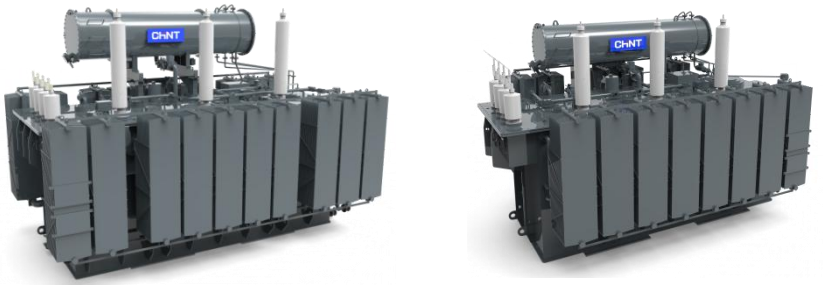
ENVIRONMENTAL PRODUCT DECLARATION

In accordance with ISO 14025:

Power Transformer

CHINT Electric Co.,Ltd

Declared product:



Power Transformer SZ-40000/150 and SZ-25000/132

Programme operator:	EPD China
Registration number:	EPD-CN-00016
Issued date:	2025-04-10
Valid until:	2030-04-09

ENVIRONMENTAL PRODUCT DECLARATION

Programme Information

EPD Owner	Name: CHINT Electric Co.,Ltd Contact information of EPD owner: No.3555 Sixian Road, Songjiang district, Shanghai, P.R. mxjun@chint.com 13669298946
Product Name	Power Transformer SZ-40000/150 and SZ-25000/132
Production Site	No.3555 Sixian Road, Songjiang district, Shanghai, P.R. China
Identification of product	46121 'Electricial transformer'
Field of Application	Electric transformers
Programme Operator	EPD China Address: 3rd floor, Lane 320, Tianping Road, Xuhui District, Shanghai Website:www.epdchina.cn Email: info@epdchina.cn | secretary@epdchina.cn
LCA Practitioner	qian.zhao@dekra.com & cheng.zhou@dekra.com
Responsibility	The EPD owner has the sole ownership, liability, and responsibility for the EPD
Comparability	EPDs within same category of product in different programme operator are not suggested to be compared. Full conformance with a PCR allows EPD comparability only when all stages of a life cycle have been considered. However, variations and deviations are possible even applying the same PCR.
Validity	The EPD is published on 2025-04-10 and valid to 2030-04-09
LCA Software (version)	Umberto.11.12.1
LCI Dataset (version)	Ecoinvent-en15804-3.10 (Rev.1,2023/11/28)
Year(s) of Primary Data	01/2024-12/2024
PCR	EPD Italy 018-Electronic and electrical products and systems – Power transformers Rev3.6
Other Reference Document	EN 50693
Verification statement according to ISO 14025:	
Independent verification of the declaration and data according to ISO 14025:2010 ☐ internal ☑ external Third-party institution verification: < Weifang Yao, WIT> is an approved certification body accountable for third-part verification. Approved by: EPD China	
Procedure for follow-up of data during EPD validity involves a third-party verifier: ☑ Yes ☐ No	

1 General Information

1.1 Company information

Founded in 1984, CHINT is a leading global provider of smart energy solutions. It is actively deploying "4+1" industrial sectors including smart electrics, green energy, industrial control and automation, smart home and incubator, forming an integrated whole industry chain of "power generation, storage, transmission, substation, distribution, sales and consumption". And it boasts an extensive business network across over 140 countries and regions as well as more than 30,000 employees and an annual sales revenue of over USD 11.4 billion. CHINT has been ranking among China's Top 500 companies for 18 consecutive years. Its subsidiary, CHINT Electrics is the first company in China with low-voltage electrics as its main business getting listed on the A-share market as one of the Top 50 Asian listed companies.

To comply with the trend of integrated development of modern energy, intelligent manufacturing and digital technology, CHINT has adopted "One Cloud & Two Nets" as the business strategy. CHINT Cloud fulfills digital application and services in both internal and external as the platform of intelligent technology and data application. Based on the Industrial Internet of Things (IIoT), CHINT built an intelligent manufacturing system and realizes intelligent application in electrical industry. Relying on the Energy Internet of Things (EIoT), CHINT built its smart energy system and develops the regional EIoT mode.

Focusing on energy system of supply, storage, transmission, distribution and consumption, CHINT has core businesses of clean energy, energy distribution, big data and energy value-added services. Furthermore, CHINT pillar businesses include photovoltaic equipment, energy storage, power transmission & distribution, low-voltage apparatuses, intelligent terminals, software development and control automation. With developing into a platform-based enterprise, CHINT provides a package of energy solutions for public institutions, industrial & commercial users and end users, by building a regional smart energy operation network.

Name and location of production site(s) within the organization

Table1. Location of PV module assembly sites

Module		
Component / Process	Manufacturing company name and address	Manufacturing country
Modules assembly	CHINT Electric Co.,Ltd No.3555 Sixian Road, Songjiang district, Shanghai, P.R. China (Postal Code 201611)	China

1.2 Scope and type of EPD

The system boundary considered in this LCA study is from the cradle to the grave. According to the PCR, the life cycle stage must refer to segmentation in the following three modules:

Manufacturing stage contains extraction and processing of raw materials, including plastic, metal, rubber, paper, etc., and the transportation of the raw material to the factory.

Production of the finished product packaging, including packaging to distribute the transformer in the reference market segment;

Generation of process waste, including its transportation to the disposal site;

Energy and material consumption associated to plant operations which are not directly linked to transformer manufacturing.

Distribution stage covers Product distribution after manufacturing;

Installation stage covers:

End of life of the packaging;

Energy consumption associated to installation and setup (oil filling, internal transportation of additional parts, etc.);

Scrap generated during the installation stage;

General waste arising from installation stage;

Use& Maintence stage:

Electricity loss in use stage of product;

Any maintenance process and related consumptions

EOL stage:

Operations to remove the transformer

Transportation of the transformer to the collection site;

Disassembly operations, including internal transportation and product dismantling;

Distribution and destination of the various material flows to be sent for recycling or disposal or incineration;

Figure 1 below illustrates the system boundaries for the Power transformers, including raw material production and transportation, manufacturing, distribution, installation, and End-of-life.

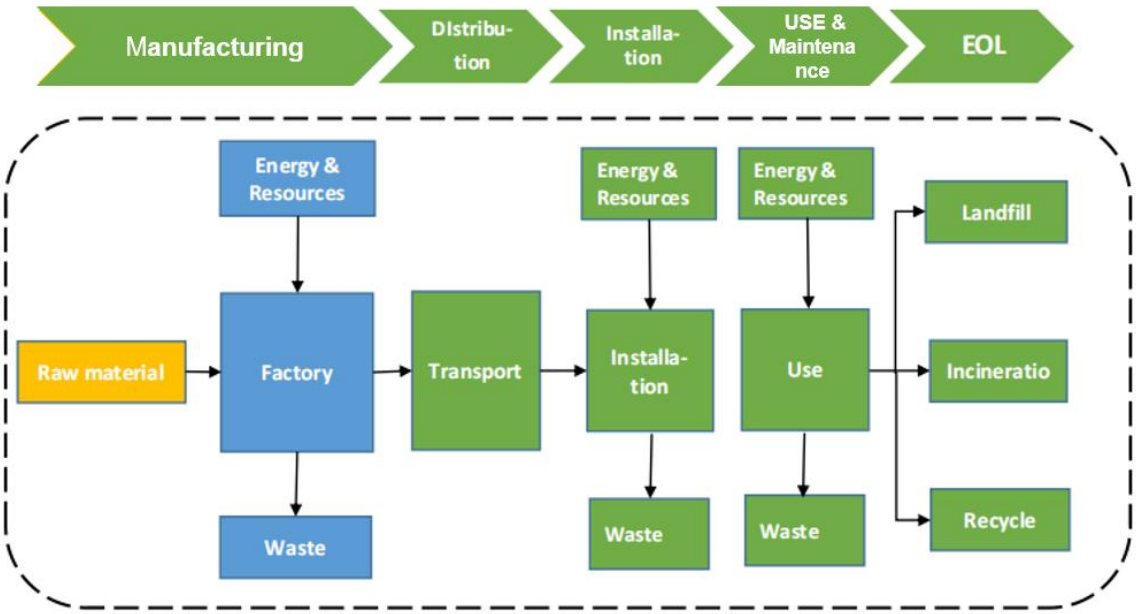


Figure 1 System boundary of target products

Note: For illustrative purposes only, landfill is not involved in this product calculation model.

Detailed information on the segmentation for the manufacturing、 distribution、 installation、 use & maintence、EOL are presented in the following.

Table 2: Division and declarations of life cycle stages according to the PCR

PHASES	MANUFACTURING STAGE	DISTRIBUTION STAGE	INSTALLATION STAGE	USE & Maintenance STAGE	END-OF-LIFE STAGE De-installation	BENEFITS & LOADS*
	IN ACCORDANCE TO EN 50693					
Phases declared	X	X	X	X	X	ND

Note: X=Declared Module, ND=Module not Declared in this LCA study

2 Detailed Product Description

Description of the product

Within this EPD, Power Transformer SZ-40000/150 and SZ-25000/132 are analyzed, there are a static piece of apparatus with two or more windings which, by electromagnetic induction,transforms a system of alternating voltage and current into another system of voltage and current usually of different values and at the same frequency for the purpose of transmitting electrical power.

Table 3. Information of target product

Operating power in VA	40000000	25000000
Operating primary voltage in V	150000	132000
Country for installation and operating	Italy	Italy
Name, model and type of product	Power Transformer SZ-40000/150	Power Transformer SZ-25000/132
Total product mass, excluding packaging	79300 kg	59100 kg
Functional unit	PCS	PCS
Production period	01/01/2024 to 31/12/2024	01/01/2024 to 31/12/2024
Production process	Assembly, testing, etc	Assembly, testing, etc

Description of the production processes

A flowchart depicting the production process stages of target product is shown in Figure 2 below.

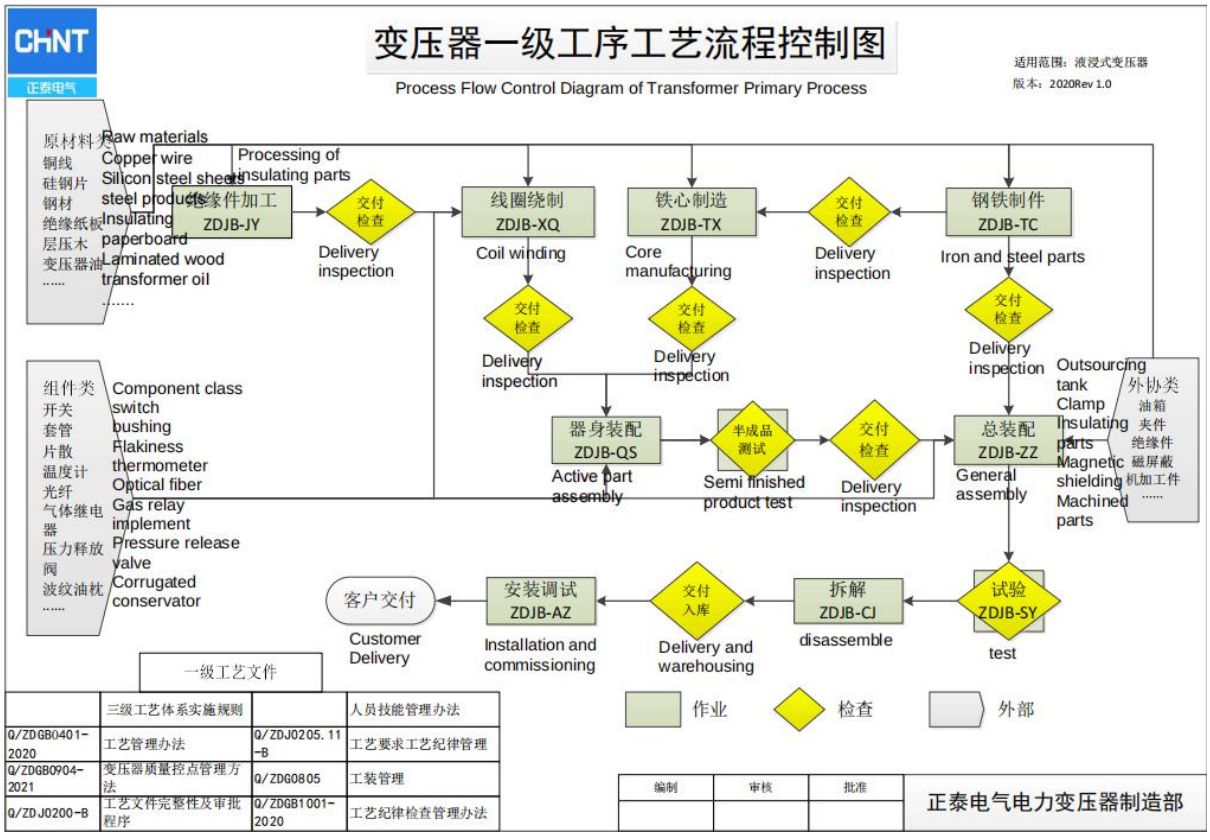


Figure 2 production processes of Power Transformer of CHINT

Table 4-1 : SZ-40000/150_Main product components and packaging materials per unit.

Product components	Weight, kg	Weight-% (versus the product)
Raw materials		
acrylonitrile-butadiene-styrene copolymer	1.875	0.00%
aluminium, cast alloy	145.2	0.18%
brass	42	0.05%
cable, unspecified	462.5	0.58%
chemi-thermomechanical pulp	200	0.25%
copper, cathode	7973.93	10.06%
epoxy resin, liquid	215.95	0.27%
glass fibre reinforced plastic, polyamide, injection moulded	6.40469	0.01%
kraft paper	35.9	0.05%
light emitting diode	0.13	0.00%
lubricating oil	19950	25.17%
nylon 6	0.573	0.00%
polycarbonate	0.18	0.00%
printed paper	1300	1.64%
steel, chromium steel 18/8	363	0.46%
steel, low-alloyed	15830	19.97%
steel, low-alloyed	24004	30.29%
steel, unalloyed	8494	10.72%
synthetic rubber	223.756	0.28%
Packaging materials		
furniture, wooden	3180	/

Table 4-2 : SZ-25000/132_Main product components and packaging materials per unit.

Product components	Weight, kg	Weight-% (versus the product)
Raw materials		
acrylonitrile-butadiene-styrene copolymer	1.88	0.00%
aluminium, cast alloy	141.60	0.24%
brass	42.00	0.07%
cable, unspecified	356.50	0.61%
chemi-thermomechanical pulp	184.00	0.32%
copper, cathode	6946.93	11.98%
epoxy resin, liquid	33.80	0.06%
glass fibre reinforced plastic, polyamide, injection moulded	6.40	0.01%
kraft paper	32.00	0.06%
light emitting diode	0.13	0.00%
lubricating oil	15000.00	25.88%
nylon 6	0.57	0.00%

Product components	Weight, kg	Weight-% (versus the product)
polycarbonate	0.18	0.00%
printed paper	1116.00	1.93%
steel, chromium steel 18/8	370.80	0.64%
steel, low-alloyed	11285.00	19.47%
steel, electric, low-alloyed	17000.00	29.33%
steel, unalloyed	5236.00	9.03%
synthetic rubber	215.36	0.37%
Packaging materials		
wooden	2452	/

Included products do not contain the substances included in the "Candidate List of SVHC" document issued by the European Chemicals Agency (http://echa.europa.eu/candidate-list-table).

Functional unit and Reference service life (RSL)

The functional unit is the product category unit to be referred to when determining environmental impacts. To assess the environmental impacts of different products, the functional units of these products must be equivalent to interpret the results.

In this study, the functional unit is specified in terms of pcs. The functional unit is in 1 pcs of Power Transformer. The functional unit is per pcs of Power Transformer with a RSL of 35 years.

3 LCA results

3.1 Environmental Impacts

The results of the underlying LCA are provided in this section as environmental impacts, resource use, output flows, and additional information on biogenic carbon.

Table 5-1 : SZ-40000/150_ Environmental impacts

RESULTS OF THE LCA –Environmental impacts per functional unit for Power Transformer SZ-40000/150							
Core indicator	Unit	Total	MANUFACTURING STAGE	DISTRIBUTION STAGE	INSTALLATION STAGE	USE & Maintenance STAGE	END-OF-LIFE STAGE De-installation
Global warming potential - Total (GWP-total)	kg CO2-Eq	1.06E+07	2.47E+05	2.98E+04	3.80E+03	1.02E+07	9.14E+04
Global warming potential - biogenic (GWP-biogenic)	kg CO2-Eq	3.47E+05	-4.44E+03	9.88E+00	4.53E+03	3.48E+05	1.34E+03
Global warming potential - land use and land use change (GWP-luluc)	kg CO2-Eq	3.04E+04	2.55E+02	1.97E+01	8.23E-01	3.01E+04	1.57E+01
Global warming potential - fossil fuels (GWP-fossil)	kg CO2-Eq	1.02E+07	2.51E+05	2.98E+04	1.47E+03	9.87E+06	9.01E+04
Depletion potential of the stratospheric ozone layer (ODP)	kg CFC-11-Eq	1.87E-01	3.47E-03	5.38E-04	2.64E-05	1.82E-01	8.57E-04
Photochemical ozone creation potential (POCP)	kg NMVOC-Eq	2.95E+04	2.13E+03	2.95E+02	1.30E+01	2.69E+04	1.86E+02
Eutrophication potential - freshwater (EP-freshwater)	kg P-Eq	9.64E+03	4.40E+02	1.80E+00	2.36E-01	9.18E+03	1.57E+01
Eutrophication potential - marine (EP-marine)	kg N-Eq	9.67E+03	4.30E+02	8.54E+01	3.53E+00	9.10E+03	4.75E+01
Eutrophication potential - terrestrial (EP-terrestrial)	mol N-Eq	8.83E+04	5.28E+03	9.43E+02	3.81E+01	8.16E+04	5.02E+02
Acidifcation potential, accumulated Exceedance (AP)	mol H+-Eq	6.41E+04	5.67E+03	3.21E+02	8.84E+00	5.80E+04	1.45E+02
Abiotic depletion potential - fossil resources (ADPF)	MJ	2.34E+08	3.81E+06	4.07E+05	2.18E+04	2.29E+08	5.16E+05
Abiotic depletion potential - non-fossil resources (ADPE)	kg Sb-Eq	1.97E+02	6.36E+01	7.66E-02	4.87E-03	1.33E+02	2.15E-01
Water (user) deprivation potential (WDP)	m3 world-Eq deprived	6.37E+06	1.15E+05	1.83E+03	2.30E+02	6.25E+06	5.62E+03

Table 5-2 : SZ-25000/132_ Environmental impacts

RESULTS OF THE LCA –Environmental impacts per functional unit for Power Transformer SZ-25000/132							
Core indicator	Unit	Total	MANUFACTURING STAGE	DISTRIBUTION STAGE	INSTALLATION STAGE	USE & Maintenance STAGE	END-OF-LIFE STAGE De-installation
Global warming potential - Total (GWP-total)	kg CO2-Eq	7.10E+06	1.87E+05	2.26E+04	3.10E+03	6.82E+06	6.88E+04
Global warming potential - biogenic (GWP-biogenic)	kg CO2-Eq	2.33E+05	-3.58E+03	7.25E+00	3.64E+03	2.32E+05	1.03E+03
Global warming potential - land use and land use change (GWP-luluc)	kg CO2-Eq	2.03E+04	2.01E+02	1.49E+01	7.66E-01	2.00E+04	1.17E+01
Global warming potential - fossil fuels (GWP-fossil)	kg CO2-Eq	6.85E+06	1.90E+05	2.25E+04	1.30E+03	6.57E+06	6.77E+04
Depletion potential of the stratospheric ozone layer (ODP)	kg CFC-11-Eq	1.25E-01	2.61E-03	4.06E-04	2.30E-05	1.21E-01	6.43E-04

Photochemical ozone creation potential (POCP)	kg NMVOC-Eq	2.00E+04	1.70E+03	2.26E+02	1.19E+01	1.79E+04	1.41E+02
Eutrophication potential - freshwater (EP-freshwater)	kg P-Eq	6.50E+03	3.73E+02	1.35E+00	2.23E-01	6.11E+03	1.18E+01
Eutrophication potential - marine (EP-marine)	kg N-Eq	6.51E+03	3.46E+02	6.56E+01	3.26E+00	6.06E+03	3.72E+01
Eutrophication potential - terrestrial (EP-terrestrial)	mol N-Eq	5.98E+04	4.31E+03	7.24E+02	3.52E+01	5.43E+04	3.81E+02
Acidifcation potential, accumulated Exceedance (AP)	mol H+-Eq	4.38E+04	4.81E+03	2.47E+02	8.13E+00	3.86E+04	1.10E+02
Abiotic depletion potential - fossil resources (ADPF)	MJ	1.56E+08	2.89E+06	3.08E+05	1.94E+04	1.53E+08	3.88E+05
Abiotic depletion potential - non-fossil resources (ADPE)	kg Sb-Eq	1.44E+02	5.51E+01	5.75E-02	4.34E-03	8.86E+01	1.61E-01
Water (user) deprivation potential (WDP)	m3 world-Eq deprived	4.26E+06	9.00E+04	1.38E+03	2.06E+02	4.16E+06	4.18E+03

3.2 Resource use and waste categories

Table 6-1 : SZ-40000/150_ Resource use and waste categories

RESULTS OF THE LCA –Resource use and waste categories per functional unit for Power Transformer SZ-40000/150							
Core indicator	Unit	Total	MANUFACTURING STAGE	DISTRIBUTION STAGE	INSTALLATION STAGE	USE & Maintenance STAGE	END-OF-LIFE STAGE De-installation
Total use of non renewable primary energy (PENRT)	MJ	2.34E+08	3.81E+06	4.08E+05	2.18E+04	2.29E+08	5.16E+05
Use of non renewable primary energy as energy carrier (PENRE)	MJ	2.34E+08	3.78E+06	4.08E+05	2.18E+04	2.29E+08	5.16E+05
Use of non renewable primary energy resources used as raw materials (PENRM)	MJ	1.29E+04	1.29E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total use of renewable primary energy (PERT)	MJ	6.34E+07	4.33E+05	6.00E+03	1.32E+03	6.29E+07	2.06E+04
Use of renewable primary energy as energy carrier (PERE)	MJ	6.34E+07	4.33E+05	6.00E+03	1.32E+03	6.29E+07	2.06E+04
Use of renewable primary energy resources used as raw materials (PERM)	MJ	8.32E+04	8.32E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use of secondary materials (SM)	MJ	7.12E+04	3.29E+04	1.97E+02	8.58E+00	3.80E+04	2.20E+02
Use of renewable secondary fuels (RSF)	MJ	2.95E+03	2.62E+03	1.79E+00	7.38E-02	3.05E+02	1.62E+01
Net use of fresh water (FW)	m3	2.01E+05	2.39E+03	5.05E+01	5.70E+00	1.98E+05	1.54E+02
Non-hazardous waste disposed (NHWD)	kg	4.72E+07	2.23E+06	1.15E+04	2.84E+03	4.49E+07	7.60E+04
Hazardous waste disposed (HWD)	kg	6.52E+05	5.95E+04	6.15E+02	4.31E+01	5.81E+05	1.06E+04
Radioactive waste disposed (RWD) - Total	kg	1.63E+03	3.73E+00	1.09E-01	3.26E-02	1.63E+03	4.15E-01
Materials for recycling (MFR)	kg	4.64E+04	0.00E+00	0.00E+00	1.59E+03	0.00E+00	4.49E+04
Materials for energy	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

recovery (MER)							
Exported energy, electric (EEE)	MJ	9.61E+04	0.00E+00	0.00E+00	1.47E+04	0.00E+00	8.14E+04
Exported energy, thermal (EET)	MJ	2.18E+05	0.00E+00	0.00E+00	1.47E+04	0.00E+00	2.04E+05
Use of non-renewable secondary fuels (NRSF)	MJ	/	/	/	/	/	/
Components for reuse (CRU)	kg	/	/	/	/	/	/

Table 6-2 : SZ-25000/132_ Resource use and waste categories

RESULTS OF THE LCA –Resource use and waste categories per functional unit for Power Transformer SZ-25000/132							
Core indicator	Unit	Total	MANUFACTURING STAGE	DISTRIBUTION STAGE	INSTALLATION STAGE	USE & Maintenance STAGE	END-OF-LIFE STAGE De-installation
Total use of non renewable primary energy (PENRT)	MJ	1.56E+08	2.89E+06	3.08E+05	1.94E+04	1.53E+08	3.88E+05
Use of non renewable primary energy as energy carrier (PENRE)	MJ	1.56E+08	2.88E+06	3.08E+05	1.94E+04	1.53E+08	3.88E+05
Use of non renewable primary energy resources used as raw materials (PENRM)	MJ	8.35E+03	8.35E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total use of renewable primary energy (PERT)	MJ	4.23E+07	3.52E+05	4.51E+03	1.28E+03	4.19E+07	1.55E+04
Use of renewable primary energy as energy carrier (PERE)	MJ	4.23E+07	3.52E+05	4.51E+03	1.28E+03	4.19E+07	1.55E+04
Use of renewable primary energy resources used as raw materials (PERM)	MJ	6.65E+04	6.65E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use of secondary materials (SM)	MJ	4.93E+04	2.37E+04	1.49E+02	7.41E+00	2.53E+04	1.65E+02
Use of renewable secondary fuels (RSF)	MJ	2.24E+03	2.02E+03	1.34E+00	6.05E-02	2.04E+02	1.21E+01
Net use of fresh water (FW)	m3	1.34E+05	2.00E+03	3.79E+01	5.30E+00	1.32E+05	1.13E+02
Non-hazardous waste disposed (NHWD)	kg	3.18E+07	1.82E+06	8.67E+03	2.39E+03	2.99E+07	5.97E+04
Hazardous waste disposed (HWD)	kg	4.42E+05	4.63E+04	4.65E+02	3.74E+01	3.87E+05	7.98E+03
Radioactive waste disposed (RWD) - Total	kg	1.09E+03	2.94E+00	8.15E-02	3.18E-02	1.08E+03	3.12E-01
Materials for recycling (MFR)	kg	3.35E+04	0.00E+00	0.00E+00	1.23E+03	0.00E+00	3.23E+04
Materials for energy recovery (MER)	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported energy, electric (EEE)	MJ	7.27E+04	0.00E+00	0.00E+00	1.13E+04	0.00E+00	6.14E+04
Exported energy, thermal (EET)	MJ	1.65E+05	0.00E+00	0.00E+00	1.13E+04	0.00E+00	1.53E+05
Use of non-renewable secondary fuels (NRSF)	MJ	/	/	/	/	/	/
Components for reuse (CRU)	kg	/	/	/	/	/	/

3.3 Information on biogenic carbon content

Information on biogenic carbon content which shall be included in the EPD as follows:

Table 7-1 : SZ-40000/150_ Resource use and waste categories

Biogenic carbon content	Unit (expressed per functional unit)
Biogenic carbon content in product	-6.01E+02 kg C
Biogenic carbon content in accompanying packaging	0 kg C
NOTE：1 kg biogenic carbon is equivalent to 44/12 kg of CO2.	

Table 7-2 : SZ-25000/132_ Resource use and waste categories

Biogenic carbon content	Unit (expressed per functional unit)
Biogenic carbon content in product	-4.27E+02 kg C
Biogenic carbon content in accompanying packaging	0 kg C
NOTE：1 kg biogenic carbon is equivalent to 44/12 kg of CO2.	

4 Supplementary information

4.1 Calculation rules

functional unit:

In this study, the functional unit is specified in terms of pcs. The functional unit is in 1 pcs of Power Transformer. The functional unit is per pcs of Power Transformer with a RSL of 35 years.

Assumptions:

1. As for the transportation for the unspecified distance such as the transport of end of life stage, there is an assumption of 1500 km of the transport in Europe according to PCR.

2. For EOL stage, products are disposed of locally, the materials' disposal rate and recycling rate of each material are followed the specific data from EN 50693 2019.

3. The data of energy consumption and pollutants emission in the raw material acquisition stage are from the Ecoinvent 3.10 database published by the European Ecoinvent Center.

4. The emission factors of electricity for manufacturing in China and for use in Europe are both from the Ecoinvent. In the evaluation process, Umberto software was used for modeling and calculation.

Cut off rules

1. Environmental impacts relating to personnel, infrastructure, and production equipment not directly consumed in the process are excluded from the system boundary.

2. Some materials whose mass less than 0.1% of the product are ignored. The total exclusion shall not exceed 1% of the total weight of the product.

3. Some of the general solid waste in the manufacturing stage is not included in the calculation because it is recycled in its disposal stage, Incineration models are used for solid waste that cannot be recycled, but the environmental impact of its transshipment to the recycling company is included in the assessment.

Data quality

In this EPD, both primary and secondary data are used. Site specific foreground data have been provided by CHINT Electric Co.,Ltd. Main data sources are the bill of materials available on the enterprise resource planning. For all processes for which primary are not available, generic data originating from the ecoinvent v3.10 database, allocation cut-off by classification, are used. The ecoinvent database is available in the Umberto.11.12.1 software used for the calculations. The ecoinvent v3.10 by cut-off classification system processes are used to model the background system of the processes. The raw material inputs are modelled with data from ecoinvent representing a global market (GLO) or rest-of-world (ROW) coverage. These datasets are assumed to be representative.

Allocation of input and output flows

The energy involved in the production stage of the product is electricity, natural gas, etc., for the production of the product, diesel for forklift trucks, and the use of refrigerant for the chiller in the workshop. The energy consumption of the production part is apportioned according to the total production capacity of the product in the workshop involved and the capacity of the product itself. The details are given in the following:

$$E = \frac{Environmental\ impacts}{Total\ (Output\ *\ Capacity)} \times Target\ Product\ Capicity\ \#(1)$$

Total (Output ∗ Capacity) is 46588188 kVA, target Product Capicity is 40000 kVA, the specific allocation results are shown in Table 8, 9, and 10.

Allocation by reuse, recycling and recovery process

Final waste treatment processes (all modeled as incineration), where waste production is linked to the product life cycle, has been included in the study.

For recovery and recycling processes, which take place outside the boundaries of the product system, only impacts related to the transportation of the waste to the treatment platform has been taken into account.

4.2 Scenarios and additional technical information

Description of the processes included in raw materials extraction, raw materials transport and product assembly.

Raw materials extraction and production： This stage mainly includes the mining, transportation and production of raw materials, using the factors of the database to calculate, the production of raw materials such as steel products, copper products, aluminum products, steel plate rolling and copper wire drawing processes energy consumption are also included.

Raw materials transport: Concerning raw material transportation, all the raw materials are sourced from domestic suppliers and are transported by truck, unspecified lorry is used for modeling in this study. The study applies an aggregated approach to raw materials transportation summarizing all the transport data by multiplying the weight and the transportation distance.

Manufacturing: The energy involved in the production stage of the product is electricity, natural gas, etc., for the production of the product, diesel for forklift trucks, and the use of refrigerant for the chiller in the workshop. The energy consumption of the production part is apportioned according to the total production capacity of the product in the workshop involved and the capacity of the product itself. The details are given in the following:

$$E = \frac{Environmental\ impacts}{Total\ (Output\ *\ Capacity)} \times Target\ Product\ Capicity\ \#(1)$$

Total (Output * Capacity) is 46588188kVA, target Product Capicity is 40000 kVA, the specific allocation results are shown in Table 8, 9, and 10.

Specific data are shown in the following table (data period is 01/01/2024 to 31/12/2024):

Table 8: Energy consumption of relative workshops

Item	Amount	Unit
Grid electricity consumption	12800886.81	kWh
Photovoltaic electricity consumption	460240	kWh
Natural gas consumption	1369633	m³
Diesel consumption	10.28	t
Refrigerant -R22- Production workshop	116	kg

Table 9: Production capacity of related products

Product	Capacity（kVA）	Product yield * Capacity（kVA）
Target product 1 : SZ-40000/150	40000kVA	/
Target product 2 : SZ-25000/132	25000kVA	/
All relevant workshop products	/	46588188

Table 10-1 : SZ-40000/150_Allocation results for SZ-40000/150

Item	Single target value	Unit
Grid electricity consumption	10990.67155	kWh
Photovoltaic electricity consumption	395.1559567	kWh
Natural Gas	1175.948719	m³
Natural Gas	41124.22025	MJ
Diesel	8.827924366	kg
Diesel	376.99651	MJ

Refrigerant - R22	0.12758711	kg

Table 10-2 : SZ-25000/132_Allocation results for SZ-25000/132

Item	Single target value	Unit
Grid electricity consumption	6869.1697	kWh
Photovoltaic electricity consumption	246.9725	kWh
Natural Gas	734.9679	m^3
Natural Gas	25702.6377	MJ
Diesel	5.5175	kg
Diesel	235.6228	MJ
Refrigerant - R22	0.0622	kg

Note：The calorific value of diesel oil is derived from GB/T 2589-2020 General Principles for the calculation of comprehensive Energy consumption， the calorific value of diesel is here 42705 kJ/kg. The calorific value of natural gas is according to Gas Quality Report provided by the factory, is 34971.1 kJ/m^3.

Product distribution: The products are assumed to be transported to Europe for application.

Table 11: Product distributions for the Power Transformer SZ-40000/150 and SZ-25000/132

Product	Start point	Terminal	Land-Transport distance (km)	Maritime-Transport distance (km)	Product Mass (kg)	Corresponding packaging (kg)
110042（SZ-25000/132）	Shanghai Songjiang District Zhengtai Smart Electric Port	Genoa Port, site coordinates: 44°28'16.7"N 7°43'50.2"E	100+80	16094	59100	2452
110035（SZ-40000/150）	Shanghai Songjiang District Zhengtai Smart Electric Port	Port of Palermo, site coordinates: 37°56'58.8"N 12°36'26.9"E	100+80	15406	79300	3180

Description of the processes for others

Installation: This stage in the study contains end of life of the packaging and energy consumption associated to installation and setup, including gasoline for transportation to and from the site, diesel for crane and forklift during installation, electricity for commissioning and testing, and the use of oil:

Table 12: Installation energy details for SZ-40000/150 and SZ-2500/132

Energy	Project 1	Project 2	Project 3	Consumption	Unit
Electricity	Debugging, testing, acceptance, handover: 7.5KW * 6 hours = 45kWh	Vacuum oil filter machine oil filtration: 48kW*10 hours=480kW (total oil weight 13300kg)		525	kWh
Gasoline	Gasoline: Round trip to the site: 1 vehicle, 10L/hour, 2 times, each 1 hour; Total = 20L	Unit conversion=20*0.74		638.2352	MJ
Diesel	Diesel: Forklift 1, 6L/hour, 1 time/2 hours, total = 12L;	10-ton crane: working 16 hours, consuming diesel: 16*4 liters=64 liters	1 crane, 30L/hour, 1 time/2 hours, total = 60L	4907.6586	MJ
Motor Oil	Motor oil: Elevator chain, guide rail lubrication / 4L	888 kg/m3		3.552	kg

Note：The calorific value of gasoline and diesel oil is derived from GB/T 2589-2020 General Principles for

the calculation of comprehensive Energy consumption， the calorific value of gasoline is here 43124 kJ/m3， the calorific value of diesel is here 42705 kJ/kg.

The density of diesel is taken as 0.845 kg/L, sourced from GB 19147-2016 "Automotive Diesel Fuel"; the density of gasoline is taken as 0.74 kg/L, sourced from GB 17930-2016 "Automotive Gasoline".

Uses and maintenance:

As for use phase, the total energy consumed shall be expressed in kWh and it can be calculated via the following formula according to PCR:

$$E_d\ [kWh] = [P_{load} * k_{load}{}^2 + P_{noload}] * t_{year} * RSL + P_{aux} * f_{aux} * t_{year} * RSL$$

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 this PCR.

All parameters and calculation results are shown in the table below:

Table 13: Ed calculated of target product

Item	Amount of SZ-40000/150	Amount of SZ-25000/132	Unit
P_{load}	162.2	107	kW
k_{load}	0.7	0.7	/
P_{noload}	18.75	13	kW
P_{aux}	/	/	kW
f_{aux}	/	/	/
t_{year}	8760	8760	hour
RSL	35	35	year
E_d	30116705	20060838	kWh

In the maintenance stage, the replacement of 2 gaskets (80kg), including the upstream and downstream transport and waste stages) is included in the calculation, because the product does not need to replace the insulation oil under normal circumstances, so the use of insulation oil is not calculated.

Decommission and waste transport: For the end-of-life stage, the disassembly model is simulated using the crane from the installation phase, using 1 crane, 30L/hour, 1 time/2 hours, total = 60L. For waste transport, 1500km transportation distance from installation site to waste treatment site is assumed.

After de-installation, the factors of manual disassembly are used in the calculation of waste processing stage. The materials' disposal rate and recycling rate of each material are followed the specific data from EN 50693 2019. Here is the table of the summary disposal material amount of target product during end-of-life:

Table 14-1 : SZ-40000/150_Waste treatment scenario

Waste type	Disposal rate	Raw materials	Packaging waste	Production waste	Maintenance waste	Unit
Steel	20%	9738.2	0	0	0	kg
Aluminium	30%	43.56	0	0	0	kg

Copper	40%	3206.372	0	0	0	kg
ABS	40%	0.75	0	0	0	kg
Other Plastic	50%	111.5538	0	0	0	kg
Rubber	50%	111.878	0	0	80	kg
Electrical and electronic cables	100%	462.5	0	0	0	kg
wood	50%	0	1590	0	0	kg
Paper	50%	767.95	0	0	0	kg
Hazardous waste	100%	19950	0	170.1205	0	kg
Solid waste	100%	0	0	170.3780	0	kg

Table 14-2 : SZ-25000/132_Waste treatment scenario

Waste type	Disposal rate	Raw materials	Packaging waste	Production waste	Maintenance waste	Unit
Steel	20%	6738.57	0	0	0	kg
Aluminium	30%	42.59	0	0	0	kg
Copper	40%	2635.91	0	0	0	kg
ABS	40%	0.75	0	0	0	kg
Other Plastic	50%	107.02	0	0	0	kg
Rubber	50%	67.90	0	0	80	kg
Electrical and electronic cables	100%	356.50	0	0	0	kg
wood	50%	0	1226	0	0	kg
Paper	50%	666.00	0	0	0	kg
Hazardous waste	100%	15000.00	0	106.33	0	kg
Solid waste	100%	0	0	106.49	0	kg

4.3 Other optional additional environmental information

In this study, it is important to note that different electricity grid mixes are used for different stages of the life cycle. Specifically, the manufacturing of the product took place in Shanghai, China, Enterprises have photovoltaic electricity consumption, the use of multi-Si photovoltaic panels. Electricity mix for Eastern Power Grid of China was used for modelling. As for the installation、use &maintence stage, European market average electricity mix is used. The detailed information can be found in Table 15.

Table 15: Electricity profiles applied

Consumption type	Electricity process type
Electricity use in manufacturing stage-grid power	Electricity, medium voltage {CN-ECGC}| market group for | Cut-off, U
Electricity use in manufacturing stage-Photovoltaic power	Electricity production, photovoltaic, 3kWp slanted-roof installation, multi-Si, panel, mounted
Electricity use in the installation、use &maintence module	Market group for electricity, low voltage - RER (Europe)

References

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[7] ISO 14044: 2006/Amd 2:2020 Environmental management - Life cycle assessment - Requirements and guidelines Amendment 2 (ISO 2020).

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[9] EPD Italy 018-Electronic and electrical products and systems – Power transformers, Rev3.6

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