CONDUMAX

ENVIRONMENTAL PRODUCT DECLARATION

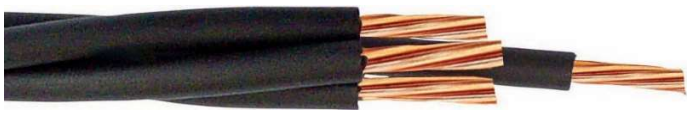
PRODUCT NAME:	SITE:
LV AERIAL BUNDLED CABLES 0,6/1 kV 3X1X35+35 MM2 COPPER CONDUCTOR XLPE INSULATION	Brazil, Olímpia – SP

in accordance with ISO 14025 and EN 50693:2019

Program Operator	EPDItaly
Publisher	EPDItaly

Declaration Number	EPD006
Registration Number	EPDITALY0883

Issue Date	24/02/2025
Valid to	24/08/2026



GENERAL INFORMATION

EPD OWNER

Name of the company	Condumax – Eletro Metalurgica Ciafundi LTDA
Registered office	Rodovia Wilquem Manoel Neves, s/n km 3,5, Olímpia – SP, Brazil, 15405-370
Contacts for information on the EPD	Robson Micheletto Quality and Environment Manager robson.micheletto@condumax.com.br

PROGRAM OPERATOR

EPDItaly	Via Gaetano De Castillia, 10 20124 – Milano Italy

INFORMATION ON THE EPD

Product name (s)	Electrical wires and cables: LV AERIAL BUNDLED CABLES 0,6/1 kV 3X1X35+35 MM2 COPPER CONDUCTOR XLPE INSULATION
Site (s)	Rodovia Wilquem Manoel Neves, s/n km 3,5, Olímpia – SP, Brazil, 15405-370
Short description and technical information of product (s)	Conductors: Phase(s): Copper wires, soft temper, stranding class 2, compacted. Neutral: Copper wires, hard temper, stranding class 2, not compacted. Insulation: Phase(s) and neutral: XLPE - Thermoset compound of cross-linked polyethylene.
Field of application of the product(s)	Used in the public secondary distribution network of energy at low voltage, urban or rural, aiming at greater safety, reliability and less aggressive visual effect. They are also suitable for use in wooded areas and in atmospheres with the presence of salinity or urban pollution.
Product reference standard(s)	PM-BR 208.15.0, 06/2018. CONDUTOR PRÉ-REUNIDO DE COBRE NBR 8182:2011 - SELF-SUPPORTED POWER CABLES, PE OR XLPE INSULATED, FOR RATED VOLTAGES UP TO 0.6/1 kV. – PERFORMANCE REQUIREMENTS
CPC Code	463 family “Insulated wire and cable; optical fibre cables” and sub-sequent clusters

VERIFICATION INFORMATION

Product category rules (PCR): (title, version, date of publication or update)	Core PCR EPDItaly007 - PCR for electronic and electrical product and systems. Revision 3.1 – 2024/11/12; Conducted by ICMQ S.p.A. – Certificazioni e controlli per le costruzioni Moderator: Eng. Vito D'Incognito, Take Care International Sub PCR EPDItaly016 - PCR for electronic and electrical product and systems – cables and wires. Revision 2 – 25/09/2020; Conducted by Enel S.p.A.; Life Cycle Engineering - Viale Regina Margherita 125 - 00198 Rome, Italy
EPDItaly Regulations (version, date of publication or update)	Regulation of the EPDItaly Program – rev.6.0 (2023/10/30)
Project Report LCA	Life Cycle Assessment (LCA) Report – LCA 12 cables_EPD 4-11_Condumax _ Rev 2_Jan 31, 2025
Independent Verification Statement	This declaration has been developed in accordance with the EPDItaly Regulations; further information and the Regulations themselves are available on the website: www.epditaly.it The PCR review was performed by ICMQ S.p.A. (PCR EPDItaly007) and Enel S.p.A (PCR EPDItaly016) - info@epditaly.it EN 50693 is the framework reference for PCRs. Independent verification of the declaration and data according to ISO 14025:2010. Internal ☐ External ☒ Third party verification carried out by: ICMQ S.p.A., via Gaetano De Castillia n ° 10 - 20124 Milan, Italy. Accredited by Accredia.
Comparability	Environmental statements published within the same product category, but from different programs, may not be comparable. EPDs of Electrical wires and cables may not be comparable if they do not comply with EN 50693. For further information about comparability, see EN 50693 and ISO 14025.
Liability Statement	The EPD owner has the sole ownership, liability, and responsibility for the EPD. The EPD Owner releases EPDItaly from any non-compliance with environmental legislation. The holder of the declaration will be responsible for the information and supporting evidence. EPDItaly disclaims any responsibility for the information, data and results provided by the EPD Owner for life cycle assessment.

Company information

Founded in 1964, Condumax is an electrical wire and cable supplier to the main energy concessionaires in Brazil and abroad. The company is located in São Paulo, Brazil, with more than 700 employees and more than 1000 indirect employees. All Condumax cables are environmentally friendly, heavy metal free and meet international RoHs directives.

The ISO 9001, IATF 16949, ISO 14001 and ISO 45001 standards certify Condumax manufacturing unit. Some of Condumax cables and wires also are Environmental Product Declaration certified according to ISO 14025. While the International Standard Industrial Classification of All (ISIC) classifies the factory as Division 27, Group 273 and Class 2732. The ABNT also granted the license for using the ABNT Environmental Mark – ABNT Ecolabel, meeting the requirements of the document PE-425, ISO 14020 and ISO 14024.

EPD Information:

Scope of EPD:

The EDP aims to communicate the impact of the cables to its customer, being a B2B communication. The Condumax customer seeks to reduce the environmental impact of its value chain and, for that, has implemented a sustainability management policy (Sustainable Purchases), starting to request actions to quantify and mitigate environmental impacts of its suppliers, such as Condumax.

Type of EPD:

This declaration is specific for electrical wires and cables.

Declared unit:

To transmit energy expressed for 1A over a distance of 1 km (cable length) for 40 years (RSL) and 100% of use rate.
For the cable, 1 km (cable length) is equal to 1398.81 kg

Reference flow:

The reference flow of the cable, LV AERIAL BUNDLED CABLES 0,6/1 kV 3X1X35+35 MM2 COPPER CONDUCTOR XLPE INSULATION, is 1398.81 kg.

Data:

Condumax has provided all information for the study execution, so it has described all the raw materials used, the acquisition method, product characteristics, production stages, waste generated and all other information for the impact's calculation.
Condumax team of experts manages the production of the cables in its factory, being possible to obtain the total quantity of the cable manufactured in 2023. The data about the cables technical specifications (or the "product structure" that contains all the information about the quantity of raw materials consumed per meter of cable produced), was obtained through the product cost sector, with the support of the engineering team that is responsible for maintaining these cables technical specifications data sheet updated. That updated cables technical specifications data sheet was used as the cable study data sheet, and given this two information (quantity production and product structure) it was possible to calculate the raw material consumption of Condumax production in 2023.
The company has its own greenhouse gas (GHG) emission management data collection standard.

Time representativeness:

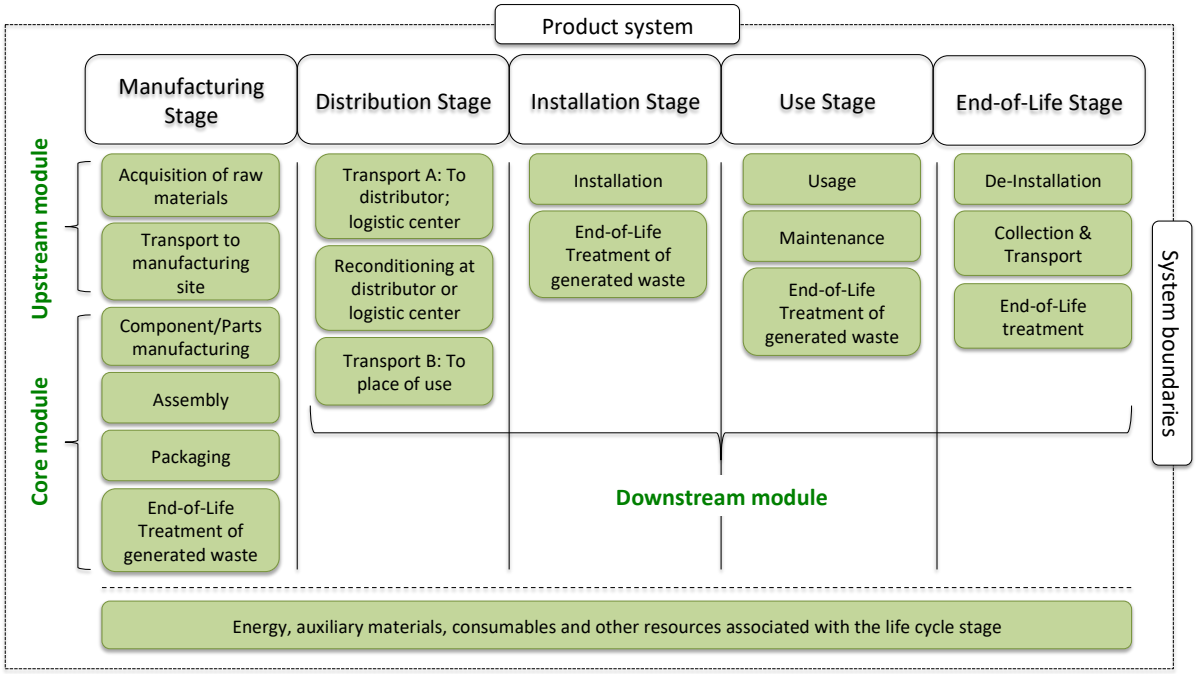
January 2023 to December 2023.

Database and LCA software used:

The source inventory and the emission factors of inputs and outputs used in the study are from the EN 15804 add-on for ecoinvent version 3.8 database, calculated using the OpenLCA software v. 2.2.

Description of system boundaries:

Cradle to grave: All stages until the end of life.



Source: Adapted from EN 50693:2019

Upstream module:

Manufacturing stage: The upstream module of the manufacturing stage considers all upstream processes to extract and process all the raw materials used by Condumax to manufacturing its products, including electricity consumption and other. This stage also accounts the emissions for the road and maritime transportation of all materials and components from suppliers to Condumax plant.

Core module:

Manufacturing stage: The core module of the manufacturing stage includes all the material transformation, assembling and packing for the cables manufacturing process; the water, gas and electricity consumptions; and the residues and effluent treatment, considering also the recycling processes of the metal end plastics scrapes generates during the manufacturing process. The processes stages to manufacturing the cables are as follow.

- Drawing – The drawing process is used to reduce the cross-section (area) of the filament and change the material's mechanical properties.
- Twist – This process aims the filaments to twist, transforming them into ropes and giving the cable certain flexibility.
- Taping – This process bandages the material using a tape. At Condumax, they can wrap study cables in aluminum or polymeric tape, to protect against electromagnetic interference.
- Extrusion - It comprises the process of the polymeric material covering the entire product surface. At Condumax, they intend the polymeric extrusion for electrical insulation.

- Measurement and packing – The measurement and packaging sector aims to ensure that products are measured, fractionated, packaged and identified in the characteristics expected by customers. They can package the products in coils, plastic spools, rolls or cardboard boxes.

Downstream module:

Distribution: The cables are transported from Condumax's factory to the client warehouse, place where the cables is stored until be sent to the installation. As the cables can be transported from São Paulo to any Brazilian state, an overland distribution scenario of 1000 km is adopted.

Installation: It was considered that the installation process generates 5% of the cable total mass and the package as waste, that is transported to its final destinations (200 km distance). The cable waste is sent for recycling, and the packaging is reused and used in handmade products.

Use: During the use stage, the cable dissipates energy due to the Joule effect. The dissipation energy calculation followed the Sub PCR EPDItaly016, considering a current of 1A during a lifetime of 40 years. The equation is presented below:

$$E_{use}\ [\frac{J}{km * A^2}] = R_{linear} * I^2 * RSL$$

Where:

E_{use} is the energy dissipated by the cable during its operating time

R_{linear} is the linear resistivity of the cable, expressed in Ω/km

I is the current, expressed in A

RSL is the reference service life of the product in second.

End-of-life: The stage considers the transport of the cable de-installed to the client warehouse (250 km distance); the cable disassembly operations, that consider the separation of the cable metal and plastic materials; the transportation of the residues from the warehouse to its disposal site (200 km) and, finally, the recycling processes of the EoL product's metal and plastic.

Allocation:

- The cable and packaging materials mass are in accordance with the structure file provided by Condumax.
- To emission of the raw materials transport, from the supplier to Condumax, it was considered the materials consumed for the cables manufacturing. That includes the material allocated in the cables and its proportional waste generated during manufacturing process.
- The scraps allocation of aluminum and copper was calculated according to the relative metal mass consumed in the product manufacture.
- It was considered mass allocation to obtain the electricity, water and LPG consumption of the manufactured cable, and also the allocation of the mass of miscellaneous waste disposal. This means that it was considered the proportion of cable-produced mass in front of the mass of all cables produced in the evaluated time of the study to obtain the mass of the utility and waste allocated for each cable.

- The discarded aqueous emulsion mass per cable was also calculated proportionally mass of the cable, but had considered only the fraction of the metal mass consumed to produce the cables.
- The discarded production scraps and various contaminated residues mass was calculated proportionally to the mass of the cable, considering the fraction of the metal and polymers mass.

Cut-off criteria:

The cut-off criteria are applied to support an efficient calculation procedure. Following the EPDItaly 016, it was considered the following operations in the cut-off criteria:

- The cable installation and de-installation operations were disregarded, since it was assumed that these operations are performed using manual tools (chapter 4.2.3.9);
- Maintenance operation was disregarded, since it was considered no scheduled interventions during the life of the product (chapter 4.2.3.5);

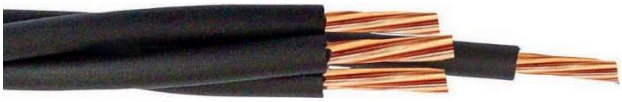
Additional information:

- During the manufacturing stage, the waste is generated during the production process and packaging (waste from raw materials), and contaminated residues and aqueous emulsion generated from production process and machine operation.
- The production and packaging generated waste are inert and sent to recycling, the contaminated residues are sent to incineration, and the aqueous emulsion is sent to effluent treatment process.
- In order to calculate the allocations based on the cable produced mass (e.g.: Energy, LPG, waste and etc.), it was considered the proportion of the produced cable mass in comparison with all raw materials used for all the cables manufactured in Condumax in the period of the inventory analysis, even if the raw materials are not used for the cables production analyzed in this report.
- Condumax customer and Condumax plant confirm that all material used in the finished product (installation waste, packaging and EoL product) are sent to recycling. The polyethylene, even if a percentage goes to the landfill, it is recovered and sold by collectors and reused, turning into sustainable products, a common practice in Brazil.
- In Brazil, commercial diesel has a 12 % biodiesel fraction (biodiesel minimum percentage added to commercial diesel).
- Electricity used to manufacture the product comes from the Brazilian Electricity Matrix.
- It was considered the Condumax technical specifications of the cable structure to obtain the life cycle inventory (LCI) of the raw material emission source. e.g.: 0.1 of aluminum to 1 meter of cable.
- Between January and December 2023, Condumax did not manufacture this product. However, in 2022, it was produced to gather primary data and assess its technical characteristics.

Detailed product description

Following ABNT ISO 14025 and EN 50693:2019, the study presents the environmental declaration of two cables produced by Condumax to meet its necessity in front of its customers.

Analyzed cable: LV AERIAL BUNDLED CABLES 0,6/1 kV 3X1X35+35 MM2 COPPER CONDUCTOR XLPE INSULATION:



The cable detail is presented as following:

Conductors:

Phase(s): Copper wires, soft temper, stranding class 2, compacted.

Neutral: Copper wires, hard temper, stranding class 2, not compacted.

Insulation:

Phase(s) and neutral: XLPE - Thermoset compound of cross-linked polyethylene.

Standard: PM-BR 208.15.0, 06/2018. CONDUTOR PRÉ-REUNIDO DE COBRE and NBR 8182:2011 - SELF-SUPPORTED POWER CABLES, PE OR XLPE INSULATED, FOR RATED VOLTAGES UP TO 0.6/1 kV. – PERFORMANCE REQUIREMENTS

Main raw materials:

In the 2023, January to December interval, Condumax has manufactured 0 km of finished products. Since the cable was a limited database cable during the referred period of time, a similar produced cable was used to estimate all the inputs of scrap generation and utilities consumption. Its mass composition is as follows:

Product Components	Weight (kg per km)	%
Conductor	1223.96	87.50
Insulation	174.85	12.49
Total	**1398.81**	**100**

The cable is packaged on a wooden reel.

Environmental performance

Besides the total results, parameters are declared separately for stage.

Environmental impact descriptive parameters

Impact category	Unit	Manufacturing		Distribution	Installation	Use	End-of-life	Total
		Upstream module	Core module	Downstream module				
GWP-total	kg CO_2 eq.	5.41E+03	3.28E+02	1.69E+02	4.14E+02	6.07E+01	1.32E+03	7.70E+03
GWP-fossil	kg CO_2 eq.	5.64E+03	1.88E+02	1.53E+02	3.40E+00	3.36E+01	1.31E+03	7.32E+03
GWP-biogen.	kg CO_2 eq.	-4.11E+02	1.27E+02	4.29E+00	4.11E+02	2.46E+01	4.64E+00	1.60E+02
GWP-luluc	kg CO_2 eq.	1.88E+02	1.28E+01	1.20E+01	2.67E-01	2.47E+00	5.25E+00	2.21E+02
Acidification	mol H^+ eq.	1.91E+02	4.69E-01	7.46E-01	1.66E-02	8.36E-02	1.66E+00	1.94E+02
EP freshwater	kg P eq.	1.05E+02	5.40E-03	1.63E-02	3.62E-04	8.45E-04	1.15E-01	1.06E+02
EP marine	kg N eq.	4.46E+01	1.53E-01	3.34E-01	7.42E-03	2.71E-02	4.61E-01	4.56E+01
EP terrestrial	mol N eq.	6.46E+02	1.59E+00	3.01E+00	6.70E-02	2.83E-01	4.35E+00	6.55E+02
POCP	kg NMVOC eq.	1.24E+02	3.78E-01	9.29E-01	2.07E-02	6.51E-02	1.19E+00	1.27E+02
ODP	kg CFC-11 eq.	5.06E-04	3.06E-05	1.47E-05	3.28E-07	5.77E-06	3.19E-05	5.89E-04
ADPN	kg Sb eq.	3.04E+00	4.06E-05	3.90E-04	8.68E-06	5.86E-06	8.30E-04	3.04E+00
ADPF	MJ	3.24E+04	3.91E+01	2.51E+02	5.59E+00	3.27E+00	2.31E+03	3.50E+04
WDP	m^3 eq.	1.08E+04	5.57E+02	2.30E+01	5.12E-01	1.09E+02	1.27E+03	1.28E+04

GWP-total: Climate change - total; **GWP-fossil**: Climate change - fossil; **GWP-biogen.**: Climate change - biogenic; **GWP-luluc**: Climate change – land use and land use change; **AP**: Acidification; **EP freshwater**: Eutrophication aquatic freshwater; **EP marine**: Eutrophication aquatic marine; **EP terrestrial**: Eutrophication terrestrial; **POCP**: Photochemical ozone formation; **ODP**: Ozone depletion; **ADPN**: Depletion of abiotic resources – minerals and metals; **ADPF**: Depletion of abiotic resources – fossil fuels; **WDP**: Water use.

Parameters describing resource use

Renewable resource	Unit	Manufacturing		Distribution	Installation	Use	End-of-life	Total
		Upstream module	Core module	Downstream module				
PERE	MJ	2.81E+04	1.64E+03	2.42E+01	5.39E-01	3.21E+02	2.96E+02	3.04E+04
PERM	MJ	1.95E+04	2.10E+02	1.38E+02	3.08E+00	4.06E+01	1.07E+02	2.00E+04
PERT	MJ	4.75E+04	1.85E+03	1.63E+02	3.62E+00	3.61E+02	4.02E+02	5.03E+04

PERE: Use of renewable primary energy excluding renewable primary energy resources used as raw material; **PERM**: Use of renewable primary energy resources used as raw material; **PERT**: Total use of renewable primary energy resources.

Non-renewable resource	Unit	Manufacturing		Distribution	Installation	Use	End-of-life	Total
		Upstream module	Core module	Downstream module				
PENRE	MJ	3.60E+04	1.34E+03	2.52E+02	5.61E+00	2.59E+02	2.77E+03	4.07E+04
PENRM	MJ	4.70E+04	3.09E+03	2.08E+03	4.62E+01	5.71E+02	2.27E+03	5.50E+04
PENRT	MJ	8.32E+04	4.44E+03	2.42E+03	5.38E+01	8.31E+02	5.08E+03	9.60E+04

PENRE: Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw material; **PENRM**: Use of non-renewable primary energy resources used as raw material; **PENRT**: Total use of non-renewable primary energy resources.

Water and secondary raw	Unit	Manufacturing		Distribution	Installation	Use	End-of-life	Total
		Upstream module	Core module	Downstream module				
FW	m^3	2.54E+02	1.41E+01	6.07E-01	1.35E-02	2.54E+00	2.97E+01	3.01E+02
MS	kg	5.27E+02	3.57E+01	2.62E+00	5.83E-02	6.97E+00	1.10E+01	5.83E+02
RSF	MJ	1.80E+01	4.71E-02	2.83E-01	6.29E-03	4.28E-03	3.97E+00	2.23E+01
NRSF	MJ	5.04E+02	1.07E-01	4.80E-01	1.07E-02	9.82E-03	5.49E+00	5.10E+02

FW: Net use of freshwater; **MS**: Use of secondary materials; **RSF**: Use of renewable secondary fuels; **NRSF**: Use of non-renewable secondary fuels.

Waste production descriptive parameters

Impact category	Unit	Manufacturing		Distribution	Installation	Use	End-of-life	Total
		Upstream module	Core module	Downstream module				
HWD	kg	5.08E+02	9.86E-03	5.87E-02	1.31E-03	1.02E-03	6.24E-01	5.09E+02
NHWD	kg	1.35E+03	8.03E+00	2.32E+02	5.17E+00	3.84E-01	1.39E+03	2.98E+03
RWD	kg	2.21E+00	8.07E-01	1.05E-02	2.33E-04	1.58E-01	2.90E-01	3.47E+00
MER	kg	3.94E+01	1.28E-01	7.44E-01	1.65E-02	9.96E-03	4.15E-01	4.07E+01
MFR	kg	9.30E+01	2.58E+01	1.37E+00	3.04E-02	5.04E+00	7.78E+00	7.99E+02
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ETE	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EEE	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

HWD: Hazardous waste disposed; **NHWD**: Non-hazardous waste disposed; **RWD**: Radioactive waste disposed; **MER**: Materials for energy recovery; **MFR**: Materials for recycling; **CRU**: Components for reuse; **ETE**: Exported thermal energy; **EEE**: Exported electricity energy.

For different impact categories, the manufacturing stage is the most relevant stage for different impact categories due to the recycled copper acquisition, followed by the EoL that has its significance mainly due to the cable dissemble process and the final copper treatment for recycling. Furthermore, in some impact categories, the distribution of the cable from factory to warehouse was more significant than the use stage due to the distance used that had considered the Brazilian geographical dimensions, while the use phase considers the energy dissipation due 1A current during 40 years of life time, what is directly proportionally to the electrical resistance value (Ω/km) of the cable. Finally, the installation stage was the less relevant for almost all impacts categories due to the study boundaries that consider the transport of the generated waste to the final collection site.

Similarity analysis of the limited database cable and its reference cable

As previously noted, the cable was classified as a limited database cable during the period covered by this report. Therefore, a reference cable was used to obtain some of the necessary data for the EPD impact emission calculations of the limited database cable. The reference cable used was manufactured at the Condumax factory in 2023, ensuring the most comparable impact processes and data in terms of timeframe, supplier material specifications, transportation, manufacturing processes, distribution, use, and end-of-life.

Considering the different cables produced at the Condumax factory, the selection of the reference cable was based on the total mass and the component composition of the cable that most closely resembles the limited database EPD cable.

- **Product composition / Bill of materials:**
  - The used data for the product composition came from the engineer cable design structure and then used e real data of the cable analyzed cable.

- The quantity of the material acquisition that became scrap came from the referenced produced cable considering that the referenced produced cable has similar mass and composition in compare with the analyzed cable.

- **Supplier transport:**
  - The data for the supplier transport emissions calculation came from the referenced cable, considering that the referenced cable have similar mass in compare with the analyzed cable.

- **Manufacturing process:**
  - The data for the manufacturing process emissions calculation came from the referenced cable, considering that the referenced cable have similar mass in compare with the analyzed cable and the inputs were calculated based on mass allocation.

- **Finished product distribution:**
  - The data for the finished product distribution emissions calculation came from the referenced cable, considering that the referenced cable have similar mass and distribution distance in compare with the analyzed cable.

- **Installation and use:**
  - The data for the installation emissions calculation consider the transportation came from the referenced cable, considering the premise that the referenced cable have similar mass and the distance transportation is the same.
  - The use of the cable emissions calculation considers the energy dissipation caused by the cable usage and it was used the resistivity data of the original analyzed limited database cables.

- **End of life:**
  - The data for transportation emissions calculation present at the End of live stage came from the referenced cable, considering the premise that the referenced cable have similar mass and the distance transportation is the same.
  - The data for cable component dissemble calculation present at the the End-of-life stage came from the original cable data, as the need data is its mass that could be obtained from its engineer cable design structure.

As a final analysis, it is important to highlight the relevance of the reference cable data compared to the original cable data used in the study. The table below presents the relevance, expressed as a percentage of emissions in relation to the total emissions of the cable, for these two data sources.

Stages of cable	Original cable data (% of the total emission)	Referenced cable data (% of the total emission)
Product composition / Bill of materials	66.04%	5.32%
Supplier transport	0.00%	1.32%
Manufacturing process	0.00%	4.76%
Finished product distribution	0.00%	2.46%
Installation and use	0.88%	0.05%
End of life	18.19%	0.98%
Total	**85.10%**	**14.90%**

As observed in the relevance impact analysis presented in the table above, the most significant data used for the cable impact analysis comes from the original data of the analyzed cables, including engineering specifications such as component mass and resistivity. Furthermore, the reference cable data played a crucial role in completing and enabling the calculation of all life cycle impact categories.

The database used is regarded as representative on the basis of a comparative study, which examined the data for a reference product(s) of the EPD Owner.

Additional information

From the data provided by Condumax, it was possible to build a model to calculate the EPD impacts categories of the life cycle assessment for each selected cable, being also possible to analyze the results in order to allow actions to compensate and improve the impact categories and to improve the environmental performance of the products and meet the demand of Condumax customers.

Reference

Life Cycle Assessment (LCA) Report – LCA 12 cables_EPD 4-11_Condumax _ Rev 2_Jan 31, 2025

BS EN 50693:2019. Product category rules for life cycle assessments of electronic and electrical products and systems.

EN 15804:2012+A2:2019/AC:2021. Sustainability of construction works – Environmental product declatations – Core rules for the product category of construction products.

PCR EPDItaly007 - PCR for electronic and electrical product and systems. EPDItaly Regulations rev 3.1. Issue date: 12/11/2024; validity: 19/01/2026.

PCR EPDItaly016 – PCR for electronic and electrical product and systems – cables and wires. EPDItaly Regulations rev 5. Issue date: 25/09/2020; validity: 25/09/2025.

Regulations of the EPDItaly Programme. Rev 6.0. Issue date: 2023/10/30.

ISO 14040:2006/AMD 1:2020 Environmental Management – Life Cycle Assessment – Principles and Framework – Amendment 1.

ISO 14044:2006.AMD 2:2020 Environmental Management – Life Cycle Assessment – Requirements and Guidelines – Amendment 2.

ISO 14025:2006 Environmental Labels and Declarations – Type III Environmental Declarations – Principles and Procedure.

Data collection issue – issue management of greenhouse effect gases (GHG). Internal procedure, Condumax – Eletro Metalúrgica Ciafundi LTDA. Issue date: 13/06/2022, rev. 1. Document in Portuguese.

Brazilian statistical yearbook of oil, natural gas and biofuels: 2020. Rio de Janeiro: National Agency of Petroleum, Natural Gas and Biofuels (ANP), 2008. Document in Portuguese.

State electrical matrix: Ministry of Mines and Energy – MME. Secretary of Energy Planning and Development. Reference year 2022. https://www.epe.gov.br/pt/abcdenergia/matriz-energetica-e-eletrica and - https://www.epe.gov.br/pt/publicacoes-dados-abertos/publicacoes/balanco-energetico-nacional-2023. Document in Portuguese.

PM-BR 208.15.0, 06/2018. CONDUTOR PRÉ-REUNIDO DE COBRE

NBR 8182:2011 - SELF-SUPPORTED POWER CABLES, PE OR XLPE INSULATED, FOR RATED VOLTAGES UP TO 0.6/1 kV. – PERFORMANCE REQUIREMENTS