non-renewable	< 1.5

Electricity consumption	MJ/100 m
Fossil fuels	830 – 850
Biofuels	< 0.1
Other fuels	< 1.0

Emissions loading	kg/100 m
Stratospheric ozone depletion	< 0.001
Greenhouse gases	< 75
Acidification gases	< 0.35
Ground level ozone	< 0.05

Other information

Emission data	g/100 m
BOD	< 12
COD	< 15
Susp. material	< 38
Metals	< 2

Waste to landfill	kg/100 m
Solid waste	< 7.5

Hazardous waste	kg/100 m
Radioactive	< 0.01
Other	< 3.1

Use:
The cable is designed for the transmission of information either indoors or outdoors. The cable satisfies the demands for fire resistance indoors.

Transmission data:
Under normal conditions the transmission capacity of the cable is 2.5 Gbit/s but the upper limit is not known.

Lifetime:
The technical lifetime is 40 years.

Emission:
No discharge into the atmosphere or water system occurs.

Health:
Repeated skin contact with acrylate can cause allergies.

Fire:
The flame retardant material in the cable is Magnesium hydroxide, which forms water while burning. Fire or excessive heating releases mainly carbonoxide and water. Small amounts of unpleasant or toxic breakdown products i.e. hydrocarbons, aldehydes, acetic acid can also be formed.

Maintenance:
The cable requires no maintenance with normal indoor use or outdoors in limited lengths.

RECYCLING DECLARATION

Ericsson Cables AB is involved in a number of research projects aimed at finding a method for the recycling of optical fibre cable.

Today it is possible to recycle part of an optical fibre cable mainly utilizing the energy content.

Recycling	kg/100 m
Polyethylene	~ 0.6

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