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Hitachi Energy Spain S.A.U.

EPD ITALY

ENVIRONMENTAL PRODUCT DECLARATION

PRODUCT:	SITE PLANT:
Transformer 1LES010182-000	Av. De Manuel Rodriguez, Ayuso170, Zaragoza (Spain)

In compliance with ISO 14025

Program Operator	EPDItaly
Publisher	EPDItaly

Declaration number	EPD-DRYZA-1.6MVA-20_0.58kV-01
Registration number	EPDITALY1015

Issue date	10/06/25
Valid to	09/06/30

www.epditaly.it

GENERAL INFORMATION

EPD OWNER	
Name of the company	Hitachi Energy Spain S.A.U.
Location of the production site	Av. De Manuel Rodriguez, Ayuso170, Zaragoza (Spain) https://www.hitachienergy.com/
Company Contact	Alberto Rodrigo, alberto.rodrigo@hitachienergy.com

PROGRAM OPERATOR	
EPD Italy	EPDItaly – www.epditaly.it Via Gaetano De Castillia 10, 20124 Milan (MI), Italy

PRODUCT	
Declared Product	Dry type with enclosure transformer
CPC code	46121 'Electrical transformers'

VERIFICATION	
Reference PCR	EPDItaly007 – PCR for Electronic and electrical products and systems, Rev. 3.1, valid until 2026/01/19 EPDItaly018 – Electronic and electrical products and systems – Power transformers, Rev. 3.6, 2029/07/01
Reference documents	EN 50693:2019 – Product category rules for life cycle assessment of electronic and electrical products and systems Regolamento del programma EPDItaly rev.6 of 30/10/23
Project Report LCA	“LCA Report_HitachiZaragoza_rev2” Emission date: 14/05/25
Independent Verification	This declaration has been developed referring to EPDItaly, following the 'Regolamento di EPDItaly”; further information and the document itself are available at: www.epditaly.it. EPD document valid within the following geographical area: Italy and other countries around the world according to the conditions of the sales market. Independent verification of the declaration and data carried out according to ISO 14025:2010. [ ] Internal [X] External Third-party verification carried out by: TÜV Italia srl (Accreditation number 0008VV)
Comparability	EPDs published within the same product category, though originating from different programs, may not be comparable. Full conformance with a PCR allows the comparability of EPD only when all stages of a life cycle

	have been considered. However, variations and deviations are possible.
Liability	EPDItaly declines any responsibility regarding the manufacturer's information, data, and results of the life-cycle assessment.

ADDITIONAL INFORMATION	
Technical support	Spin Life s.r.l. Spin-off of University of Padova Via C. Cerato 14 - 35122 Padova T. 049 878 9120 - info@spinlife.it

Additional explanatory material can be obtained by contacting the EPD owner.

COMPANY INFORMATION

The Zaragoza Transformers Factory in Spain is part of Hitachi Energy (a subsidiary of Hitachi corporation).

Hitachi Energy is a technology and market global leader in electrical power grids. The company provides engineering services for grid infrastructures, grid automation solutions, high voltage products, and transformers.

Hitachi Energy is advancing the world's energy system to be more sustainable, flexible, and secure. As the pioneering technology leader, the company collaborates with customers and partners to enable a sustainable energy future for today's generations and those to come.

The production plant is covered by EMS according to ISO 14001.

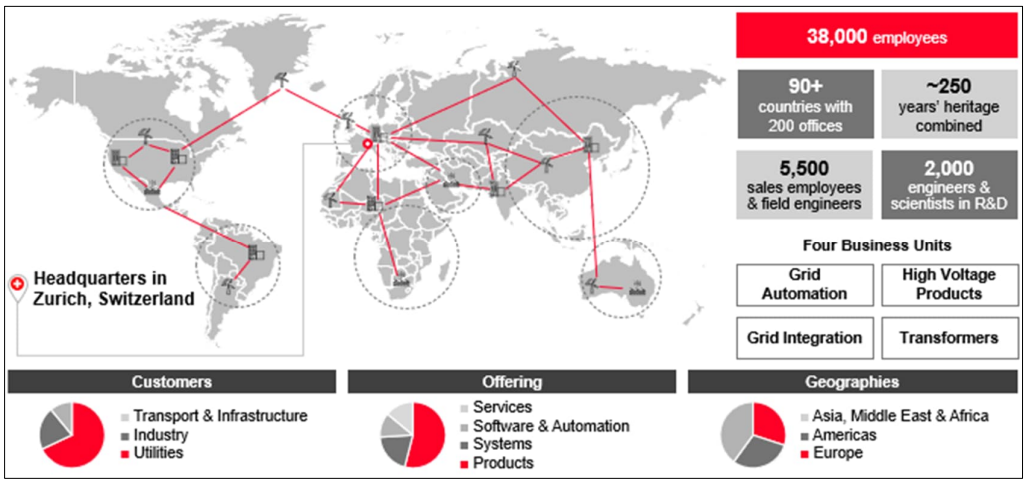

Figure 1 Hitachi Energy global headquarters

Hitachi Energy

PRODUCTS AND PROCESSES

Table 1 Main information about the product

Product ID	1LES010182
Type	Dry type with enclosure transformer (DTE)
Rated voltage [kV]	20/2X0,586
Rated Power [MVA]	1,600
Frequency [Hz]	50
Classification according to the reference PCR	Electrical transformer
Mass [kg]	4879
Type and quantity of insulating liquid [kg]	N/A
Cooling system	AN
Area in which transformers are sold and installed (or intended to be installed)	Finland

Table 2 Material composition of the product (in accordance with EN IEC 62474) considered in the analysis. Materials accounting for less than 1% of the total mass was not considered.

Materials	1LES010182		
	Weight [kg]	%	Biogenic Carbon Content
Electrical steel	2706,0	55,5%	/
Steel	255,4	5,2%	/
Aluminium	1081,0	22,2%	/
Copper	30,8	0,6%	/
Cast iron	16,8	0,3%	/
Fiberglass	20,2	0,4%	/
Paper	88,6	1,8%	38,12
Polyester	141,0	2,9%	/
Resin	471,4	9,7%	/
Others	67,8	1,4%	/

The product under study has no additional packaging and It does not contain any hazardous substance.

LIFE CYCLE ASSESSMENT INFORMATION

Life Cycle Assessment (LCA) is an analytical tool that captures the overall potential environmental impacts of a product, process or human activity from raw material extraction, through production and use, to end of life. LCA studies are structured in four phases. The Goal and scope definition phase clarifies the objective of the study and determines the main methodological boundaries, as well as the life cycle processes to be included in the analysis (also referred to as system boundaries). Another fundamental step of this phase is the definition of the so-called functional unit which is the measuring unit that quantifies the function of the product under study. The Inventory analysis phase includes data collection and modelling of all the input and outputs of material, energy, and other elementary flows that can cause potential environmental impacts. In the Life cycle impact assessment phase, inventory data are characterized into potential environmental impacts. Finally, in the Interpretation phase the validity of the results with respect to the purpose and scope of the study are commented and the most impactful stages of the life cycle are identified.

The objective of this study is to assess the potential environmental impacts from a life-cycle perspective associated with the product under study. A specific EPD for a single product has been created.

The declared unit is defined as a single unit of transformer operating for 35 years. The reference flow is defined as a single unit of transformer produced by Hitachi Energy Spain. The main characteristics of the transformer analysed are described in Table 1.

Product stage			Construction process stage		Use stage							End of life stage				Resource recovery stage
Raw material supply	Transport	Manufacturing	Transport	Construction installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling-potential
A1	**A2**	**A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
X	X	X	X	X	ND	X	ND	ND	ND	X	ND	X	X	X	X	X

The system boundary includes the whole life cycle of the analysed product, according to a "from cradle to grave" application, covering the following life cycle stages:

1. Manufacturing stage. This phase includes the upstream and core modules described previously (raw material transformation, transportation of raw materials and semi-finished products, production of the finished product packaging, generation of process waste including its transportation to the disposal sire, energy and material consumption associated to plant operations);
2. Distribution stage. This module includes the impacts related to the distribution of the product at the installation site;
3. Installation stage. This module includes the end of life of packaging, the energy consumption associated to installation and setup, scrap and waste generated during the installation stage;
4. Use & Maintenance Stage. This module includes the energy consumed by the transformer to operate during its entire reference service life, ordinary scheduled maintenance and extraordinary scheduled maintenance.
5. End of Life Stage. This module includes the transportation of the transformer to the collection site, disassembly operations, distribution and destination of the various material flows to be sent for recycling or disposal.

It should be noted that the construction, maintenance, and decommissioning of infrastructure, i.e. buildings and machinery, as well as the occupation of industrial land have not been considered, as their contribution to the environmental impact of the declared unit is considered negligible.

For the study, reference was made to the data deriving from the BOMs of the specific products. For plant consumption, reference was made to the data related to the Zaragoza plant (Spain) and referred to the year 2022 (January - December), considered representative.
The suppliers of raw materials and semifinished products are located all over the world. Where possible, the specific origin of the raw material has been investigated and characterized accordingly. For the downstream phases, a Finnish scenario was considered, knowing the exact position of where the transformers will be installed.

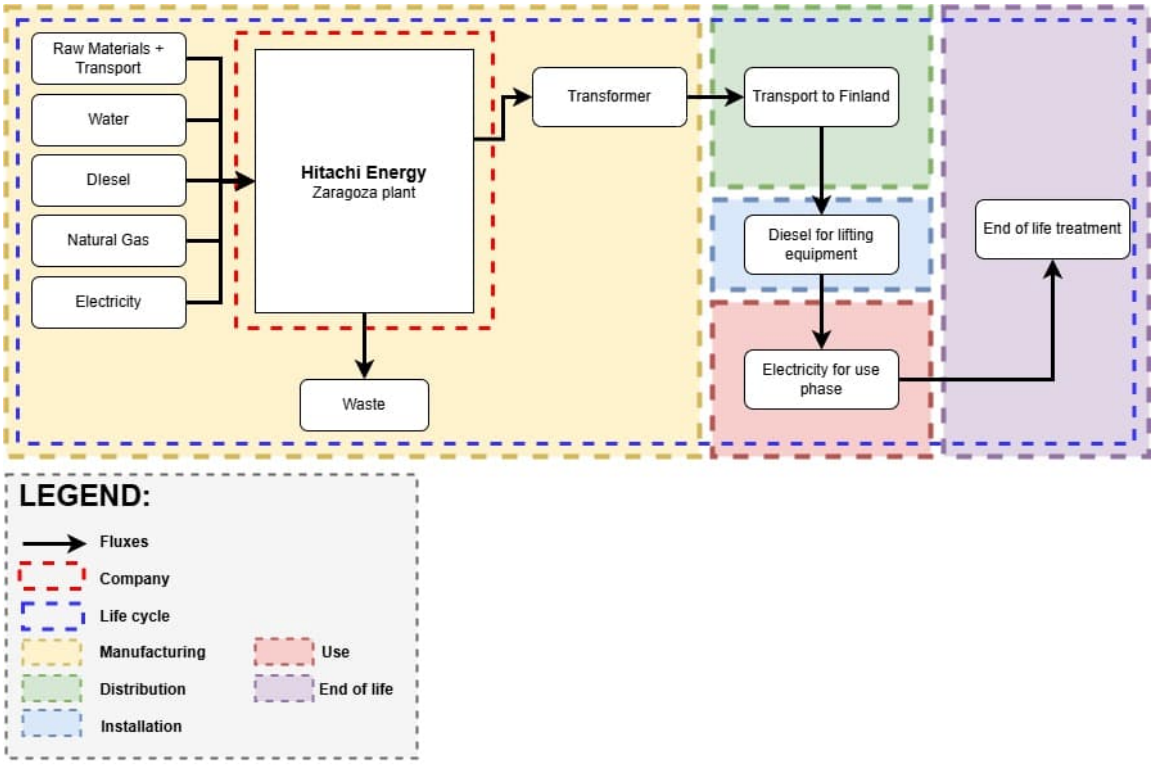

Figure 2 Flux diagram for the product under study

LCA INFORMATION	
Reference year	January – December 2022
Geography	Global
Energy mix	Spanish Residual mix
Software	SimaPro version 9.6.0.1
Database	Ecoinvent version 3.10
LCA Method	Cut-off by classification
Characterization factors	Method EN 15804

CALCULATION RULES

Cut-off criteria: The criterion chosen for the initial inclusion of inputs and outputs is based on the definition of a 5% cut-off level (according to EN 50693:2019), both in terms of mass, energy and environmental significance. This means that a process is considered negligible if it represents less than 5% of the total mass, primary energy and impact.

Impact categories: The methodology chosen to evaluate the potential environmental impacts of the product subject of this study includes all the impact categories required by the Standard EN 50693:2019. The models used are those shown in EN 15804 + A2: 2019, as implemented in the SimaPro software.

Allocation principles: In the case under study, allocation of material and energy flows was necessary as much several transformer models are produced in the Zaragoza (Spain) plant. The allocation principle chosen is based on a physical property of transformers that is considered representative, namely their apparent power (measured in MVA).

The allocation was applied in the following cases: consumption of electricity, methane gas, diesel fuel, water consumptions and packaging of the raw material, associated with the processes carried out at the Zaragoza (Spain) plant.

Data quality: where available, primary data directly provided by the factory have been preferred; secondary data, where used, refer to the most recent available version of the Ecoinvent database.

Inventory analysis:

Life Cycle Stage	Description
Upstream – Manufacturing stage	For the characterization of raw materials and semi-finished products entering the plant, reference was made to Ecoinvent 3.10 datasets, where possible suitably modified in order to make them more representative of the specific country of origin. The origin of the raw materials, and the consequent transport process, was modeled in a punctual manner for at least 98% by weight of the components. The distances were calculated using web tools such as Google Maps and Ecotransit.
Core – Manufacturing stage	The production process at the plant has been characterized by considering the following inventory flows: consumption of electricity, combustion of methane gas and diesel fuel, water withdrawal and waste management. For the modeling of electricity, reference was made to the Spanish Residual Mix contained in the Ecoinvent 3.10 database..
Downstream - Distribution	For the definition of the distribution processes, the actual distances were calculated for the product, as the installation location is known (Tampere tramway). The product is intended for the Finnish market.
Downstream - Installation	The transformer is shipped already assembled (without any packaging), therefore the only significant activity relevant for the installation phase is the operation of the lifting equipment.

Life Cycle Stage	Description
Downstream – Use	Quantification of losses during the use phase was performed in accordance with the reference PCR by applying the following equation: $$E_d[kWh] = (P_{load} \cdot k_{load}^2 + P_{noload}) \cdot t_{year} \cdot RSL + P_{aux} \cdot f_{aux} \cdot t_{year} \cdot RSL$$ *Where: P_{load} is the load loss of the transformer at 75 °C reference temperature at nominal power. It is expressed in kW; K_{load} represents an average load factor for the equipment. For calculations based on this PCR, 70% of nominal power shall be adopted; P_{noload} is the power dissipated in case no losses shall occur. It is expressed in kW; P_{aux} is the power loss due to auxiliary activities at no load (such as cooling). It is expressed in kW; f_{aux} represents the fraction of time in which ancillary equipment is operating. It is expressed in % over 1 year; t_{year} is the total amount of hours during a year. For this calculation, 8 760 hours shall be considered; RSL represents the Reference Service Life, defined as 35 years for EPDs based on the PCR.* The electrical energy in this phase was modelled according to the Finnish energy mix (medium voltage): Electricity, medium voltage {FI}| market for electricity, medium voltage | Cut-off, U, which has an emission factor of 0,265 kgCO2e/kWh in terms of Global Warming Potential.
Downstream – Maintenance	For the product under study, no ordinary maintenance is required.
Downstream – End of Life	The disassembly phase includes the same operations and consumptions included in the installation phase. Moreover, the dataset Waste electric and electronic equipment {GLO}| treatment of waste electric and electronic equipment, shredding | Cut-off, U was associated. For the transport to the collection site, a transport of 500 km by lorry>32 ton was assumed. The transformer end-of-life modelling choices were made on the basis of the material destinations provided by the EN 50693: aluminum (70% recycling, 30% landfill), steel and cast iron (80% recycling, 20% landfill) and copper (60% recycling, 40% landfill). The others were modelled 50% as incineration and 50% as disposal in a landfill.

ENVIRONMENTAL IMPACT ASSESSMENT

The results refer to the declared unit.

Table 3 Results for environmental potential impacts

Impact category	Unit	Total	Manufacturing	Distribution	Installation	Use	End of life	Module D
GWP-total	kg CO2 eq	4,03E+05	2,75E+04	3,67E+03	3,61E+01	3,70E+05	1,34E+03	-5,25E+03
GWP-fossil	kg CO2 eq	3,94E+05	2,73E+04	3,67E+03	3,61E+01	3,61E+05	1,20E+03	-5,10E+03
GWP-biogenic	kg CO2 eq	1,60E+03	-1,90E+01	6,64E-01	3,18E-03	1,48E+03	1,40E+02	-2,40E+01
GWP-luluc	kg CO2 eq	7,47E+03	1,98E+02	1,22E+00	3,11E-03	7,27E+03	2,45E-01	-1,25E+02
ODP	kg CFC11 eq	7,33E-03	3,78E-04	7,29E-05	5,47E-07	6,87E-03	1,46E-05	-8,95E-05
AP	mol H+ eq	1,50E+03	1,59E+02	7,64E+00	1,66E-01	1,33E+03	2,26E+00	-3,97E+01
EP-freshwater	kg P eq	1,10E+02	1,15E+01	2,48E-01	1,04E-03	9,77E+01	2,82E-01	-3,08E+00
EP-marine	kg N eq	3,35E+02	2,86E+01	1,83E+00	7,28E-02	3,04E+02	7,33E-01	-4,66E+00
EP-terrestrial	mol N eq	3,48E+03	2,93E+02	1,98E+01	7,98E-01	3,16E+03	7,61E+00	-4,35E+01
POCP	kg NMVOC eq	1,07E+03	1,05E+02	1,27E+01	2,64E-01	9,46E+02	2,98E+00	-1,91E+01
ADP-minerals&metals	kg Sb eq	2,26E+00	3,12E-01	1,19E-02	1,28E-05	1,94E+00	2,00E-03	-1,19E-01
ADP-fossil	MJ	1,47E+07	1,92E+05	4,29E+03	1,90E+01	1,45E+07	1,17E+03	-3,91E+04
WDP	m3 depriv.	1,99E+05	6,78E+03	2,14E+02	1,01E+00	1,92E+05	-4,34E+01	-6,41E+02
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; EP-marine = Eutrophication potential, fraction of nutrients reaching marine end compartment; EP-terrestrial = Eutrophication potential, Accumulated Exceedance; 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							

Table 4 Results for resource use

Impact category	Unit	Total	Manufacturing	Distribution	Installation	Use	End of life	Module D
PERE	MJ	5,74E+06	6,79E+04	8,56E+02	2,79E+00	5,67E+06	3,00E+02	-3,37E+04
PERM	MJ	1,08E+03	1,08E+03	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
PERT	MJ	5,74E+06	6,90E+04	8,56E+02	2,79E+00	5,67E+06	3,00E+02	-3,37E+04
PENRE	MJ	1,69E+07	3,72E+05	5,16E+04	4,68E+02	1,64E+07	8,73E+03	-7,99E+04
PENRM	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
PENRT	MJ	1,69E+07	3,72E+05	5,16E+04	4,68E+02	1,64E+07	8,73E+03	-7,99E+04
SM	kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
RSF	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
NRSF	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
FW	m3	1,48E+04	4,98E+02	6,80E+00	3,04E-02	1,43E+04	-3,61E-01	-2,37E+02
Acronyms	PERE = Use of renewable primary energy excluding renewable primary energy resources used as raw materials; PERM = Use of renewable primary energy resources used as raw materials; PERT = Total use of renewable primary energy resources; PENRE = Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials; PENRM = Use of non-renewable primary energy resources used as raw materials; PENRT = Total use of non-renewable primary energy re-sources; SM = Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of non-renewable secondary fuels; FW = Use of net fresh water							

Table 5 Results for waste production and output fluxes

Impact category	Unit	Total	Manufacturing	Distribution	Installation	Use	End of life	Module D
HWD	kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
NHWD	kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
RWD	kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
CRU	kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
MFR	kg	3,39E+03	2,48E+02	0,00E+00	0,00E+00	0,00E+00	3,14E+03	0,00E+00
MER	kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
EE	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Acronyms	HWD = rifiuti pericolosi smaltiti; NHWD = rifiuti non pericolosi smaltiti; RWD = rifiuti radioattivi smaltiti; CRU = componenti per il riutilizzo; MFR = materiali per il riciclaggio; MER = materiali per il recupero energetico; EE = energia esportata.							

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