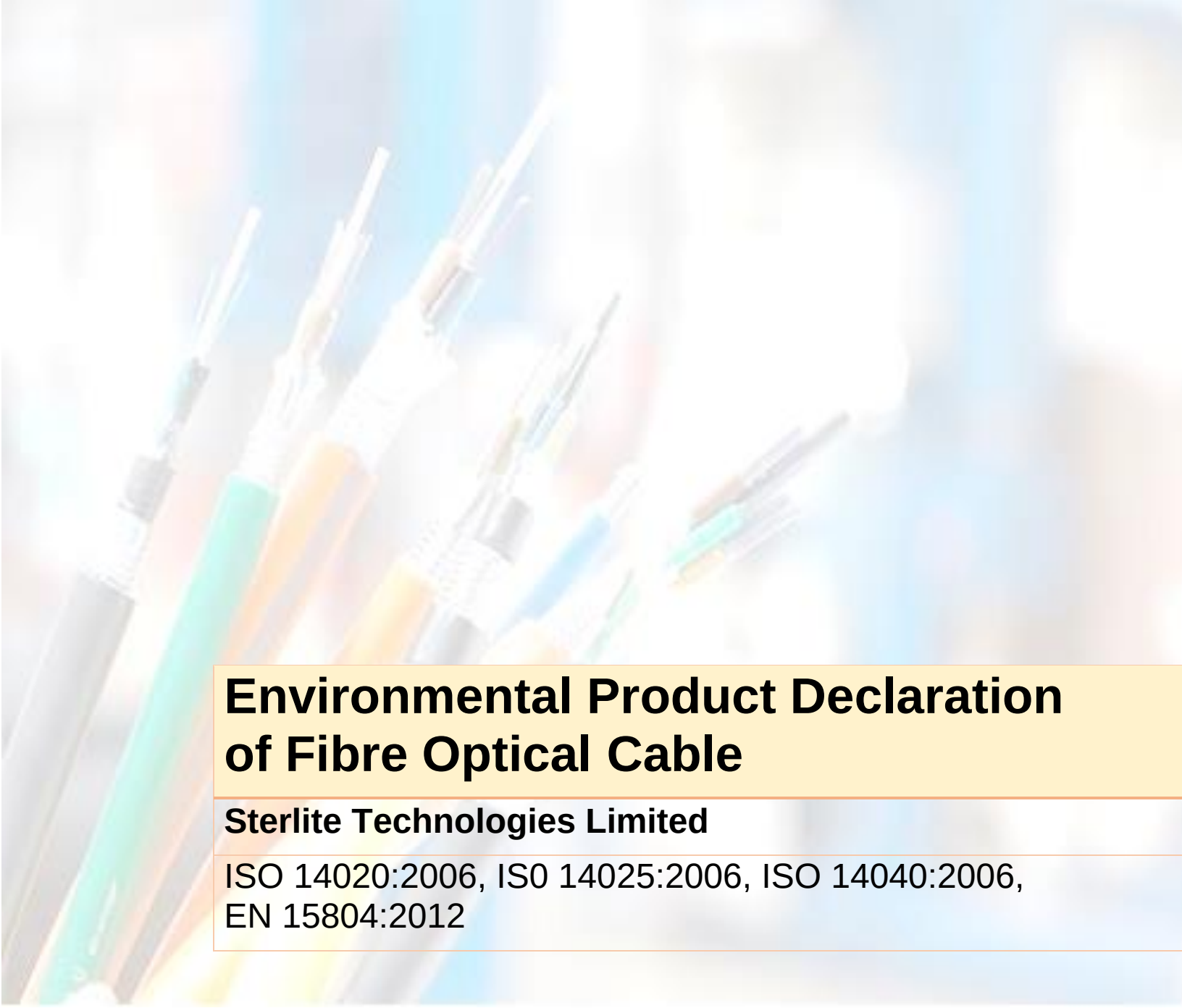

Environmental Product Declaration of Fibre Optical Cable

Sterlite Technologies Limited

ISO 14020:2006, IS0 14025:2006, ISO 14040:2006, EN 15804:2012

EPD registration number:	S-P-01416
Publication date:	31 March 2020
Validity date:	30 March 2025
Geographical scope:	India

INDIA EPD®

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1. Introduction

This current declaration aims to provide the effects measurable and verifiable for the environmental assessment of 1 km of Fibre Optical Cable used for 20 years.

Sterlite Technologies Limited (STL) is a global leader in end-to-end data network solutions. It designs and deploys high-capacity converged fibre and wireless networks. With expertise ranging from fibre optic and cables, hyper-scale network design, and deployment and network software, STL is the industry's leading integrated solutions provider for global data networks. STL partners with global telecom companies, cloud companies, citizen networks and large enterprises to design, build and manage such cloud-native software-defined networks.

STL has innovation at its core. With intense focus on end-to-end network solutions development, we conduct fundamental research in next-generation network applications at its Centres of Excellence. STL has strong global presence with next-gen optical preform, fibre and cable manufacturing facilities in India, Italy, China and Brazil, along with two software-development centres across India and one datacentre design facility in the UK.

STL is committed to sustainable growth and preserving the environment and thus steers several key projects in this direction: Zero Waste to Landfill, Project Zero Water Discharge which aims at enabling the Company to reduce its fresh water intake by recycling and reusing waste water generated at the manufacturing plant., Project Jaldoot which reaches to villages making them drought-free through watershed development, community ownership and water literacy, Project Green Belt started in FY2016-17 by planting over 5,000 trees specifically for air filtration on both sides of the 2-km road to MIDC Waluj. The Company has maintained a 90% sustainability rate, setting a benchmark in the region.

Fibre Optical has become a necessity for telecommunication companies as a preferred transmission medium catering to their most aggressive bandwidth demands. Fibre Optical Cable is used across the backbone, aggregate, and access networks. Fiber to the home (FTTH), Fiber to the antenna (FTTA), and Fiber to the building (FTTB) applications are key factors driving the demand of Fibre Optical Cable. In OSP installations, Sterlite's customised cable solution cater to high-bandwidth applications ranging from underground, direct buried, aerial, submarine to FTTx.

The LCA conducted is in accordance with PCR 2012:01 Construction products and construction services (EN 15804) for preparation of Environmental Product Declaration (EPD). Results presented in this EPD are for 1 km of Fibre Optical Cable used for 20 years.

2. General Information

2.1 EPD, PCR, LCA Information

Table 1. EPD Information

Programme	The International EPD® System, www.environdec.com
Program operator	EPD International AB Box 210 60, SE- 100 31 Stockholm, Sweden.
Declaration holder	Mr. Vineel R 68/1, Madhuban Dam Road, Rakholi Village,Silvassa,Dadra and Nagar Haveli - 396240 India Email: vineel.r@sterlite.com
Product	Fiber Optic Cable, CPC Code: 88753
EPD registration number	S-P-01416
Publication date	31 March 2020
Validity date	30 March 2025
Geographical scope	Manufacturing in India
Reference standards	IS0 14025:2010; 1SO 14001; 1SO 14040/44:2006 EN 15804:2012

Table 2. PCR Information

Reference PCR	PCR 2012:01 Construction products and construction services, version 2.2 in compliant with EN 15804:2012+A1:2013
Date of Issue	May 2017

Table 3. Verification Information

Demonstration of verification	External, independent verification
Third party verifier	Dr Hudai Kara, Metsims Sustainability Consulting, 4 Clear Water Place, Oxford OX2 7NL, UK Email: hudai.kara@metsims.com

Table 4. LCA Information

Title	Environmental Product Declaration of Fibre Optical Cable
Preparer	Dr. Rajesh Kumar Singh thinkstep Sustainability Solutions Pvt. Ltd. 707, MEADOWS, Sahar Plaza, Andheri Kurla Road, Andheri East, Mumbai, India - 400059 Email: rsingh@sphera.com
Reference standards	ISO 14040/44 standard

2.2 Reference Period of EPD Data
The reference period for the data used within this EPD is the year 2018.

2.3 Geographical Scope of EPD Application
The geographical scope of this EPD is Manufacturing in India.

2.4 Additional Information about EPD
Sterlite Technologies Limited manufactures Fiber Optic Cable (Cable - IS 60794-1-1), at Rakholi Plant, Dadar and Nagar Havelli, India. The Fiber glass is manufactured at Sterlite Technologies Limited's Waluj and Shendra plant. The EPD is declared for 1 km of Fibre Optical Cable used for 20 years. The target group of EPD are Green Building Certification Program holders and consultants, customers, project developers, statutory agencies and government.

This EPD is in accordance with ISO 14025 and EN 15804. EPD of construction products may not be comparable if they do not comply with EN 15804. Product Category Rules (PCR) for the assessment of the environmental performance of Fiber Optic Cable is PCR 2012-01 v2.2 Construction products and construction services, compliant with the European standard EN 15804:2012+A1:2013 (Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products).

3. Product Description and System Boundaries

3.1 Product Identification and Usage

In today's world of global telecommunications, Fibre Optical is the core of connectivity, providing the medium through which networks instantaneously transmit voice, data, and video along a strand of glass that is stronger than steel yet thinner than a human hair.

A fiber optic cable is a network cable that contains strands of glass fibers inside an insulated casing. They're designed for long distance, very high-performance data networking, and telecommunications. Compared to wired cables, fiber optic cables provide higher bandwidth and can transmit data over longer distances. Fiber optic cables support much of the world's internet, cable television, and telephone systems.

The present declaration is conducted for 1 km of Fibre Optical Cable used for 20 years.

The data for Fibre Optical used in the study is NLD 48F Fiber Optical Cable was used. NLD 48F Fiber Optical Cable has 6 number of Loose Tubes with 8 Fibers each and Gel. Thus, a total of 48 Fibers in one cable. The core has a central strength member made of (2.1 mm +/- 0.1mm) Fiber Reinforced Plastic (FRP) to provide tensile strength and anti-buckling properties. Further, Water Blocking Elements Water Swellable Yarns are added to prevent water ingress in the core of cable Peripheral Strength Member. Glass Roving Yarns are used to meet the tensile Strength. Core Wrapping is done using Binder and Water Blocking Tape. Outer Cable consists of Rip Cord, Twisted yarns, Armouring of corrugated ECCS Tape and Outer Sheathing of UV Proof Anti-termite HDPE. Cable diameter is 12 ± 0.5 mm and Cable weight is 140 kg/km +/- 14kg/Km. The material composition is presented in the table given below.

Table 5. Material composition of NLD 48F Fibre Optical cable per km

Material	Mass (kg)	Mass (%)	DQI*
Fibre Optical	9.52	7.05%	Measured
Fiber Reinforced Plastic	16.29	12.06%	Measured
Water Swellable Yarns	0.24	0.18%	Measured
Loose tube without glass Fibers	20.02	14.83%	Measured
Glass roving yarn	6.79	5.03%	Measured
Ripcord	1.45	1.07%	Measured
Water blocking tape	3.09	2.29%	Measured
HDPE	43.27	32.05%	Measured
ECCS Tape	34.34	25.44%	Measured
Total weight of cable per km	135.00	100.00%	Measured

3.2 Product Manufacturing

The three basic elements of a fiber optic cable are the core, the cladding and the coating:

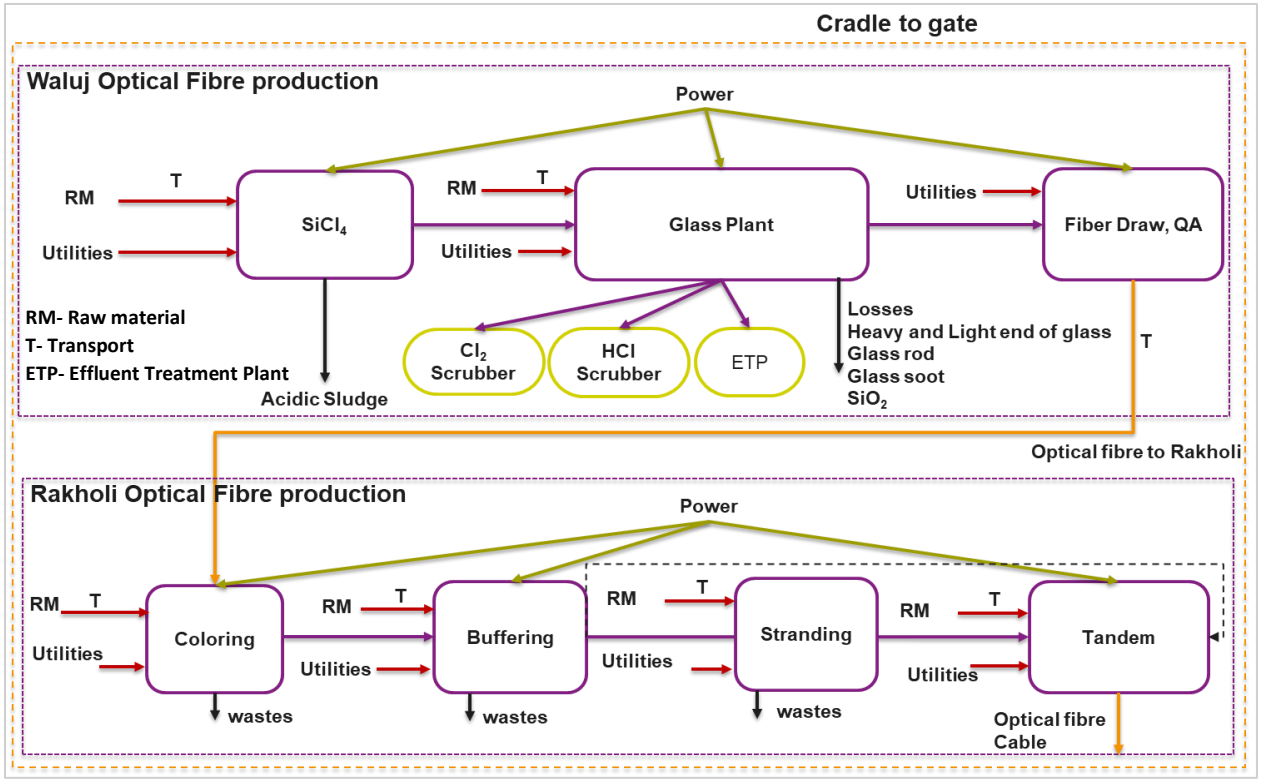

Figure 1: Fibre Optical cable manufacturing process (Cradle to gate)

- **Core**: This is the light transmission area of the fiber, either glass or plastic. The larger the core, the more light that will be transmitted into the fiber.

- **Cladding**: The function of the cladding is to provide a lower refractive index at the core interface to cause reflection within the core so that light waves are transmitted through the fiber.

- **Coating**: Coatings are usually multi-layers of plastics applied to preserve fiber strength, absorb shock and provide extra fiber protection.

3.3 System Boundaries

The selected system boundaries comprise the production of Fibre Optical cable including raw material extraction, inbound & outbound transportation, installation, use and disposal of the product including packaging.

Table 6. System boundary and product stages

Module	Product stages
A1	Production of raw materials including packaging
A2	Upstream Transport (Inbound transportation)
A3	Manufacturing (Core, Cladding & Coating)
A4	Downstream Transport (Outbound transportation)
A5	Installation
B1	Use
C4	Disposal (product and packaging material)

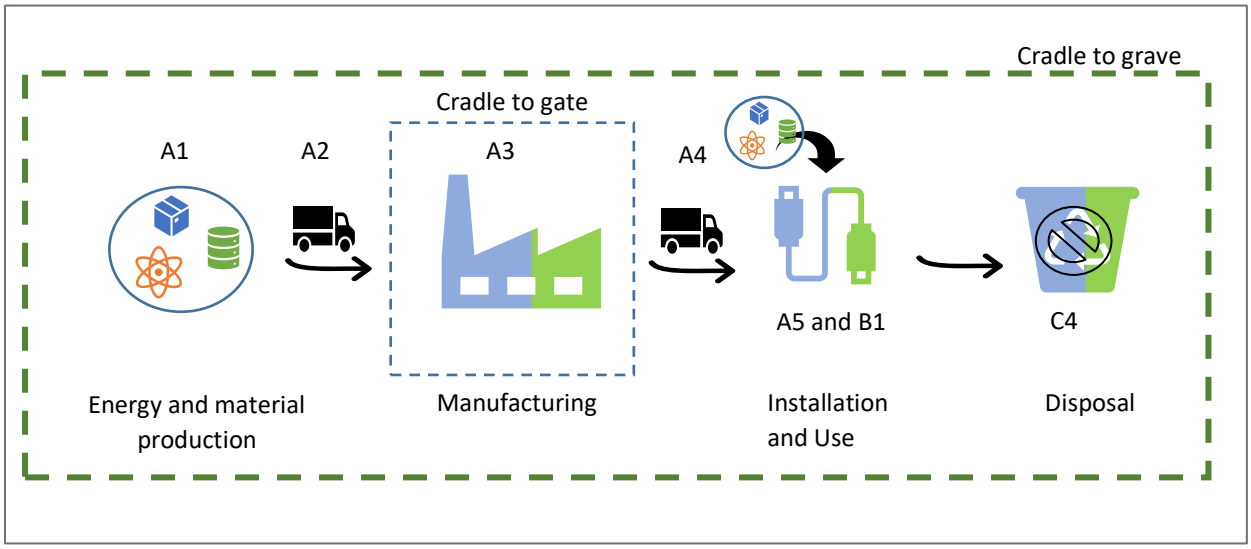

Figure 2: System boundary diagram of Fibre Optical cable

The system boundary does not include:

- Capital equipment and maintenance of production facility
- Maintenance and operation of support equipment
- Human labor and employee transport

4. LCA

4.1 Information Sources and Data Quality

It is important that data quality is in accordance with the requirements of the LCA's goal and scope. This is essential to the reliability of LCA and achievement of the intended application. The quality of the LCI data for modelling the life cycle stages have been assessed according to ISO 14044 (ISO, 2006b). Data quality is judged by its precision (measured, calculated or estimated), completeness (e.g. are there unreported emissions?), consistency (degree of uniformity of the methodology applied on a LCA serving as a data source) and representativeness (geographical, time period, technology). To cover these requirements and to ensure reliable results, first-hand industry data in combination with consistent, upstream LCA information is used. The datasets have been used in LCA-models worldwide for several years in industrial and scientific applications for internal as well as critically reviewed studies. In the process of providing these datasets, they have been cross-checked with other databases and values from industry and science. Sterlite Technologies Limited provided the most accurate and representative data for Fibre Optical cable production. For all data requirements, primary data were used where possible.

4.2 Estimations and Methodology

4.2.1 Allocation procedures

Allocation has been applied for the glass plant.

4.2.2 Declared unit

The declared unit for the EPD is 1 km of Fibre Optical Cable manufactured by Sterlite Technologies Limited used for 20 years of life span.

4.2.3 Impact assessment

A list of relevant impact categories and category indicators is defined and associated with the inventory data. Various environmental impacts and emissions are associated with the raw material production, transport of materials to manufacturing site and Fibre Optical cable production.

CML 2001 (January 2013) method developed by Institute of Environmental Sciences, Leiden University, Netherlands have been selected for evaluation of environmental impacts. These indicators are scientifically and technically valid.

A list of relevant impact categories and category indicators is defined and associated with the inventory data. PCR 2012-01 v2.2 has been used to conduct the LCA. The PCR identifies the following LCI and LCIA.

1. Potential Environmental Impact (according with EN15804)
   - Global warming potential, GWP (100 years) (kg CO_2 equivalent)
   - Depletion potential of the stratospheric ozone layer, ODP (20 years) (kg CFC-11 equivalent)
   - Acidification potential of soil and water, AP (kg SO_2 equivalent)
   - Eutrophication potential, EP (kg PO_4^{3-} equivalent)
   - Formation potential of tropospheric ozone, POCP (kg Ethene (C_2H_2) equivalent)
   - Abiotic depletion potential (ADP-elements) for non-fossil resources (kg Sb equivalent)
   - Abiotic depletion potential (ADP-fossil fuels) for fossil resources (MJ, net calorific value)

2. Use of Natural Resources (according with EN15804)
   - Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials) (MJ, net calorific value)

- Total use of non-renewable primary energy resources (primary energy and primary energy resources used as raw materials) (MJ, net calorific value)
- Use of secondary material (kg)
- Use of renewable secondary fuels (MJ, net calorific value)
- Use of non- renewable secondary fuels (MJ, net calorific value)
- Use of net fresh water (m^3)

3. Other Environmental Indicators
   - Components for re-use (kg)
   - Materials for recycling (kg)
   - Materials for energy recovery (kg)
   - Exported energy (MJ)
   - Dust (total dust and PM_{10}) (kg)
   - Hazardous waste (as defined by regional directives) disposed (kg)
   - Non-hazardous waste disposed (kg)
   - Radioactive waste disposed/stored (kg)

4.3 Cut Off Rules

Input and output data have been collected through detailed questionnaires which have been developed and refined. In practice, this means that, at least, all material flows going into the Fibre Optical cable production processes (inputs) higher than 1% of the total mass flow (t) or higher than 1% of the total primary energy input (MJ) are part of the system and modelled in order to calculate elementary flows. All material flows leaving the product system (outputs) accounting for more than 1% of the total mass flow is part of the system. All
available inputs and outputs, even below the 1% threshold, have been considered for the LCI calculation. For hazardous and toxic materials and substances the cut-off rules do not apply.

Secondary raw materials used in the production system is accounted adopting the following approach:

- The environmental impacts related to the 'previous life' is not considered.
- The processes needed to prepare the secondary raw material to the new use is considered.
- If the secondary raw material contains energy, the amount is estimated considering the gross calorific value and presented as secondary energy resource.
- If the secondary raw material does not contain energy, the quantity that enter the system is considered as secondary raw material.

4.4 Background Data

All relevant background datasets were taken from the GaBi-8 software database developed by thinkstep AG. To ensure comparability of results in the LCA, the basic data from the GaBi-8 database were used for fuel, energy, transportation and auxiliary materials.

4.5 System Boundaries

4.5.1 Technical system boundaries

The LCA model of 1 km of Fibre Optical cable represents a cradle-to-grave system, starting from raw material production, manufacturing, use (20 years) and ending with the product disposal (End of life).

The system boundary and geographical scope includes:

- Extraction and production of raw materials and other inputs such as $SiCl_4$ & fiber glass.
- Transport of raw materials to factory gate
- Production of Fibre Optical cable.
- Electricity from all sources (import from grid and DG set), Energy, water and raw materials used in the all the above process.
- Emissions to air, effluent discharges and solid waste disposal.
- Disposal by landfill includes the product (135 kg/ km) after its useful life as well as duct/packaging material (191 kg /km) used in the installation phase amounting to 326 kg/km.

Table 7. Modules of the production life cycle included (X = declared module; MNA = module not assessed)

Production			**Installation**		**Use stage**							**End-of-Life**				**Next product system**
Raw material supply	Transport to manufacturer	Manufacturing	Transport to building site	Installation into building	Use / application	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction / demolition	Transport to EoL	Waste processing for reuse, recovery, recycle	Disposal	Reuse, recovery or recycling potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	X	X	X	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	X	MNA

4.5.2 Geographical system boundaries

The geographical system boundaries of the LCA cover the production of Fibre Optical cable in India.

4.5.3 Temporal system boundaries

The data collection is related to one year of operation and the year of the data is indicated in the questionnaire for each data point. The majority of data was derived from the period April 2017 to March 2018.

4.6 Comparability

The EPD is established on the basis of the PCR 2012-01 v2.2 compliant to EN 15804. According to these standards, EPDs do not compare the environmental performance of products in the construction sector. Any comparison of the declared environmental performance of products lies outside the scope of these standards and is suggested to be feasible only if all compared declarations follow equal standard provisions.

4.7 Results

The LCIA result of Fibre Optical cable of Sterlite Technologies Limited has been presented in tables given below.

Table 8. LCIA result for 1 km of Fibre Optical Cable used for 20 years

LCIA Impact Category	Unit	A1- A3	A-4	A-5	B-1	C-4
Abiotic Depletion (ADP elements)	kg Sb-Eq.	2.92E-03	1.28E-11	5.26E-05	9.61E-06	6.44E-07
Abiotic Depletion (ADP Fossil)	MJ	27955.10	0.01	12903.21	1570.70	70.88
Acidification Potential (AP)	kg SO_2-Eq.	19.68	6.75E-06	0.66	1.90	0.02
Eutrophication Potential (EP)	kg Phosphate-Eq.	0.93	1.45E-06	0.07	0.08	1.62
Global Warming Potential (GWP)	kg CO_2-Eq.	1996.30	1.09E-03	310.11	154.40	392.21
Ozone Layer Depletion Potential (ODP)	kg CFC11-Eq.	-3.65E-07	5.09E-18	1.13E-10	2.74E-11	1.13E-12
Photochemical Ozone Creation Potential (POCP)	kg Ethene-Eq.	0.99	3.95E-05	0.09	0.09	0.11

Table 9. Use of natural resources for 1 km of Fibre Optical Cable used for 20 years

Parameters	**Unit**	**A1- A3**	**A-4**	**A-5**	**B-1**	**C-4**
Renewable primary energy as energy carrier	MJ	3438.79	4.76E-05	238.95	188.76	6.82
Renewable primary energy resources as raw materials	MJ	282.10	0	0	0	0
Total renewable primary energy resources (primary energy and primary energy resources as raw materials)	MJ	3720.89	4.76E-05	238.95	188.76	6.82
Non- renewable primary energy as energy carrier	MJ	28945.59	0.01	13137.41	1618.52	73.36
Non- renewable primary energy resources as raw materials	MJ	0	0	0	0	0

Total non- renewable primary energy resources (primary energy and primary energy resources as raw materials)	MJ	28945.59	0.01	13137.41	1618.52	73.36
Use of net fresh water	m^3	1.23E+01	2.20E-07	1.42	1.06	0.01

Table 10. Other indicators for 1 km of Fibre Optical Cable used for 20 years

Parameters	Unit	A1- A3	A-4	A-5	B-1	C-4
Components for reuse	kg	0.00	0.00	0.00	0.00	0.00
Materials for recycling	kg	5.56	0.00	0.00	0.00	0.00
Materials for energy recovery	kg	0.00	0.00	0.00	0.00	0.00
Exported energy	MJ	0.00	0.00	0.00	0.00	0.00

Table 11. Supplementary indicators for 1 km of Fibre Optical Cable used for 20 years

Parameters	Unit	A1- A3	A-4	A-5	B-1	C-4
Non-hazardous waste	kg	40.71	8.81E-08	1.78	0.46	257.52
Hazardous waste	kg	2.01E-04	9.65E-13	2.96E-06	1.21E-06	1.67E-07
Radioactive waste	kg	3.79E-01	3.40E-09	9.24E-02	1.82E-02	9.82E-04

4.8 Interpretation

Table 12. Interpretation of life cycle parameters for 1 km of Fibre Optical Cable used for 20 years

Parameter	Interpretation
ADP elements	Abiotic depletion potential (ADP element) is 2.98E-03 kg Sb-Equiv. In which 98% contribution is from manufacturing phase where raw materials contribute 95%.
ADP Fossil	Abiotic depletion potential (ADP Fossil) is 42499.90 MJ of which 66% is contributed by manufacturing phase where 35% comes from gate to gate, 30% comes from Raw materials and installation phase each. Use phase contributes 2% of ADP-fossil.
Acidification Potential	Acidification Potential is 22.27 kg SO_2-Equiv. The contribution of manufacturing phase 88% out of which 81% comes from gate to gate. Use phase contributes 9% and installation phase contributes 3% to the total Acidification Potential impact.
Eutrophication Potential	Eutrophication Potential is 2.70 kg Phosphate-Equiv. The contribution of landfilling in disposal phase is 60% while manufacturing phase contributes 35% with gate to gate contributing about 29%. The installation phase and use phase each contribute 3% to the total Eutrophication Potential impact.
Global Warming Potential	Global Warming Potential is 2853.02 kg CO_2-Equiv. The contribution of manufacturing phase is 70% where 51% is the gate to gate impact and 18% is contributed by raw materials, disposal phase contributes 14% followed by installation 11% and use phase 5% to the total Global Warming Potential impact.
Ozone Depletion Potential	Ozone Layer Depletion Potential is -3.65E-07 kg CFC11-Equiv. Raw materials in the manufacturing phase contribute to nearly 100% of the Ozone Layer Depletion Potential impact.
Primary Energy Demand	Both Non - renewable and renewable energy demand is highest in the Fiber glass production in the manufacturing phase contributing 66% and 89% respectively. Installation phase has a contribution of 30% in the non-renewable energy demand. Use phase has 3% and 4% contribution for both Non - renewable and renewable energy demand, respectively.

Photochemical Ozone Creation Potential	Photochemical Ozone Creation Potential is 1.28 kg Ethene-Equiv. The major contribution of POCP comes from fiber glass production in the manufacturing phase which contributes 78%, disposal phase contributes 9%, installation 7% and use phase contributes 7%.
Waste Generation	The total amount of hazardous waste generated is 2.06E-04 kg, the non-hazardous waste is 300.47 kg and radioactive waste generation is 0.49 kg. Most of the hazardous waste is contributed by manufacturing phase with 98% coming out from the fibre glass production. Landfilling of the cable in the disposal phase leads to 86% of the total Non-hazardous waste.
Water Demand	The net fresh water used is 14.78 m^3 over cradle to grave system boundary. The manufacturing phase contributes the highest with 74% out of which 68% lies in the gate to gate with highest consumption in Fibre production. Istallation phase has a 10% and use phase 7% share in the total water demand.

5. Other Environmental Information

The constituent materials used within our products are responsibly sourced and we apply the principles of Sustainable Development and of Environmental Stewardship as a standard business practice in our operations. Protecting the environment by preserving non-renewable natural resources, increasing energy efficiency, reducing the environmental emissions, limiting the impact of materials transportation to and from our operations is part of our way in doing business.

Products do not contain any substances that can be included in “Candidate List of Substances of Very High Concern for Authorization” and raw materials used are not part of the EU REACH regulation.

6. References

- EN 15804:2012+A1:2013, Sustainability of construction works - Environmental Product Declarations - Core rules for the product category of construction products
- PCR for Construction Products and CPC 54 Construction Services/ Prepared by IVL Swedish Environmental Research Institute, Swedish Environmental Protection Agency, SP Trä, Swedish Wood Preservation Institute, Swedisol, SCDA, Svenskt Limträ AB, SSAB, The International EPD System, 2012:01 Version 2.2, Date 2017-05-30.
- GABI 8: 2019. thinkstep AG; GaBi 8: Software-System and Database for Life Cycle Engineering. Copyright. Leinfelden, Echterdingen, 1992-2019.
- ISO 14020:2001 Environmental labels and declarations - General principles
- ISO 14025:2006 Environmental labels and declarations - Type III environmental declarations - Principles and procedures
- ISO 14040:2006 Environmental management - Life cycle assessment - Principles and framework
- ISO 14044:2006 Environmental management - Life cycle assessment - Requirements and guidelines
- ISO 21930:2007 Sustainability in building construction - Environmental declaration of building products.