



Environmental Product Declaration

In compliance with 14025 & EN 50693

Pinggao Tianling N2X-24 AC Metal-enclosed Switchgear- 1250A & 2500A



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General Information

EPD owner: Shanghai Pinggao Tianling Switchgear Co., Ltd.

Location of production site: No. 868, Jiaxing Road, Jiading District, Shanghai City, P.R. (China)

Company contact: Yuan Yuan <95886050@qq.com>

Name of the product: Pinggao Tianling N2X-24 Gas-insulated Metal-enclosed Switchgear-1250A & 2500A

Applied standards: ISO 14040/44 – Life cycle assessment

ISO 14025 - Environmental labels and declarations - Type III environmental declarations - Principles and procedures

Reference EPD system: Regulation of the EPDItaly Programme – rev.6

Program Operator & Publisher: EPDItaly Via G. De Castilia, 10 20124 Milan, Italy www.epditaly.com

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Independent verifier: This declaration has been developed referring to EPDItaly, following the General Program Instruction; further information and the document itself are available at: www.epditaly.it. Independent verification of the declaration and data, according to EN ISO 14025:2010.

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Comparability: EPDs relating to the same category of products but belonging to different programs may not be comparable. 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. Example of variations: Different LCA software and background LCI datasets may lead to different results for upstream or downstream of the life cycle stages declared.

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Contents

Contents	3
1 Introduction	4
1.1 Company Information	4
1.2 Product information	4
2 Specification of methodology	8
3 Environmental performance	10
4 References	164

1 Introduction

1.1 Company Information

Shanghai Pinggao Tianling Switchgear Co., Ltd. (hereinafter referred to as Tianling), founded in 1987, is a high-tech enterprise specializing in the production of power transmission and distribution equipment approved by the former Ministry of Machinery and the Ministry of Electric Power. The company has a registered capital of 212 million yuan and specializes in the production of high-voltage switchgear, low-voltage switchgear, high-voltage electrical components, outdoor high-voltage products, etc. The company has two holding joint ventures, Seagate Ace (Shanghai) Electric Co., Ltd. and Shanghai Lei Zeling Electric Co., Ltd. There are nearly 500 employees, of which more than 60% are professional and technical personnel. After joining Pinggao Group Co., Ltd., State Grid, in 2014, Tianling has been ranked among the top 500 industrial sales companies in Shanghai, the top 500 Chinese machinery industry companies, and the top 20 Chinese switch control equipment companies for four consecutive years. The registered trademark "Tianling" was rated as a famous trademark in Shanghai. The company's products have been continuously rated as Shanghai famous brand products since 1998.

Relying on the professional switch R&D, manufacturing and testing platform of State Grid Pinggao Group Co., Ltd., Tianling expands information system integration services, intelligent control system integration, computer system services, and software development, mechanical equipment sales, electrical equipment sales, intelligent robot production, communication equipment sales, road motor vehicle sales, firefighting equipment sales, etc. in the field of distribution network on the basis of traditional switch manufacturing, striving to build a diversified first-class medium and low-voltage power distribution comprehensive solution provider integrating switch manufacturing, operation and maintenance, system integration, etc.

Product-related or management system-related certifications:

- ISO9001: 2015
- ISO14001: 2015
- ISO45001: 2018

1.2 Product information

Product name:

Pinggao Tianling N2X-24 Gas-insulated Metal-enclosed Switchgear-1250A & 2500A

Product description:

N2X-24 SF6 gas-insulated metal-enclosed switchgear applies to the 24kV transmission and distribution system. Micro-positive pressurized SF6 is used as insulating gas, and the maximum transmission current of the switchgear can reach 2500A. It is suitable for the transmission and distribution grid, rail transit, commercial buildings, mines, underground substations and the primary and secondary power distribution systems in high-altitude, hot and humid occasions. It is a medium pressure gas-insulated switchgear developed based on low-pressure gas insulation, epoxy solid seal insulation, plug-in interface insulation, stainless steel laser welding, helium leak detection and other technologies and processes, and is characterized by high-level safety, high operation continuity, small size, low sensitivity to environmental impact, maintenance-free, etc.

The basic features of a N2X gas insulated switchgear are as follows:

Rated voltage: 24kV;

- N2X box type, single bus system;
- Low circuit resistance, low energy consumption, and low operation cost;
- The gas in the high pressure chamber (gas seal) is only used as the insulating medium, and the breaking is realized by the vacuum arc extinguishing chamber;
- Factory assembled, gas treatment is not allowed during field installation and use;
- Microprocessor-based control and protection;
- Indoor installation;
- Easy to install, maintain, expand and replace on site.

■ Applicable to neutral point direct grounding systems, ungrounded systems, impedance grounding systems, arc suppression coil grounding systems.

■ Service continuity

N2X-24 Switchgear products are manufactured, assembled and finished in Shanghai plant (No. 868, Jiaxing Road, Jiading District, Shanghai City, P.R. (China)). This report covers two current levels of N2X-24 Switchgear products, 1250A and 2500A. These two products are of the same appearance and function, the main differences between the two products are the size and the raw material use accordingly, as well as the operation power in use stage.

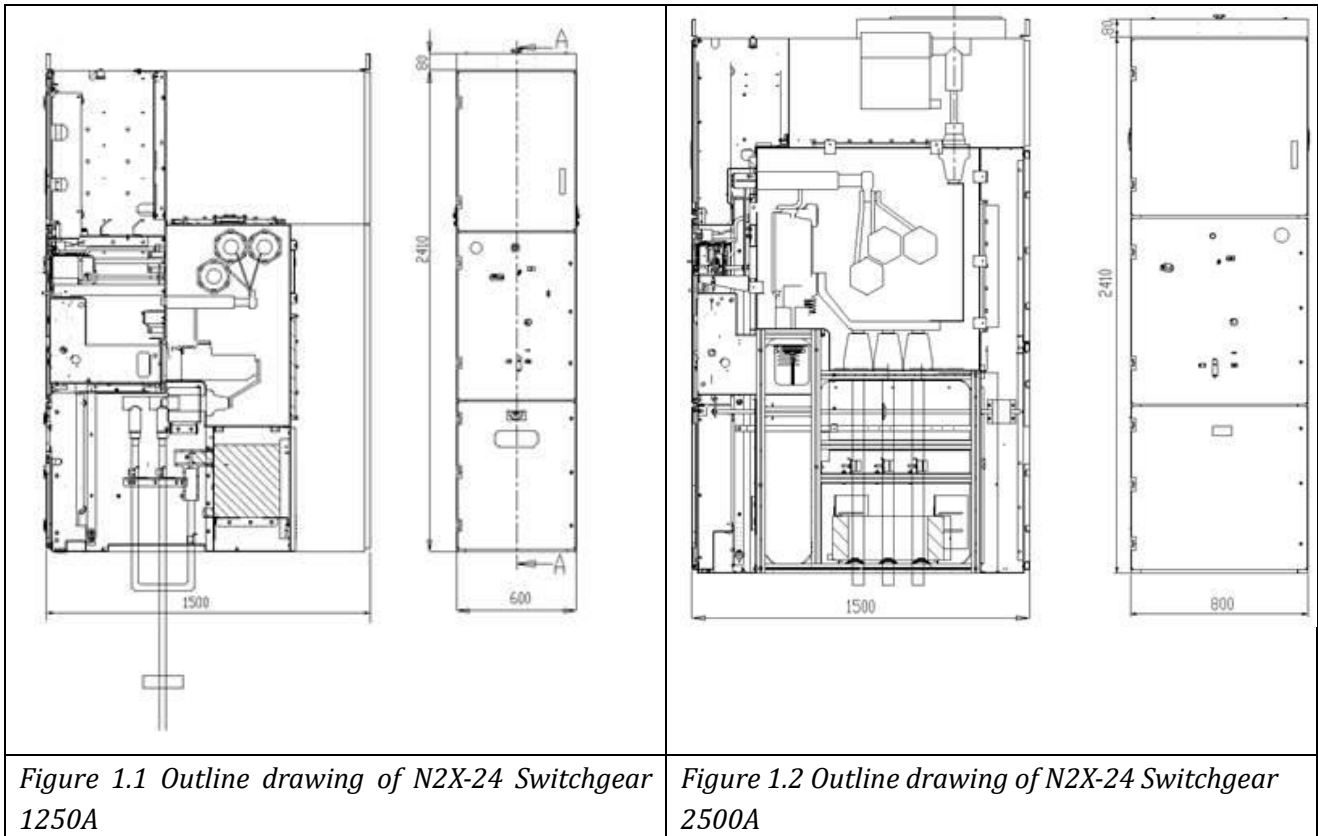


Table 1.1 shows the technical information about the N2X-24 Switchgear products (1250A/2500A) and Table 1.2 presents the major components and the weight of the N2X-24 Switchgear products (1250A/2500A). The raw material composition for one N2X-24 Switchgear product (1250A/2500A) is presented in Table 1..

Table 1.1 The technical information of the N2X-24 Switchgear products (1250A/2500A).

Parameter	Unit	1250A	2500A
Rated voltage	kV	24	24
Rated current	A	630	1600
Operation resistance	$\mu\Omega$	0.00152	0.0008
Class of insulation	/	SF6	SF6
Annual leakage of SF6 gas	%	$\leq 0.05\%$	$\leq 0.05\%$

Table 1.2 Major components and the weight of the N2X-24 Switchgear products (1250A/2500A)

Components	Weight (kg)	
	N2X-24 Switchgear 1250A	N2X-24 Switchgear 2500A
Gas tank	328.3682	648.8853
Three position	26.8528	34.3322
Circuit breaker	130.227	195.1878
Framework	247.6659	322.1729
Transformer	269.052	320.355
Total	1002.167	1520.933

Table 1.3 Raw material composition for one N2X-24 Switchgear product (1250A/2500A).

Input materials	Unit	N2X-24 Switchgear 1250A		N2X-24 Switchgear 2500A	
		Mass in product (kg)	Percent (%)	Mass in product (kg)	Percent (%)
Steel	kg	490.30	48.92%	690.67	68.92%
Aluminium	kg	42.99	4.29%	222.74	22.23%
Copper	kg	171.43	17.11%	350.87	35.01%
Silver	kg	0.0088	0.00%	0.091	0.01%
Plastics	kg	295.88	29.52%	253.18	16.65%
SF6 ⁽¹⁾	kg	1.55	0.15%	3.39	0.22%
Total	kg	1002.167	100.0%	1520.933	100%

(1) The SF6 presented here is to be inserted into the gas tank when the N2X-24 Switchgear product (1250A/2500A) is finished in Tianling's plant.

2 Specification of methodology

Functional Unit:

According to the PCR and EN50693, functional unit should be used in case that the function can be quantified. It can be described as :

A single N2X-24 Switchgear product (1250A/2500A) , which is an assembly of electric and electronic devices to delivering control, distribution, and safety functions during a reference service life of 20 years.

Product system description:

This study is a cradle-to-grave LCA analysis, assessing the potential environmental impacts associated with the studied product. An overview of the life cycle stages included in the LCA study are presented in Figure 2.2.

Geographical scope:

The study reflects production of Tianling product in China. The country grid average “CN: Electricity grid mix (China electric power yearbook)” of electricity applied for the manufacturing and assembling activities. The installation and operation site is in Spain according to Tianling. Spain medium voltage grid mix “ES: electricity, medium voltage, residual mixecoinvent 3.9.1” was applied to the product use stage.

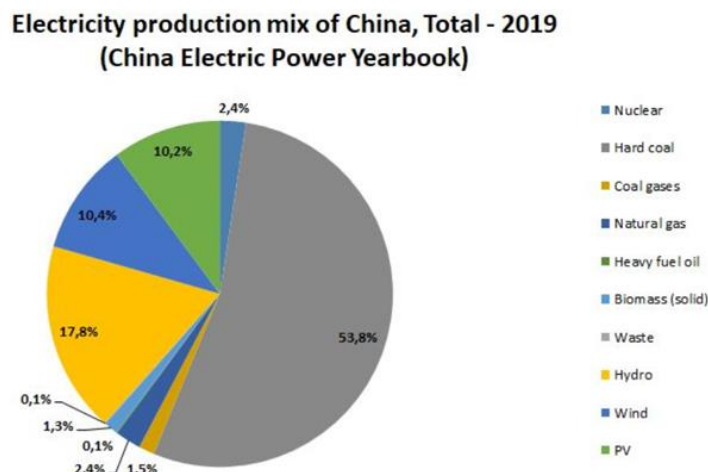


Figure 2.1 Mix of energy sources for electricity production in China

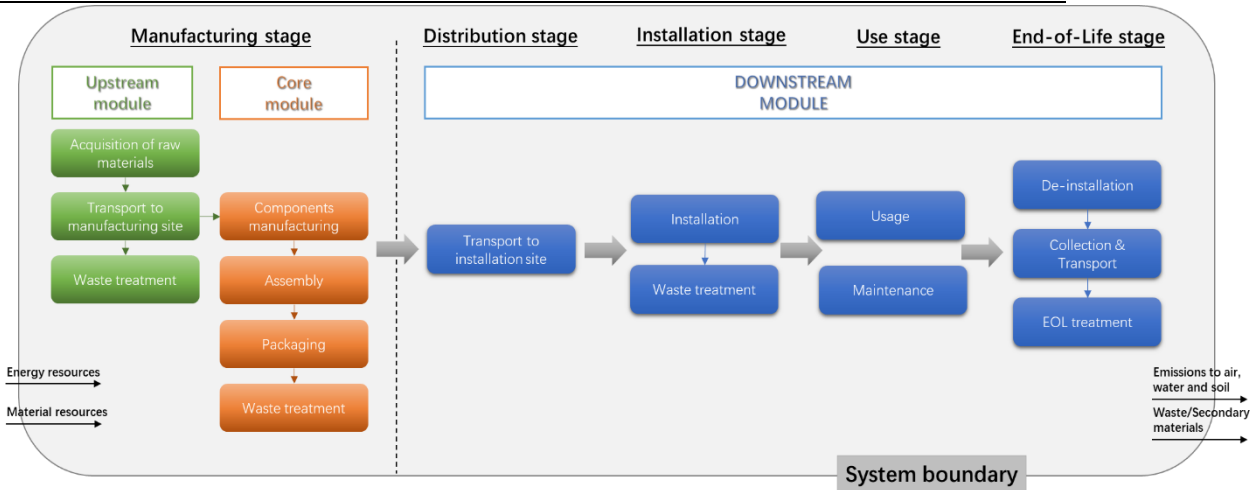


Figure 2.2 The flow chart of the product and product system used for the LCA assessment.

Time representativeness:

The reference year for this study is 2022. Manufacturing data were collected based on the most representative year for annual output of product.

Database(s) and LCA software used:

The LCA-systems are modeled in the Gabi LCA software, Gabi 10.7; Gabi data base and professional Ecoinvent database 3.9.1 have been used in modelling.

Cut-off rules:

The cut-off criteria established by the EPDItaly is no more than 2% of materials and energy flows within the system controlled by the EPD holder. This study strictly follows the cut-off rule, no raw materials was cut off.

Assumptions made:

According to Tianling, the actual current of N2X-24 Switchgear products (1250A/2500A) in use stage is between 15% to 50% of the rated current. The products work at 50% of the rated current for around 8 hours/day and work at 15% of the rated current for the rest of the hours according to Tianling technical expert, so an average 30% of the rated current was used in this EPD.

3 Environmental performance

In the result tables below, it is possible to see the environmental performance of all categories.

Each impact category results of N2X-24 Switchgear 1250A and N2X-24 Switchgear 2500A are presented respectively in below tables. **Errore. L'origine riferimento non è stata trovata.** The results are categorized into Manufacturing stage, Distribution stage, Installation stage, Use & Maintenance stage, and End-of-life stage. The column named “Total” is the sum of the 5 stage results.

The result is calculated by GaBi mainly, however, materials for recycling (MFR) is calculated manually since GaBi cannot calculate the result in the software. The biogenic-CO₂ up-taken and stored in wooden and paper packaging is balanced at Installation stage since wooden and paper package is wasted and incinerated at Installation stage.

The use of renewable/non-renewable primary energy resources used as raw materials is calculated through multiplying the low heating value (LHV) and the mass of the material. The indicator “use of renewable/non-renewable primary energy excluding renewable/non-renewable primary energy resources used as energy carrier” is calculated as the difference between the total input of primary energy and the input of energy resources used as raw materials.

Results for N2X-24 Switchgear 1250A per functional unit

Environmental impact descriptive parameters

Impact category	Unit	Manufacturing stage	Distribution stage	Installation stage	Use & Maintenance stage	End-of-life stage	Total
Climate Change - total	kg CO2 eq	4.48E+03	3.32E+02	1.76E+02	7.59E+02	1.10E+03	6.85E+03
Climate Change - fossil	kg CO2 eq	4.53E+03	3.32E+02	3.87E+01	7.59E+02	1.10E+03	6.77E+03
Climate Change - biogenic	kg CO2 eq	-6.42E+01	4.75E-01	1.37E+02	2.26E-01	1.70E+00	7.55E+01
Climate Change - land use and land use change	kg CO2 eq	6.18E+00	1.70E-01	3.47E-03	4.85E-02	1.97E-01	6.60E+00
Ozone depletion	kg CFC-11 eq	9.59E-05	2.13E-11	5.27E-12	1.02E-05	9.30E-07	1.07E-04
Acidification	mole H+ eq	3.00E+01	1.11E+01	2.84E-01	1.08E+00	9.06E-01	4.34E+01
Eutrophication aquatic freshwater	kg P eq	6.14E-01	1.30E-04	2.36E-05	4.93E-02	3.67E-02	7.00E-01
Eutrophication aquatic marine	kg N eq	4.29E+00	2.63E+00	1.37E-01	2.51E-01	3.85E-01	7.70E+00
Eutrophication terrestrial	mole N eq	4.07E+01	2.89E+01	1.53E+00	2.51E+00	3.78E+00	7.74E+01
Photochemical ozone formation	kg NMVOC eq	1.33E+01	7.44E+00	2.67E-01	1.03E+00	8.38E-01	2.29E+01
Consumption of abiotic resources - minerals and materials	kg Sb eq	6.10E-01	4.38E-06	3.08E-07	6.09E-04	5.10E-04	6.11E-01
Consumption of abiotic resources - fossil resources	MJ	5.92E+04	4.07E+03	5.52E+02	1.04E+04	1.49E+03	7.58E+04
Water consumption	m3	1.87E+03	6.93E-01	7.71E+00	9.25E+01	3.12E+01	2.00E+03

Resource consumption descriptive parameters

Parameters	Unit	Manufacturing stage	Distribution stage	Installation stage	Use & Maintenance stage	End-of-life stage	Total
Use of renewable primary energy excluding renewable primary energy resources used as raw material (PERE)	MJ	9.09E+03	3.15E+01	5.48E+00	2.25E+02	-1.77E+02	9.18E+03
Use of renewable primary energy resource used as raw material (PERM)	MJ	5.61E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.61E+02
Total use of renewable primary energy resources (PERT)	MJ	9.09E+03	3.15E+01	5.48E+00	2.25E+02	-1.77E+02	9.18E+03
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw material (PENRE)	MJ	5.93E+04	4.08E+03	5.53E+02	1.04E+04	1.49E+03	7.58E+04
Use of non-renewable primary energy resource used as raw material (PENRM)	MJ	2.94E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.94E+03
Total use of non-renewable primary energy resources (PENRT)	MJ	5.93E+04	4.08E+03	5.53E+02	1.04E+04	1.49E+03	7.58E+04
Use of secondary raw material (MS)	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use of renewable secondary fuels (RSF)	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use of non renewable secondary fuels (NRSF)	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Net use of fresh water (FW)	m3	4.81E+01	3.90E-02	1.80E-01	2.15E+00	1.02E+00	5.15E+01

Waste production descriptive parameters

Impact category	Unit	Manufacturing stage	Distribution stage	Installation stage	Use & Maintenance stage	End-of-life stage	Total
Hazardous landfill waste (HWD)	kg	3.61E-02	2.55E-08	7.39E-10	0.00E+00	9.52E-08	3.61E-02
Non-hazardous waste disposed (NHWD)	kg	3.31E+02	3.88E-01	2.29E+00	0.00E+00	3.59E+02	6.93E+02
Radioactive waste disposed (RWD)	kg	3.27E-01	4.81E-03	6.71E-04	0.00E+00	-6.88E-02	2.64E-01
Components for reuse (CRU)	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for recycling (MFR)	kg	7.38E+00	0.00E+00	0.00E+00	0.00E+00	5.25E+02	5.33E+02
Material for energy recovery (MER)	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported electrical energy (EEE)	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported thermal energy (ETE)	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Results for N2X-24 Switchgear 2500A per functional unit

Environmental impact descriptive parameters

Impact category	Unit	Manufacturing stage	Distribution stage	Installation stage	Use & Maintenance stage	End-of-life stage	Total
Climate Change - total	kg CO2 eq	9.84E+03	4.97E+02	1.76E+02	2.12E+03	1.60E+03	1.42E+04
Climate Change - fossil	kg CO2 eq	9.89E+03	4.96E+02	3.87E+01	2.12E+03	1.60E+03	1.41E+04
Climate Change - biogenic	kg CO2 eq	-6.33E+01	7.11E-01	1.37E+02	7.79E-01	1.75E+00	7.72E+01
Climate Change - land use and land use change	kg CO2 eq	1.05E+01	2.54E-01	3.47E-03	1.67E-01	2.90E-01	1.12E+01
Ozone depletion	kg CFC-11 eq	1.06E-04	3.19E-11	5.27E-12	3.49E-05	1.41E-06	1.43E-04
Acidification	mole H+ eq	6.86E+01	1.65E+01	2.84E-01	3.71E+00	1.23E+00	9.04E+01
Eutrophication aquatic freshwater	kg P eq	9.95E-01	1.95E-04	2.36E-05	1.70E-01	5.35E-02	1.22E+00
Eutrophication aquatic marine	kg N eq	8.75E+00	3.94E+00	1.37E-01	8.64E-01	5.17E-01	1.42E+01
Eutrophication terrestrial	mole N eq	8.84E+01	4.32E+01	1.53E+00	8.64E+00	4.97E+00	1.47E+02
Photochemical ozone formation	kg NMVOC eq	2.76E+01	1.11E+01	2.67E-01	3.54E+00	1.14E+00	4.37E+01
Consumption of abiotic resources - minerals and materials	kg Sb eq	1.23E+00	6.56E-06	3.08E-07	2.10E-03	7.77E-04	1.23E+00
Consumption of abiotic resources - fossil resources	MJ	1.11E+05	6.09E+03	5.52E+02	3.58E+04	2.26E+03	1.56E+05
Water consumption	m3	3.28E+03	1.04E+00	7.71E+00	3.18E+02	7.12E+01	3.68E+03

Resource consumption descriptive parameters

Parameters	Unit	Manufacturing stage	Distribution stage	Installation stage	Use & Maintenance stage	End-of-life stage	Total
Use of renewable primary energy excluding renewable primary energy resources used as raw material (PERE)	MJ	1.46E+04	4.72E+01	5.48E+00	7.74E+02	-1.20E+01	1.54E+04
Use of renewable primary energy resource used as raw material (PERM)	MJ	5.61E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.61E+02
Total use of renewable primary energy resources (PERT)	MJ	1.46E+04	4.72E+01	5.48E+00	7.74E+02	-1.20E+01	1.54E+04
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw material (PENRE)	MJ	1.11E+05	6.11E+03	5.53E+02	3.58E+04	2.26E+03	1.56E+05
Use of non-renewable primary energy resource used as raw material (PENRM)	MJ	2.70E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.70E+03
Total use of non-renewable primary energy resources (PENRT)	MJ	1.11E+05	6.11E+03	5.53E+02	3.58E+04	2.26E+03	1.56E+05
Use of secondary raw material (MS)	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use of renewable secondary fuels (RSF)	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use of non renewable secondary fuels (NRSF)	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Net use of fresh water (FW)	m3	8.19E+01	5.83E-02	1.80E-01	7.41E+00	1.90E+00	9.14E+01

Waste production descriptive parameters

Impact category	Unit	Manufacturing stage	Distribution stage	Installation stage	Use & Maintenance stage	End-of-life stage	Total
Hazardous landfill waste (HWD)	kg	5.05E-02	3.81E-08	7.39E-10	0.00E+00	7.14E-08	5.05E-02
Non-hazardous waste disposed (NHWD)	kg	1.20E+03	5.81E-01	2.29E+00	0.00E+00	3.74E+02	1.58E+03
Radioactive waste disposed (RWD)	kg	5.12E-01	7.19E-03	6.71E-04	0.00E+00	-4.30E-02	4.77E-01
Components for reuse (CRU)	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for recycling (MFR)	kg	1.21E+01	0.00E+00	0.00E+00	0.00E+00	9.19E+02	9.31E+02
Material for energy recovery (MER)	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported electrical energy (EEE)	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported thermal energy (ETE)	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Interpretation

The above data shows the contribution to each impact category of the various life cycle stages and activities occurred during life cycle stages of N2X-24 Switchgear 1250A and N2X-24 Switchgear 2500A respectively per functional unit.

The “Manufacturing stage” has the greatest contribution to the climate change categories (total and fossil), which is responsible for about 63% and 65% of the total CO₂ and other greenhouse gas emissions in terms of global warming potential for N2X-24 Switchgear 1250A and N2X-24 Switchgear 2500A respectively. For the other impact categories, “Manufacturing stage” is also the dominant impact source which varies around 60% to 100% for both products. In general, “Manufacturing stage” is the main factor to the N2X-24 Switchgear products (1250A/2500A) life cycle environmental impacts.

Impact from “Distribution stage” is visible in Photochemical Ozone formation and Acidification, which represent emissions caused by long distance shipping (16400 km) by container ship from China to Europe by burning fossil fuels.

Impact from “Use & Maintenance stage” is visible in several indicators such as GWP, Ozone Depletion, eutrophication of water, etc., which is resulted from electricity consumption and SF₆ leakage.



4 References

- *PCR EPDItaly007, issued at 2023-01-13, for Electronic and electrical products and systems [Revision 3, valid until 2025-01-19],*
- *PCR EPDItaly015, issued at 2022-02-23, for Electronic and electrical products and systems - Switchboards [Revision.1.5, valid until 2025-09-24];*
- *The EPDItaly system, <https://www.epditaly.it>*
- *Reference EPD system: Regulation of the EPDItaly Programme – rev.6*
- *Gabi database. GaBi LCA Databases 2023 Edition.*
- *Gabi LCA software. The Gabi LCA software and corresponding database are provided by Sphera in Leinfelden-Echterdingen, Germany. Gabi version 10.7 was used.*
- *LCA database published by the ecoinvent association originally known as the ecoinvent Centre, the Swiss Centre for Life Cycle Inventories. Since June 2013 ecoinvent is a not-for-profit association founded by institutes of the ETH Domain and the Swiss Federal Offices. The version 3.9.1 was used.*
- *Sphera. The provider of the Gabi LCA software and database.*
- *ISO (2006a). ISO 14025:2006, Environmental labels and declarations – Type III environmental*

declarations – Principles and procedures.

- *ISO (2006b). ISO 14040:2006, Environmental management – Life cycle assessment – Principles and framework.*
- *ISO (2006c). ISO 14044: 2006, Environmental management – Life cycle assessment – Requirements and guidelines.*
- *EN 50693:2019, Product category rules for life cycle assessments of electronic and electrical products and systems.*
- *Tianling technical documents.*
- *LCA report Pinggao Tianling N2X-24 AC Metal-enclosed Switchgear-1250A & 2500A as the basis for the publication of EPD within the EPDItaly system commissioned by Shanghai Pinggao Tianling Switchgear Co., Ltd – Jan-Apr 2024*



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