Environmental Product Declaration

In accordance with ISO 14025 and EN 50693:2019 for:

Inductive Voltage Transformer for Outdoor Use

72.5 kV (22.5318) and 145 kV (22.5501)

from

Balteau Produtos Elétricos LTDA.

Declaration number:	EPDBALTEAU02
Production site:	Itajubá, Minas Gerais – Brazil
Programme:	EPD Italy®, www.epditaly.it
Programme operator:	EPDItaly
EPD registration number:	EPDITALY0418
Issue date:	2023-03-14
Valid until:	2024-09-14

General information

Programme information

Programme:	EPDItaly®
Address:	EPDItaly Via Gaetano De Castillia, 10 20124 – Milano Italy
Website:	www.epditaly.it
E-mail:	info@epditaly.it

Scope of application:	*Inductive Voltage Transformer for Outdoor Use 72.5 kV (code 22.5318) and 145 kV (code 22.5501): inductive voltage transformer in mineral cooled oil, with low level of loss and noise and 72.5 kV and 145 kV of maximum voltage. Cradle to grave with 30 years of reference service life (RSL).*
Functional unit:	*A single piece of transformer operating for 30 years*
CPC code:	*46121 - Electrical transformers*
Geography:	*World (raw materials), Brazil (production, use and end-of-life)*
LCA report	*[Balteau-LCA] transformers_final_report (2023)*
Product category rules (PCR):	*Core PCR EPDItaly007:20 Electronic and Electrical Products and Systems, revision 2 (2020-10-21)*
Other mandatory references:	*Regulations of the EPDItaly Programme rev 5.2, 2022-02-16* *EN 50693 is the framework reference for the Product Category Rules (PCR)* *EPDItaly Operating Instructions IO-EPD-01, Release 20-07-22*
Other useful references:	*Sub PCR EPDItaly018:21 Electronic and Electrical Products and Systems – Power Transformers, version 3.5 (2021-12-13)*
Core PCR review was conducted by:	*ICMQ S.p.A. – Certificazioni e controlli per le costruzioni* *Moderator: Eng. Vito D'Incognito, Take Care International*
Sub PCR review was conducted by	*ENEL S.p.A.; Life Cycle Engineering* *Moderator: Massimo De Pieri, Life Cycle Engineering*

Independent third-party verification of the declaration and data, according to ISO 14025:2006:
☐ internal ☒ external

Third party verification carried out by:
ICMQ spa - Via Gaetano De Castillia, 10 - 20124 – Milano/Italy

Procedure for follow-up of data during EPD validity involves third party verifier:
☒ Yes ☐ No

The EPD owner has the sole ownership, liability, and responsibility for the EPD.
EPDs relating to the same category of products but belonging to different programmes may not be comparable. EPDs of electronic and electrical products may not be comparable if they do not comply with EN 50693. For further information about comparability, see EN 50693 and ISO 14025.

Company information

Owner of the EPD:	Balteau Produtos Elétricos LTDA.
Address:	R. Prof. Álvaro Pereira Rizzi, 90 – Distrito Industrial
Location of production site(s):	Itajubá, State of Minas Gerais, Brazil
Website:	https://balteau.com.br/
Tel:	+55 (35) 3629-5500
Email:	alan.pereira@balteau.com.br

About the organization

Traditional manufacturer of Transformers for Instruments and Measuring Sets, BALTEAU is always present as a supplier to electric power companies, panel manufacturers, mining sector, metallurgy, steel, chemical and oil industries, in Brazil and in several countries abroad.

Founded in 1977, headquartered in the Industrial District of Itajubá, Minas Gerais, BALTEAU has been ISO 9001 certified since 1994 and has been achieving the world market in a solid and efficient manner. For this, the company has cutting edge technology and qualified professionals, who have consolidated experience in design, manufacture, electrical tests and technical assistance for Current and Capacitive Potential Transformers up to 550 kV, Inductive Potential Transformers up to 145 kV and Measurement Sets up to 36 kV, with guaranteed international quality, serving the most demanding markets.

WORLD EXCELLENCE IN TRANSFORMERS FOR INSTRUMENTS

Sustainability

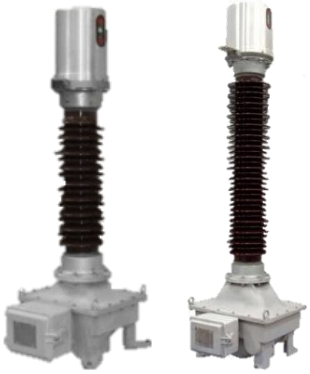
Balteau – Grupo WEG, traditional manufacturer of Transformers for Instruments, and supplier for the main generation, transmission, and distribution systems of electric energy, seeks through its Integrated Management System (IMS):

• Provide quality products and services that meet the needs and expectations of customers;
• Comply with current legislation applicable to the environment and occupational health and safety at work, in addition to other requirements relevant to its products and activities;
• Protect the environment and develop actions to prevent environmental pollution, such as: consumption of natural resources, generation of solid waste, atmospheric emissions and liquid effluents;
• Continuously improve the IMS to increase its performance, establishing objectives and targets.

Balteau – Grupo WEG holds the ISO 14001, ISO 9001 and ISO/IEC 17025 standards for IMS aligning environmental, quality and health responsibilities.

Owned certifications

Product information

Product name:	Inductive Voltage Transformer for Outdoor Use		
Product description:	A transformer is an electrical device that transfers energy from one circuit to another by magnetic coupling without requiring relative motion between its parts and comprises generally two or more coupled windings and (in most cases) a magnetic core to concentrate magnetic flux. Inductive voltage transformers are instrument transformers and produce a current in their secondary which is proportional to the current in its primary. Instrument transformers scale the large values of voltage or current into small, standardized values that are easy to handle for measuring instruments and protective relays.		
Average dimensions:	1546 mm height x 692 mm length x 500 mm width	2254 mm height x 771 mm length x 640 mm width	**Inductive Voltage Transformers** **IVT-72** **IVT-145** 
Expedition weight:	243.78 kg	389.40 kg	
Product weight:	193.78 kg	328.40 kg	
Packaging weight:	50 kg	61 kg	
Type:	Inductive voltage	Inductive voltage	
Maximum voltage:	72.5 kV	145 kV	
Maximum primary voltage:	69000/√3	138000/√3	
Secondary voltage:	115/√3	115/√3	
Colled-oil type:	Mineral (naphthenic) oil	Mineral (naphthenic) oil	
Products covered:	IVT 72 kV (22.5318)	IVT 145 kV (22.5501)	
Geographical scope:	Brazil	Brazil	

LCA information

Functional unit / declared unit:

A single piece of transformer operating for 30 years (according to Balteau's engineering teams)

Time representativeness:

January 2021 to December 2021

Data representativeness:

Raw materials and end-of-life characterization are representative of the products. This also applies to the transformers' use phase since the losses are based on the product operational parameters. Inbound logistics and manufacturing phases data are based on similar products from which most of the bill-of-materials are equal with minor differences on some components, and that went through the same production processes at the same Production Unit with identical energy carriers. Therefore *"the database used is regarded as representative on the basis of a comparative study, which examined the data for a reference product of the EPD Owner"* according to EPDItaly IO-EPD-01.

Database(s) and LCA software used:

SimaPro® software v.9.4.0.2 developed by PRé Consultants was used to create the product system model. The ecoinvent® database version 3.8 provided the life cycle background data for product system modelling.

System boundaries:

Cradle to grave with upstream, core and downstream modules;

Modules declared, geographical scope, share of specific data and data variation:

	Manufacturing			Distribution	Installation	Use and Maintenance	End-of-Life and Deinstallation
Module	**Upstream**		**Core**	**Downstream**			
Supply chain processes	extraction of raw materials and the production of semi-finished products and auxiliary items; electricity production; transport of raw materials to Balteau plant		transformer assembling, waste and effluent management at plant; air emissions from paint solvents	transformer transport into the operation site, installation and packaging waste management, operating for 30 years (RSL) in Brazil, deinstallation and transformer EoL, including metal recycling, mineral oil incineration and final disposal of non-recyclable fractions at sanitary landfill. Transport of waste flows			
Modules declared	X	X	X	X	X	X	X
Geography	GLO	BR	BR	BR	BR	BR	BR
Variation – sites	Not relevant						

Manufacturing:

Transformer manufacturing occurs in a sequential production line with electricity consumption as well as other ancillary inputs (such as welding gas, soap and water) meanwhile different wastes are generated during the processes. The rationale to disaggregate these data and adjust to each transformer was created based on the total operation hours required to produce each product. Electricity[1] was based on the total amount consumed only by the High Voltage Manufaturing Building (i.e., administrative building consumption was not considered). Other inputs and the outputs were estimated similarly, based on the values of product acquisition from the Balteau supply section and waste generation declaration, respectively, portioned by the same theoretical production factor.

Distribution:

The transformer is transported to Embú das Artes, São Paulo State (south-eastern Brazil) or to Magé, Rio de Janeiro State (south-eastern Brazil) by road transportation in diesel-powered lorries. The distances were estimated with a weighted average between the number of transformers x distance travelled during 2021 historical data from Balteau and defined as 317.38 km for IVT-72 and 325 km for IVT-145.

Installation:

The installation phase implies in the transportation of 100km of the transformer and its packaging from energy company storage until the operation site. Then, the transformer is lifted and (generally) installed through manual/pneumatic tools. This phase also includes the disposal of the packaging of the transformer,

[1] According to Instituto Totum (2021) the carbon footprint variation between the average Brazilian mix and the Residual Mix is lower than 2%. Thus, the dataset used to represent the electricity consumption at manufacturing stage is the *'Electricity, medium voltage {BR}| market group for electricity, medium voltage | Cut-off, U'* which represents the national grid without residual mix correction.

first returning until the energy company waste management central (100 km) and then transported until the waste management company (200km).

Use stage:

The total energy consumed during 30 RSL by the IVT-72 kV transformer is 9,016.74 kWh, and by the IVT-145 kV transformer is 12.896,78 kWh (losses and operational consumptions). These values were calculated according to IEC 60076-1 technical standard, expressed in kWh via the following equation (PCR0018 v.3.5).

$$E_d[kWh] = [P_{load} \times K^2{}_{load} + P_{noload}] \times t_{years} \times RSL + P_{aux} \times f_{aux} \times t_{years} \times RSL$$

Table 1. Values applied to estimate the energy dissipated during transformer RSL.

	IVT-72	IVT-145
P_{load} (kW)*	0.000074	0.00005
k_{load}	0.70	0.70
P_{noload} (kW)*	0.03427	0.04905
t_{years} (hours)	8,760	8,760
RSL (years)	30	30
Electricity (kWh)	9,016.74	12,896.78

**For instrument transformers, the calculation of the P_{load} and P_{noload} factors considered aspects such as losses in the primary and secondary windings, losses in the cores, and their rated loads connected to the secondary terminals. The descriptive memorial for the calculations of each factor, associated with each transformer, is presented in Annex D of LCA report.*

End-of-Life:

EoL stage assumes that the discontinued equipment is sent for material recovering. The disassembling process is manual or done with the aid of pneumatic tools at the secondary metal recovering market. Most valuable fractions (steel, aluminium and copper) are recycled within the default recycling recovering rate established in BSI EN 50693:2019. Mineral oil is recovered and the remaining parts, based on mass balance, are sent to sanitary landfill. Based on direct consultation and project assumptions the transport distances from energy company storage into the disassembly facility is 100 km, from disassembly facility to recycling plant and to the oil treatment company is 200 km, meanwhile the range into a landfill is 50 km.

Table 2. End-of-life baseline scenario definition per functional unit (downstream module).

Processes		IVT-72	IVT-145	Unit
Collection process	From energy company storage to recovering market	193.78	328.40	kg
Recovery system specified by type	Reuse	0.00	0.00	kg
	Recycling	92.13	165.13	kg
	Incineration for energy recovery	0.00	0.00	kg
Disposal specified by type	Product or material for final deposition	101.65	163.27	kg
	Incineration	0.00	0.00	kg
Assumption for scenario development	Assuming that 100% of the transformer is sent for disassembling (based on direct consultation with energy company), assuming that 80% of steel is recycled, 70% of aluminium is recycled, 60% of cooper parts are recycled (G.5 section from BSI EN 50693:2019 - Default values for R2) and that the mineral oil is recovered. Following mass balance principle and Brazilian environmental laws, the remaining parts of the product are sent for final disposal at sanitary landfills.			

Allocation:

Allocation can be defined as the impact factors distribution between the reference product and the coproducts when they are simultaneous and dependent. At Balteau value chain there is one type of situation where allocation may be required located at three points in end-of-life processes (i.e., the recycling processes) that occurs: at assembling line (core module) due to process waste generation, at transformer

installation step (downstream module) due to wooden packaging waste generation that follows for energy recovering and at EoL (downstream module) due to metal recovering from obsolete transformers

- **Assembling line, Installation and EoL**: regarding to the recycling of steel, amorphous-steel, copper and aluminium generated during transformer manufacturing and recovered at EoL, as well as wood waste from packaging sent for energy recovering (co-processing) we considered the cut-off approach. According to the core EPDItaly core-PCR (PCR007), for recovery and recycling processes, which take place outside the boundaries of the product system, only impacts related to the transport of the waste to the treatment platform should be considered. Therefore, all the impacts of the waste transportation by road were fully attributed to the Balteau product.

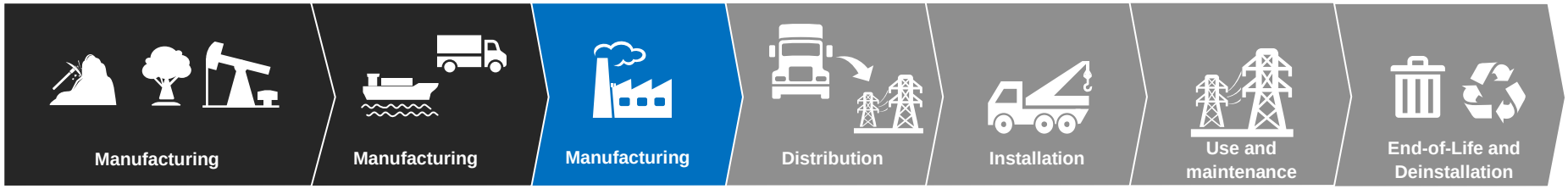
Cut-off criteria:

The cut-off criteria are applied to support an efficient calculation procedure. According to EN 50693 (2019) and PCR018 (2021), specifically the following flows and operations may be cut-off:

- Production, use and disposal of the packaging of components and semi-finished intermediates;
- Materials making up the transformer itself whose total mass does not exceed 1% of the total weight of the device;
- Material and energy flows related to dismantling phase, whenever it is reasonable to assume that dismantling is performed by adopting manual tools (e.g., screwdrivers, hammers, etc.);
- Devices external to the product itself required for installation;
- Maximum 5% of the overall environmental impact of the analysed product system;

In this LCA, all input and output flows have been considered at 100%, including raw materials as per the product composition provided by the manufacturer as well as the final product. The coverage of inbound logistics was of 100% of mass composition for the transformer.
The cut-off criterion was the environmental relevance of the production of capital equipment, construction activities, and infrastructure, maintenance and operation of capital equipment, personnel-related activities, energy and water use related to company management and sales activities, although some irrelevant inputs may eventually not be considered, e.g., the cardboard used to clean the moulding machine. At core module welding smokes were cut-off.

Description of the system boundaries:



Upstream module Core module Downstream module

Upstream module

The Inductive voltage transformer is majorly made of steel and amorphous-steel, porcelain (insulator), aluminium/copper, paper/paperboard and oil (for cooling purposes). There are also parts of polymers, chemicals (painting, varnish, resin), rubber and wood for packaging. The upstream module considers all upstream processes to extract such materials and process them into the final components that are inserted into the Balteau manufacturing line, including auxiliary consumptions at the factory such as electricity and others. This stage of the life cycle accounts also for the road and maritime transport of all materials and components from suppliers to the Balteau plant (inbound logistics).

Core module

The manufacturing process of Balteau's transformers can be subdivided into 6 processes: 1) Winding: Angles are placed on each edge of the core and a mylar tape coating is made. Then the assembled set is coated with cotton tape, mylar tape and creped paper. Finally, the 'mattress' winding is started so that there is a perfect distribution of the number of turns in the mattress dimension. In the derivation regions, welds are made and tefzel cables are placed. The coil assembly (coupling) is then insulated with double mylar tape. The inside of the Shielding Box (SB) is then filled with resin and hardener. 2) Insulation: Application of specific papers to provide insulation for the active part of the transformer. 3) Casting: Assembly of the primer on the primary plate of the mold that is taken to the oven so that the casting process can be started, and it can be filled with resin. 4) Porcelain assembly: The active part is inserted into the insulator and the resin terminal block assembly for secondary connections of the equipment is carried out. 5) Oil treatment: The equipment undergoes a treatment under controlled temperature and vacuum in ovens. After this step, the transformers are filled with insulating oil in the space between the active part and the porcelain insulator. 6) Finishing: Once the oil treatment is finished, the 'fole cover' is fixed, and primers are fixed. Then the secondary box is fixed. Afterwards, the final finishes and the fixing of the nameplates and the ground connector are carried out. Finally, the dome and fole latch are fixed. At this stage, some equipment accessories may undergo a painting process, in an existing booth on site. The last process in Balteau operation is the product's packaging, that is made entirely from wooden bars. After packaging, material is stored and ready for shipment.

Downstream module

This module encompasses all steps after product expedition from Balteau manufacturing plant until its End-of-life (EoL). The transformer is distributed by large diesel-truck through road transportation. The installation requires a lifting device that works for transport (from energy company storage into the operation point) and to elevate and install the transformer. During 30 years of Reference Service Life (RSL) the Inductive voltage transformer will convert energy voltage for use of measuring instruments and consumes medium voltage electricity from the Brazilian national grid to operate and through losses in the transformation. During this period, an inspection should be made every 12 months of transformer operation to check for leakages, corrosion, and others. Every 5 years, some tests should be made as for example, oil sample for quality analysis, insulating checks, etc. If there are no anomalies, no maintenance is necessary. According to Balteau product specialists, in Brazil many transformers operate until its failure and maintenance is not a controlled practice. When discontinued, a inductive voltage transformer is generally disassembled for metal recovery due to its high aggregated value. In Brazil this may be done at the secondary scrap market or by specialized recycling companies. Steel, aluminium, copper and other metallic fractions are recovered and reinserted into the market. Other fractions are more likely to be discarded in a sanitary landfill following Brazilian environmental laws. Mineral oil may be recycled or incinerated in waste management specialized companies depending on its quality when discarded.

Content information

Product components	Material classes*	IVT-72 kV		IVT-145 kV	
		Weight, kg	Weight-% (versus the product)	Weight, kg	Weight-% (versus the product)
Other ferrous alloys, non-stainless steel	M-119	42.44	21.90%	71.80	21.86%
Aluminium and its alloys	M-120	36.29	18.73%	54.29	16.53%
Copper and its alloys	M-121	9.28	4.79%	13.53	4.12%
Stainless steel	M-100	4.54	2.34%	5.39	1.64%
Tin and its alloys	M-126	0.76	0.39%	0.70	0.21%
Other non-ferrous metals and alloys	M-149	0.51	0.26%	0.49	0.15%
Paper/paperboard	M-341	11.20	5.78%	27.63	8.41%
Ceramics	M-160	56.00	28.90%	87.00	26.49%
Oils and greases	M-410	27.21	14.04%	61.56	18.75%
Chemicals (paints, varnish, dilutant, glues)	-	4.17	2.15%	3.99	1.22%
Polyamide	M-208	0.03	0.01%	0.04	0.01%
Polymers	-	0.84	0.44%	0.32	0.10%
Rubber	M326	0.50	0.26%	1.65	0.50%
Fibre, Other organics	M-342 M-399	0.01	0.00%	0.00	0.00%
TOTAL	**-**	**193.78**	**100.00%**	**328.40**	**100.00%**
Packaging materials	**Material classes****	**IVT-72 kV**		**IVT-145 kV**	
		Weight, kg	**Weight-% (versus the product)**	**Weight, kg**	**Weight-% (versus the product)**
Wood	M-340	50.00	100.00%	61.00	100.00%
TOTAL	**-**	**50.00**	**100.00%**	**61.00**	**100.00%**

**According to IEC 62474 - Material Declaration for Products of and for the Electrotechnical Industry;*

Substances of very high concern (SVHC)

These products contain no substances of very high concern (SVHC) on the REACH Candidate List published by the European Chemicals Agency in a concentration that exceed 0.01% (w/w).

Environmental Information

Potential environmental impact – mandatory indicators according to core-PCR IVT-72 kV

Results per a single piece of transformer operating for 30 years								
Indicator	Unit	Manufacturing stage		Distribution stage	Installation stage	Use and Maintenance stage	End-of-Life and deinstallation stage	Total
		upstream	core	downstream				
GWP-total	kg CO_2 eq	1,329.72	13.88	48.60	91.93**	2,570.39	57.78	4,112.31**
GWP-fossil	kg CO_2 eq	1,351.01	10.04	42.42	21.78	1,564.89	30.75	3,020.89
GWP-biogenic	kg CO_2 eq	-29.64	2.74	1.49	69.81**	867.60	26.50	938.51**
GWP-luluc	kg CO_2 eq	8.35	1.09	4.69	0.34	137.90	0.53	152.91
ODP	kg CFC11 eq	7.36E-05	5.45E-07	2.32E-06	4.33E-06	1.50E-04	5.90E-06	2.37E-04
AP	mol H+ eq	18.83	0.04	0.18	0.11	11.79	0.16	31.11
EP-freshwater	kg P eq	8.93E-02	4.55E-04	1.89E-03	1.49E-04	2.68E-02	2.52E-04	1.19E-01
POCP	kg NMVOC eq	6.01	0.05	0.23	0.13	4.47	0.22	11.11
ADP-minerals & metals*	kg Sb eq	2.35E-01	2.01E-06	8.61E-06	1.58E-06	1.19E-04	2.26E-06	2.35E-01
ADP-fossil*	MJ	16,116.10	134.94	576.51	298.32	23,804.75	417.78	41,348.41
WDP*	m^3 depriv.	322.17	0.26	1.10	0.15	458.19	0.26	782.12
Acronyms	GWP-fossil = Global Warming Potential fossil fuels; GWP-biogenic = Global Warming Potential biogenic; GWP-luluc = Global Warming Potential land use and land use change; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential, Accumulated Exceedance; EP-freshwater = Eutrophication potential, fraction of nutrients reaching freshwater end compartment; POCP = Formation potential of tropospheric ozone; ADP-minerals & metals = Abiotic depletion potential for non-fossil resources; ADP-fossil = Abiotic depletion for fossil resources potential; WDP = Water (user) deprivation potential, deprivation-weighted water consumption.							

** Disclaimer: The results of this environmental impact indicator shall be used with care as the uncertainties of these results are high or as there is limited experience with the indicator.*

***Final GWP value mathematically adjusted assuming that 100% of the uptake carbon by packaging is emitted at the installation phase based on the biogenic GWP profile of the wood.*

Use of resources
IVT-72 kV

Results per a single piece of transformer operating for 30 years									
Indicator		Unit	Manufacturing stage		Distribution stage	Installation stage	Use and Maintenance stage	End-of-Life and deinstallation stage	Total
			upstream	core	downstream				
Primary energy resources - Renewable	Use as energy carrier (PERE)	MJ, net calorific value	3,058.82	19.60	83.85	6.43	29,472.76	10.61	32,652.07
	Use as raw materials (PERM)	MJ, net calorific value	1,023.45	0.00	0.00	0.00	0.00	0.00	1,023.45
	Total (PERT)	MJ, net calorific value	4,082.26	19.60	83.85	6.43	29,472.76	10.61	33,675.52
Primary energy resources - Non-renewable	Use as energy carrier (PENRE)	MJ, net calorific value	14,784.16	142.61	609.41	300.68	23,874.03	421.48	40,132.38
	Use as raw materials (PENRM)	MJ, net calorific value	1,341.50	0.00	0.00	0.00	0.00	0.00	1,341.50
	Total (PERNT)	MJ, net calorific value	16,125.65	142.61	609.41	300.68	23,874.03	421.48	41,473.88
Secondary material (MS)		kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Renewable secondary fuels (RSF)		MJ, net calorific value	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non-renewable secondary fuels (NRSF)		MJ, net calorific value	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Net use of fresh water (FW)		m3	8.18	0.03	0.12	0.01	6.80	0.02	15.16

Waste production and output flows
IVT-72 kV

Waste production

Results per a single piece of transformer operating for 30 years								
Indicator	Unit	Manufacturing stage		Distribution stage	Installation stage	Use and Maintenance stage	End-of-Life and deinstallation stage	Total
		upstream	core	downstream				
Hazardous waste disposed (HWD)	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non-hazardous waste disposed (NHWD)	kg	0.00	2.67	0.00	0.00	0.00	101.65	104.32
Radioactive waste disposed (RWD)	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Output flows

Results per a single piece of transformer operating for 30 years								
Indicator	Unit	Manufacturing stage		Distribution stage	Installation stage	Use and Maintenance stage	End-of-Life and deinstallation stage	Total
		upstream	core	downstream				
Materials for energy recovery (MER)	kg	0.00	2.13	0.00	50.00	0.00	0.00	2.13
Material for recycling (MFR)	kg	0.00	6.05	0.00	0.00	0.00	92.13	148.18
Components for reuse (CRU)	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Exported thermal energy (ETE)	MJ	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Exported electricity energy (EEE)	MJ	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Potential environmental impact – mandatory indicators according to core-PCR IVT-145 kV

Results per a single piece of transformer operating for 30 years								
Indicator	Unit	Manufacturing stage		Distribution stage	Installation stage	Use and Maintenance stage	End-of-Life and deinstallation stage	Total
		upstream	core	downstream				
GWP-total	kg CO_2 eq	1,989.99	22.27	10.98	108.53**	3,676.47	104.66	5,912.90**
GWP-fossil	kg CO_2 eq	2,025.69	16.12	9.58	22.91	2,238.29	38.53	4,351.13
GWP-biogenic	kg CO_2 eq	-45.88	4.39	0.34	85.15**	1,240.94	65.23	1,350.17**
GWP-luluc	kg CO_2 eq	10.17	1.76	1.06	0.46	197.24	0.91	211.60
ODP	kg CFC11 eq	9.47E-05	8.75E-07	5.24E-07	4.39E-06	2.14E-04	6.99E-06	3.22E-04
AP	mol H+ eq	27.71	0.07	0.04	0.11	16.86	0.21	45.00
EP-freshwater	kg P eq	1.32E-01	7.31E-04	4.27E-04	1.99E-04	3.83E-02	4.23E-04	1.73E-01
POCP	kg NMVOC eq	9.03	0.09	0.05	0.14	6.39	0.29	15.98
ADP-minerals & metals*	kg Sb eq	3.37E-01	3.23E-06	1.95E-06	1.81E-06	1.70E-04	3.14E-06	3.37E-01
ADP-fossil*	MJ	24,930.41	216.66	130.19	313.72	34,048.31	523.07	60,162.36
WDP*	m^3 depriv.	481.84	0.41	0.25	0.17	655.35	0.41	1,138.44
Acronyms	GWP-fossil = Global Warming Potential fossil fuels; GWP-biogenic = Global Warming Potential biogenic; GWP-luluc = Global Warming Potential land use and land use change; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential, Accumulated Exceedance; EP-freshwater = Eutrophication potential, fraction of nutrients reaching freshwater end compartment; POCP = Formation potential of tropospheric ozone; ADP-minerals & metals = Abiotic depletion potential for non-fossil resources; ADP-fossil = Abiotic depletion for fossil resources potential; WDP = Water (user) deprivation potential, deprivation-weighted water consumption.							

** Disclaimer: The results of this environmental impact indicator shall be used with care as the uncertainties of these results are high or as there is limited experience with the indicator.*

***Final GWP value mathematically adjusted assuming that 100% of the uptake carbon by packaging is emitted at the installation phase based on the biogenic GWP profile of the wood.*

Use of resources
IVT-145 kV

Results per a single piece of transformer operating for 30 years									
Indicator		Unit	Manufacturing stage		Distribution stage	Installation stage	Use and Maintenance stage	End-of-Life and deinstallation stage	Total
			upstream	core	downstream				
Primary energy resources - Renewable	Use as energy carrier (PERE)	MJ, net calorific value	4,169.76	31.47	18.94	8.67	42,155.35	17.91	46,402.10
	Use as raw materials (PERM)	MJ, net calorific value	1,473.29	0.00	0.00	0.00	0.00	0.00	1,473.29
	Total (PERT)	MJ, net calorific value	5,643.05	31.47	18.94	8.67	42,155.35	17.91	47,875.39
Primary energy resources - Non-renewable	Use as energy carrier (PENRE)	MJ, net calorific value	21,962.06	228.98	137.62	316.96	34,147.40	529.42	57,322.45
	Use as raw materials (PENRM)	MJ, net calorific value	2,979.35	0.00	0.00	0.00	0.00	0.00	2,979.35
	Total (PERNT)	MJ, net calorific value	24,941.42	228.98	137.62	316.96	34,147.40	529.42	60,301.80
Secondary material (MS)		kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Renewable secondary fuels (RSF)		MJ, net calorific value	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non-renewable secondary fuels (NRSF)		MJ, net calorific value	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Net use of fresh water (FW)		m3	12.24	0.04	0.03	0.02	9.72	0.03	22.08

Waste production and output flows

IVT-145 kV

Waste production

Results per a single piece of transformer operating for 30 years								
Indicator	Unit	Manufacturing stage		Distribution stage	Installation stage	Use and Maintenance stage	End-of-Life and deinstallation stage	Total
		upstream	core	downstream				
Hazardous waste disposed (HWD)	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non-hazardous waste disposed (NHWD)	kg	0.00	4.27	0.00	0.00	0.00	163.31	167.58
Radioactive waste disposed (RWD)	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Output flows

Results per a single piece of transformer operating for 30 years								
Indicator	Unit	Manufacturing stage		Distribution stage	Installation stage	Use and Maintenance stage	End-of-Life and deinstallation stage	Total
		upstream	core	downstream				
Materials for energy recovery (MER)	kg	0.00	3.42	0.00	61.00	0.00	0.00	3.42
Material for recycling (MFR)	kg	0.00	9.69	0.00	0.00	0.00	165.12	235.81
Components for reuse (CRU)	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Exported thermal energy (ETE)	MJ	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Exported electricity energy (EEE)	MJ	0.00	0.00	0.00	0.00	0.00	0.00	0.00

References

BSI (2019) EN 50693:2019 – Product category rules for LCA of electronic and electrical products and systems. Final version, August 2019. British Standard.
BSI (2019) EN 15804+A2:2019 – Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products. British Standard.
EPDItaly, 2022. Regulations of the EPDItaly Programme. Revision 5.2. Issue date 2022/02/16.
EPDItaly007, 2020. Electronic and Electrical Products and Systems. Issue date 2020/01/20 Rev 2. core-PCR.
EPDItaly Operating Instructions IO-EPD-01, Release 20-07-22.
EPDItaly018, 2021. Electronic and Electrical Products and Systems – Power Transformers. Issue date 2021/12/13 revision v. 3.5. (2021/04/12) sub-PCR.
IEC (2022). International Electrotechnical Commission IEC 62474 - Material Declaration for Products of and for the Electrotechnical Industry IEC 62474 MCL updated on February 10, 2022. Available at https://www.iec.ch/homepage. Accessed on March 2022.
Instituto TOTUM (2021). Cálculo do Mix Residual do Brasil para ano calendário 2019. 27/04/2021. Available in:
<https://institutototum.com.br/images/totum/arquivos/Mix_Residual_2019_versao_02.pdf>
ISO (2006a) 14040: Environmental Management - Life Cycle Assessment - Principles and Framework.
ISO (2006b) 14044: Environmental Management - Life Cycle Assessment - Requirements and guidelines.

Contact information

Author of the Life cycle assessment:
EnCiclo Soluções Sustentáveis Ltda.
Florianópolis – Santa Catarina
Brazil
Tel: +55 48 99144-9245
+55 11 95694-7217
Mail: guilherme@enciclo.com.br
Web: www.enciclo.com.br

Owner of the Declaration:
Balteau Produtos Elétricos LTDA.
R. Prof. Álvaro Pereira Rizzi, 90 – Distrito Industrial.
Itajubá, State of Minas Gerais, Brazil
Tel: +55 (35) 3629-5500
Mail: alan.pereira@balteau.com.br
Web: https://balteau.com.br/

www.epditaly.it