Environmental Product Declaration

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

Three-phase industrial transformer 630 kVA (335.668)

from

Romagnole Produtos Elétricos S.A.

Declaration number:	EPD03
Production site:	Rodovia BR 376, km 394 – Parque Industrial – CEP 86.975-000 – Mandaguari, State of Paraná, Brazil
Programme:	EPD Italy®, www.epditaly.it
Programme operator:	EPDItaly
EPD registration number:	EPDITALY0500
Issue date:	2023-11-21
Valid until:	2025-05-21

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

EPD type	*Specific product EPD – concerning a specific product by a specific manufacturer, EPD is cradle-to-grave*
Scope of application:	*Three-phase industrial transformer – 630 kVA (code 335.668): three-phase transformer in vegetal cooled oil, with low level of loss and noise and 630 kVA of nominal power. Cradle to grave with 35 years of reference service life (RSL).*
Functional unit:	*A single piece of transformer operating for 35 years*
CPC code:	*46121 - Electrical transformers*
Geography:	*World (raw materials), Brazil (production, use and end-of-life)*
Production period:	*June 2023 to September 2023*
LCA report	*[Romagnole-LCA] 500-630 kVA transformer_final_report_v2.0 (2023)*
Product category rules (PCR):	*Core PCR EPDItaly007: Electronic and Electrical Products and Systems, revision 3 (2023-01-13)* *Sub PCR EPDItaly018: Electronic and Electrical Products and Systems – Power Transformers, version 3.5 (2021-12-13)*
Other references:	*Regulations of the EPDItaly Programme rev 5.2, 2022-02-16* *EN 50693 is the framework reference for the Product Category Rules (PCR)*
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:	Romagnole Produtos Elétricos S.A.
Address:	Rodovia BR 376, km 394 – Parque Industrial – CEP 86.975-000 – Mandaguari, State of Paraná, Brazil
Location of production site(s):	Rodovia BR 376, km 394 – Parque Industrial – CEP 86.975-000 – Mandaguari, State of Paraná, Brazil
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About the organization

Romagnole Produtos Elétricos S.A. is one of the largest manufacturers of electrical products in Brazil, with a wide range of distribution, industrial and power transformers, input cabins, electrotechnical hardware, structures for solar power plants, transmission towers, poles and other concrete artifacts used in electrical networks.

Acting in the market since 1962, Romagnole is a reference in its area of expertise, by combining quality of materials while caring for stakeholders' relationship. Romagnole products are present throughout the Brazilian territory, Americas, Africa, and the Middle East.

PROVIDING SOLUTIONS THAT TRANSFORM

Sustainability

Sustainability is one of the core values of Romagnole, present in the company governance through solid management projects, reduction in water and energy consumptions and environmental awareness. Romagnole holds the ISO 14001, ISO 9001 and ISO 45001 standards for integrated management system aligning environmental, quality and health responsibilities.

In 2020, the company received the Renewable Energy Certificate, based on a report on avoided greenhouse gas emissions (GHG) resulting from the use of energy produced by renewable sources. The report is produced by Sinerconsult Consultoria Treinamentos e Participação Ltda. And by COMERC Energia. It presents the results GHG emissions avoided in the consumption of electricity from non-polluting and renewable sources.

Owned certifications

ISO 9001 · ISO 14001 · ISO 45001 · Certificado de Energia Renovável 2023 – Comerc · Sinerconsult

Product information

Product name:	Three-phase industrial transformer – 630 kVA	
Product description:	The 335.668 Three-phase industrial transformer is an electrical device that transfer energy from one circuit to another by magnetic coupling without requiring relative motion between its parts and comprises three coupled windings and a magnetic core to concentrate magnetic flux made of silicon steel. It is a three-phase transformer in Vegetal cooled oil, with nominal power of 630 kVA and final project mass (without packaging) of **2,763 kg**. The packaging consists of wooden bars.	
Average dimensions:	1,790 mm height x 1,795 mm length x 1,065 mm width	**Three-phase industrial transformer** 
Expedition weight:	2,906 kg	
Product weight:	2,763 kg	
Packaging weight:	143 kg	
Type:	Three-phase industrial, oil-immersed	
Number of phases:	3P	
Voltage class:	Medium	
Nominal primary voltage	15 kV	
Nominal power:	630 kVA	
Colled-oil type:	Vegetal oil	
Products covered:	630 kVA Three-phase industrial oil immersed transformer	
Geographical scope:	Brazil	

LCA information

Functional unit / declared unit:

A single piece of transformer operating for 35 years.

Time representativeness:

January 2022 to December 2022.

Time 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*".

Database(s) and LCA software used:

SimaPro® software v.9.5.0.1 developed by PRé Consultants was used to create the product system model. The ecoinvent® database version 3.9 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:

Module	Raw material supply	Transport	Manufacturing	Distribution	Installation	Use and Maintenance	Deinstallation and End-of-Life
	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 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 35 years (RSL), deinstallation and transformer EoL, including metal recycling, insulating oil treatment 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:

Manufacturing data is aggregated for all the factory, and therefore, it is not possible to estimate inputs and outputs directly for a specific transformer since Romagnole produces other equipment at the same plant. Thus, to relate utility consumptions and waste generation per transformer, it was necessary to apportion aggregated data. Electricity[1] input was estimated on a ratio of the total consumption by the manufacturing sector (where the product is produced) and the total of manufacturing hours over 2022. The consumption per hour was then adjusted based on the number of hours on each manufacturing step necessary to process the transformer. Ancillary inputs and waste flows from the processes followed the same approach. Waste flows (from product inputs) were based on controlled losses whitin Romagnole internal system, applying the mass balance on gross weight of each component that enters the system. Solvent emissions during the painting and paint drying processes were quantified based on estimates derived from monitoring reports.

Distribution:

The transformer is transported to Embu das Artes, São Paulo State (south-eastern Brazil) by road transportation in diesel-powered lorries. The distance was estimated according to the most probable road from Mandaguari plant until Embu das Artes Municipality, 614 km.

Installation:

The installation phase implies in the transportation of 100 km 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 landfill disposal of the packaging of the Transformer, first returning until the energy company waste management central (100 km) and then transported until the waste management company (200 km).

Use stage:

The total energy consumed during 35 RSL by the transformer is **1,238,970.60 kWh** (losses and operational consumptions). This value was calculated according to IEC 60076-1 technical standard, expressed in kWh via the following equation (PCR0018 v.3.5):

[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.

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

The energy consumption during operation, as well as the P_{load} and P_{noload} factors were estimated to meet the guaranteed maximum values for the supply of the products (these values apply to both the reference temperatures of 75°C and 85°C) and are presented in Table 1 for the RSL of 35 years. The transformers do not have auxiliary operation, and therefore, the P_{aux} and f_{aux} values are null or zero.

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

Variable	Amount
P_{load} (kW)	5.900
k_{load}	0.70
P_{noload} (kW)	1.150
t_{years} (hours)	8,760
RSL (years)	35
Electricity (kWh)	1,238,970.60

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. Vegetal oil is incinerated without energy recovering 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		Value	Unit
Collection process	From energy company storage to recovering market	2,762.59	kg
Recovery system specified by type	Reuse	0.00	kg
	Recycling	1,402.36	kg
	Incineration for energy recovery	0.00	kg
Disposal specified by type	Product or material for final deposition	577.31	kg
	Incineration	782.92	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 Vegetal oil is incinerated. 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 Romagnole value chain there is one type of situation where allocation may be required located at two points in end-of-life processes (i.e., the recycling processes) that occurs: at assembling line (core module) due to process waste generation and at EoL (downstream module) due to metal recovering from obsolete transformers.

- **Assembling line and EoL**: regarding to the recycling of steel, silicon-steel, copper and aluminium generated during transformer manufacturing and recovered at EoL, 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 Romagnole product.

Cut-off criteria:

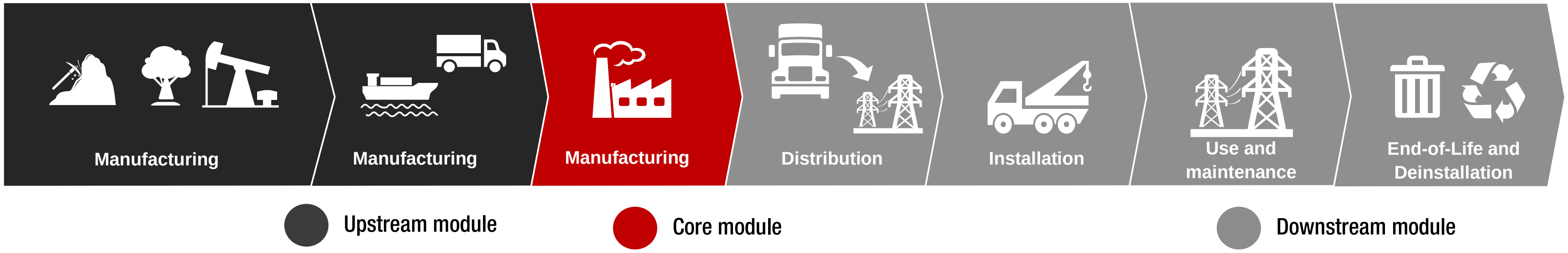
The cut-off criteria are applied to support an efficient calculation procedure. According to EN 50693 (2019) and PCR018 (2023), specifically the following flows and operations may be cut-off:

- 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. Cut-off criteria was the environmental relevance for infrastructure impacts, although some irrelevant inputs may eventually not be considered, e.g., the cardboard used to clean the moulding machine. For inbound logistics, mass-based cut-off criteria was applied for minor components (screws, washers, rivets, etc). The coverage of inbound logistics was of 99.9% of mass composition for the transformer. At core module welding smokes were cut-off.

The only 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.

Description of the system boundaries:



Upstream module

The Three-phase industrial transformer is majorly made of steel and silicon-steel, aluminium/copper, paper/paperboard and oil (tank filled for cooling purposes). There are also minor parts of polymers, chemicals (painting, varnish…), 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 Romagnole 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 Romagnole plant (inbound logistics).

Core module

The Three-phase industrial transformer manufacturing is an assembling line. Metal sheets are cut, bended, calendared, moulded and welded into the final transformer structure (tank, lid and bars). Those parts are cleaned and painted. In parallel, the core is made of silicon-steel and assembled from several different pieces that are cut to be geometrically positioned into the magnetic core that is wrapped with wildings prepared with insulated conductor wires and covered with insulating paper. Core and transformer body meet at the final assembling, with connections, cables and other minor parts and are tested for security, functioning and tightness. After packaging, the transformer is stored and ready for shipment. The manufacturing line at Romagnole plant requires ancillary inputs, such as electricity and water to operate and generate wastes and other outputs. Electricity consumed at Romagnole plant is 100% from renewable source (hydro) meanwhile a major part of wastes is recycled.

Downstream module

This module encompasses all steps after product expedition from Romagnole manufacturing plant until its End-of-life (EoL). The Transformer is distributed to São Paulo state 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 35 years of Reference Service Life (RSL) the Three-phase industrial transformer will convert energy voltage for urban consumption and consumes medium voltage electricity from 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 check, etc. If there are no anomalies, no maintenance is necessary. According to Romagnole product specialists, in Brazil many transformers operate until its failure and maintenance is not a controlled practice. When discontinued, the transformer is generally disassembled for metal recovering due to its high aggregated value. In Brazil this may be done at 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 to sanitary landfill following Brazilian environmental laws. Vegetal oil may be recycled or incinerated in waste management specialized companies depending on its quality when discarded.

Content information

Product components	Material classes*	Weight, kg	Weight-% (versus the product)
Other ferrous alloys, non-stainless steel	M-119	1,455.36	52.68%
Aluminium and its alloys	M-120	313.97	11.36%
Copper and its alloys	M-121	30.49	1.10%
Stainless steel	M-100	4.97	0.18%
Tin and its alloys	M-126	2.97	0.11%
Paper/paperboard	M-341	80.26	2.91%
Wood	M-340	17.03	0.62%
Ceramics	M-160	28.32	1.02%
Oils and greases	M-410	782.92	28.34%
Chemicals (paints, varnish, dilutant, glues)	-	45.56	1.65%
Polymers	-	0.00	0.00%
Rubber	M326	0.73	0.03%
TOTAL	**-**	**2,762.59**	**100.00%**
Packaging materials	**Material classes***	**Weight (kg)**	**Weight (%)**
Wooden bars	M-340	123.34	86.00%
Other ferrous alloys, non-stainless steel	M-119	20.08	14.00%
TOTAL	**-**	**143.42**	**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

Results per a single piece of transformer operating for 35 years									
Indicator*	**Unit**	**Raw material supply**	**Transport**	**Manufacturing**	**Distribution stage**	**Installation stage**	**Use and Maintenance stage**	**Deinstallation stage and End-of-Life**	**Total**
		upstream		**core**	**downstream**				
GWP-total	kg CO_2 eq	1.57E+04		2.06E+02	1.59E+02	2.57E+02	2.82E+05	1.27E+03	3.00E+05
GWP-fossil	kg CO_2 eq	1.50E+04		2.06E+02	1.48E+02	4.93E+01	1.40E+05	1.43E+02	1.55E+05
GWP-biogenic**	kg CO_2 eq	-1.05E+03		4.00E-02	2.93E+00	2.06E+02	1.19E+05	1.12E+03	1.20E+05
GWP-luluc	kg CO_2 eq	1.77E+03		3.74E-03	7.96E+00	1.49E+00	2.34E+04	4.44E+00	2.52E+04
ODP	kg CFC11 eq	3.99E-04		8.73E-07	6.35E-06	1.52E-06	3.75E-03	5.60E-06	4.17E-03
AP	mol H+ eq	1.41E+02		1.04E-01	6.06E-01	2.07E-01	9.48E+02	7.66E-01	1.09E+03
EP-freshwater	kg P eq	4.11E+01		8.43E-05	5.85E-04	1.42E-04	3.20E+00	1.07E-02	4.43E+01
EP-marine	kg N eq	3.35E+01		2.02E-02	3.18E-01	1.05E-01	1.73E+02	6.14E-01	2.08E+02
EP-terrestrial	mol N eq	2.18E+02		2.09E-01	2.74E+00	9.56E-01	1.76E+03	3.49E+00	1.98E+03
POCP	kg NMVOC eq	7.29E+01		3.92E+00	8.35E-01	3.04E-01	5.43E+02	1.14E+00	6.22E+02
ADP-m***	kg Sb eq	4.42E-01		3.27E-06	2.17E-05	4.94E-06	2.28E-02	1.59E-05	4.65E-01
ADP-f***	MJ	1.55E+05		6.09E+02	1.90E+03	6.32E+02	2.01E+06	1.74E+03	2.17E+06
WDP***	m^3 depriv.	-8.17E+02		-1.10E+02	2.73E+01	5.48E+00	4.77E+05	2.15E+01	4.76E+05
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.								

**The applied characterization factors are associated with the EF 3.0 method.*

***For the GWP-biogenic indicator, it was assumed that carbon uptake is fully emitted at the disposal point, even though degradation may occur over a more extended period within the 100-year timeframe of GWP analysis. Consequently, the biogenic carbon contents of the vegetable oil and paper within the product, as well as the wood composing the packaging (captured throughout their value chains, i.e., - 1 kg CO_2 eq), were manually adjusted to be 100% emitted during the installation phase (for wood packaging) and end-of-life phase (for the vegetal oil and paper), resulting in +1 kg CO_2 eq.*

**** 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.*

Potential environmental impact – additional indicators according to core-PCR

Results per a single piece of transformer operating for 35 years									
Indicator*	Unit	Raw material supply	Transport	Manufacturing	Distribution stage	Installation stage	Use and Maintenance stage	Deinstallation stage and End-of-Life	Total
		upstream		core	downstream				
PM	disease inc.	1.18E-03	1.06E-06	1.59E-05	4.66E-06	2.65E-02	2.27E-05	2.78E-02	
IRP	kBq U-235 eq	2.51E+02	1.01E-01	1.47E-01	6.93E-02	6.22E+03	4.64E-01	6.48E+03	
ETP-fw	CTUe	1.65E+06	3.68E+02	7.33E+03	1.51E+03	4.60E+05	5.58E+03	2.12E+06	
HTP-c	CTUh	4.42E-05	2.58E-07	3.16E-08	1.89E-08	9.14E-05	2.07E-07	1.36E-04	
HTP-nc	CTUh	9.41E-04	1.30E-06	2.57E-06	6.11E-07	1.31E-03	4.76E-06	2.26E-03	
SQP	Pt	9.55E+04	3.40E+00	1.59E+02	5.54E+01	1.46E+06	1.74E+02	1.56E+06	
Acronyms	PM = Potential incidence of disease due to PM emissions; IRP = Potential Human exposure efficiency relative to U235; ETP-fw = Potential Comparative Toxic Unit for ecosystems; HTP-c = Potential Comparative Toxic Unit for humans; HTP-nc = Potential Comparative Toxic Unit for humans; SQP = Potential Soil quality index.								

The applied characterization factors are associated with the EF 3.0 method.

Use of resources

Results per a single piece of transformer operating for 35 years										
			Raw material supply	Transport	Manufacturing	Distribution stage	Installation stage	Use and Maintenance stage	Deinstallation stage and End-of-Life	Total
Indicator		unit	upstream		core	downstream				
Primary energy resources - Renewable	Use as energy carrier (PERE)	MJ, net calorific value	3,327.62		2.39	75.74	14.98	5,144,972.57	54.97	5,148,448.28
	Use as raw materials (PERM)	MJ, net calorific value	30,527.94		0.00	0.00	0.00	0.00	0.00	30,527.94
	Total (PERT)	MJ, net calorific value	33,855.55		2.39	75.74	14.98	5,144,972.57	54.97	5,178,976.21
Primary energy resources - Non-renewable	Use as energy carrier (PENRE)	MJ, net calorific value	166,906.88		609.48	1,958.11	642.34	2,010,354.25	1,765.63	2,182,236.69
	Use as raw materials (PENRM)	MJ, net calorific value	26.42		0.00	0.00	0.00	0.00	0.00	26.42
	Total (PERNT)	MJ, net calorific value	166,933.31		609.48	1,958.11	642.34	2,010,354.25	1,765.63	2,182,263.11
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 9FW)		m3	97.00		-1.75	0.84	0.17	10,890.27	1.14	10,987.66

Waste production and output flows

Waste production

Indicator	Unit	Raw material supply	Transport	Manufacturing	Distribution stage	Installation stage	Use and Maintenance stage	Deinstallation stage and End-of-Life	Total
		upstream		core	downstream				
Hazardous waste disposed (HWD)	kg	0.00		38.00	0.00	0.00	0.00	0.00	38.00
Non-hazardous waste disposed (NHWD)	kg	0.00		0.00	0.00	143.42	0.00	1,360.23	1,503.65
Radioactive waste disposed (RWD)	kg	0.00		0.00	0.00	0.00	0.00	0.00	0.00

Results per a single piece of transformer operating for 35 years

Output flows

Indicator	Unit	Raw material supply	Transport	Manufacturing	Distribution stage	Installation stage	Use and Maintenance stage	Deinstallation stage and End-of-Life	Total
		upstream		core	downstream				
Materials for energy recovery (MER)	kg	0.00		0.00	0.00	0.00	0.00	0.00	0.00
Material for recycling (MFR)	kg	0.00		181.58	0.00	0.00	0.00	1,402.36	1,583.94
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

Results per a single piece of transformer operating for 35 years

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.

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