Jiangsu Rugao High Voltage Electric Apparatus Co., Ltd.

ENVIRONMENTAL PRODUCT DECLARATION

ZHW58A-72.5 Hybrid Gas-Insulated Switchgear

No.1,West Huimin Road,Economic Development Distric,Rugao,Jiangsu Province, P.R.China.

In accordance with ISO 14025:2006 and EN 50693:2019

Program Operator	EPDItaly
Publisher	EPDItaly

Declaration Number	*Rugao -HGIS(T)-001*
Registration Number	EPDITALY0775

Issue date	13 / 12 / 2024
Valid to	13 / 12 /2029

GENERAL INFORMATION

EPD OWNER

Name of the company	Jiangsu Rugao High Voltage Electric Apparatus Co., Ltd.
Registered office	No.1,West Huimin Road,Economic Development Distric,Rugao,Jiangsu Province, P.R.China.
Contacts for information on the EPD	wgm.01279@Rugao.com

PROGRAM OPERATOR

EPDItaly	Via Gaetano De Castillia n° 10 - 20124 Milano, Italy

INFORMATION ON THE EPD

Product name (s)	ZHW58A-72.5 Hybrid Gas-Insulated Switchgear
Site (s)	No.1,West Huimin Road,Economic Development Distric,Rugao,Jiangsu Province, P.R.China.
Short description and technical information of the product (s)	ZHW58A-72.5 Hybrid Gas-Insulated Switchgear
Field of application of the product (s)	ZHW58A-72.5 Hybrid Gas-Insulated Switchgear including circuit breakers, disconnectors, earthing switches, bushings, operating mechanism and all other components as in service. It is of three-phase binning structure and designed for outdoor application, each of which is equipped with a spring operating mechanism that can realize a three-phase mechanical linkage. It applies SF6 gas as insulation and arc extinguishing media and is applied with pointer-type density relay for monitoring its pressure and density.
Product (s) reference standards (if any)	EN 50693:2019 – Product category rules for life cycle assessment of electronic and electrical products and systems
Type of EPD	Product-specific EPD
CPC Code (number) https://unstats.un.org/unsd/classifications/Econ	46211 – "Electrical apparatus for switching or protecting electrical circuits, or for making connections to or in electrical circuits, for a voltage exceeding 1000 V"

VERIFICATION INFORMATION

PCR (title, version, date of publication or update)	EPDItaly007 – PCR for Electronic and electrical products and systems, Rev. 3, 2023/01/13 EPDItaly012 – Electronic and electrical products and systems – Switchs, Rev. 0, 2020/03/16
EPDItaly Regulation (version, date of publication or update)	Regulations of the EPDItaly Programm Rev.6.0, 2024/01/30
Project Report LCA	JIANGSU RUGAO ZHW58A-72.5 Hybrid Gas-Insulated Switchgear LCA Report
Independent Verification Statement	Independent verification of the declaration and data, carried out according to ISO 14025: 2010. Internal ☑ External Third party verification carried out by: ICMQ S.p.A., via Gaetano De Castillia n ° 10 - 20124 Milan, Italy. Accredited by Accredia.
Comparability Statement	Environmental statements published within the same product category, but from different programs, may not be comparable. In particular, EPDs of construction products may not be comparable if they do not comply with EN 15804: 2012 + A2: 2019.
Liability Statement	The EPD Owner releases EPDItaly from any non-compliance with environmental legislation. The holder of the declaration will be responsible for the information and supporting evidence. EPDItaly disclaims any responsibility for the information, data and results provided by the EPD Owner for life cycle assessment.

Contents

1. Company information

Jiangsu Rugao High Voltage Electric Apparatus Co., Ltd. is a well-known enterprise specialized in R&D and production of powertransmission and transformation equipment The company was established in 1967 and has more than 50 years of R&D and productionexperience. Mainly produce high voltage AC disconnectors (800kV and below)， circuit breakers (252kV and below) and HGIS（T）(145kV and below) .Rugao company is the drafting unit of 16 national standards andindustry standards such as GB/T11022. All products have completed afull set of type tests by third-party authoritative verification agencies athome and abroad (including XiAN High Voltage Apparatus ResearchInstitute,CESI,KEMA, etc). The product technology has reached the international advanced level, and it has won the provincial and ministerial quality product awards and the scientific and technological progress award for many times. 48 products have successfully passed the national or provincial new product appraisal. It has 120 national independent intellectual property patents, including more than 40 invention patents.The company fully implements an ERP management system and quality management throughout its life cycle, and implements a delivery project anager system to maximize customer needs.

Figure 1.1 – Jiangsu Rugao High Voltage Electric Apparatus Co., Ltd.

The company has also obtained ISO9001, ISO14001 and ISO45001 management system certifications.

2. Product Information

ZHW58A-72.5 Hybrid Gas-Insulated Switchgear including circuit breakers, disconnectors, earthing switches, bushings, operating mechanism and all other components as in service. It is of three-phase binning structure and designed for outdoor application, each of which is equipped with a spring operating mechanism that can realize a three-phase mechanical linkage. It applies SF6 gas as insulation and arc extinguishing media and is applied with pointer-type density relay for monitoring its pressure and density.

Specifications:

- Rated Voltage: 72.5kV

- Rated Frequency: 50/60Hz

- Rated Current: 2500A

- Rated Short-time Withstand Current: 40kA.

Figure 2.1 - Hybrid Gas-Insulated Switchgear ZHW58A-72.5

The product manufacturing process is as follows:

Step 1: Main Assembly

This process focuses on assembling the arc extinguishing unit, isolation switch, and grounding switch within the product.

Step 2: Actuator Mechanism Assembly

This process involves assembling the circuit breaker mechanism, as well as the mechanisms for the isolation switch and grounding switch.

Step 3: Integration of Actuator Mechanism with Main Assembly

This process involves assembling the main body with the support frame, connecting the support frame with the mechanism, and connecting the mechanism with the main body's bending arm.

Step 4: SF6 Gas Filling

This process involves injecting SF6 gas into the product's interior to reach the specified pressure.

Step 5: Testing

This process focuses on testing the product's mechanical characteristics and confirming whether its insulation performance meets design requirements.

Step 6: Inspection

This process involves conducting a visual inspection of the product before packaging, in accordance with specified requirements.

Step 7: Packaging

The finished products are packaged in specified quantities for transportation and sale

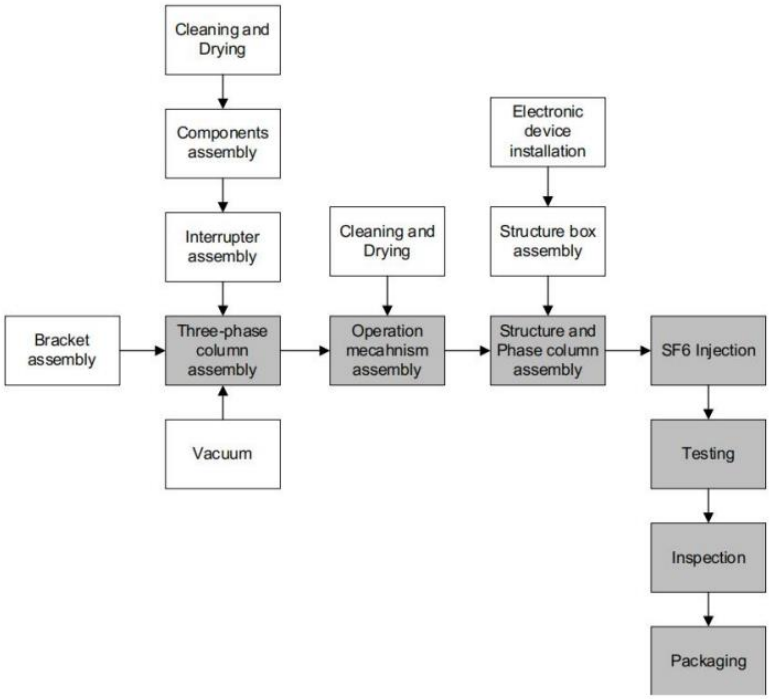

Figure 2.2 - Hybrid Gas-Insulated Switchgear ZHW58A-72.5

Table 2.1 Material composition of the products (in accordance with EN IEC 62474)

Product Identification Code	Hybrid Gas-Insulated Switchgear ZHW58A-72.5		
Country of installation	Global		
Total product mass, without packaging	5187		
Material content	**ID**	**kg**	**%**
Stainless steel	M-100	509.87	9.83%
Other ferrous alloys, non-	M-119	2046.46	39.45%

stainless steels			
Aluminium and its alloys	M-120	1706.88	32.91%
Copper and its alloys	M-121	100.09	1.93%
Acrylonitrile-Butadiene-Styrene (ABS)	M-206	0.32	0.01%
Thermoplastic Elastomeres (TPE)	M-327	100.26	1.93%
Other unfilled thermoplastics	M-249	184.84	3.56%
Glass	M-161	1.16	0.02%
Other material（cable，BVR，etc）		537.06	10.35%

Note: No substance in the product greater than 0.10% by weight is present on the "List of Potentially Hazardous Substances" candidates for authorization under the REACH legislation

Table 2.2 Material composition of the packaging (in accordance with EN IEC 62474)

Product Identification Code	Hybrid Gas-Insulated Switchgear ZHW58A-72.5		
Country of installation	Global		
Total packaging mass	952		
Material content	**ID**	**kg**	**%**
Wood	M-340	830.28	97.43%
Other ferrous alloys, non-stainless steels	M-119	21.93	2.57%

3. Life Cycle Assessment Information

A Life Cycle Assessment (LCA) is a methodology for assessing the environmental impacts associated with the entire life cycle of a particular product or process. LCA consists of 4 stages (Goal and Scope, Inventory Analysis, Impact Assessment, and review/presentation) which must follow similar procedures to a PCR (Product Category Rules) and helps to evaluate the carbon footprint and natural resources of a product or process. In this EPD, LCA is conduted speately to obtain environmental impact information.

3.1. Declared unit

According to PCR EPDItaly012, a single switch is adopted as the declared unit which establishes or interrupts the electrical continuity of the circuit to which it is applied, during a service life of 20 years.
The declared unit is therefore defined as a single unit of ZHW58A-72.5 Hybrid Gas-Insulated Switchgear operating for 20 years. Reference flow is one single unit of ZHW58A-72.5 Hybrid Gas-Insulated Switchgear..

3.2. System, temporal, and geographical boundaries

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:

<table>
<tr><td colspan="2">MANUFACTURING STAGE</td><td>DISTRIBUTION STAGE</td><td>INSTALLATION STAGE</td><td>USE & Maintenance STAGE</td><td>END-OF-LIFE STAGE

De-installation</td></tr>
<tr><td>UPSTREAM MODULE</td><td>CORE MODULE</td><td colspan="4">DOWNSTREAM MODULE</td></tr>
<tr><td>extraction of raw materials, including waste recycling processes and the production of semi-finished, packaging and ancillary products</td><td>manufacturing of the product constituents, including all the stages</td><td colspan="4" rowspan="4">IN ACCORDANCE WITH EN 50693</td></tr>
<tr><td>transportation of raw materials to the manufacturing company</td><td>product assembly</td></tr>
<tr><td></td><td>packaging</td></tr>
<tr><td></td><td>waste handling processes</td></tr>
</table>

Figure 3.1: System boundary

Manufacturing phase. This stage includes the upstream and core modules described above (transformation of raw materials, transport of raw materials and semi-finished products, production of finished product packaging, generation of process waste including its transport to disposal sites, energy and material consumption associated with plant operations);
Distribution stage. This module includes the impacts related to the distribution of the product at the installation site;

Installation stage. This module includes the end of life of the packaging, the on-site injection of SF6, the energy consumption associated with installation and set-up, scrap and waste generated during the installation phase;
Use and maintenance phase. This module includes the energy consumed by the product to operate throughout its reference life, ordinary scheduled maintenance and extraordinary scheduled maintenance.
In this module, the energy consumed during the product life cycle is calculated using the formula below.

$$E_{use}[\mathrm{kWh}] = \frac{P_{use} * 8760 * RSL * \alpha}{1000}$$

where: (P_{use} is the power consumed by the switch at a given value of current;RSL is the service life of the product, assumed to be 20 years; 8760 is the number of hours in a year; α is a coefficient describing the amount of time in which the switch is requested to operate its function, according to PCR, 30% is selected for high voltage equipment; 1000 is the conversion factor that allows the energy consumed in kWh over the product's service life to be expressed. (P_{use} can be calculated by the following formula. The referenced current specified in PCR is 50% of the nominal current, while according to Jiangsu Rugao, the real testing current normally is only 10% of the nominal current.Thus, in this study the reference current Ir is calculated as 10% of the nominal current In. The P_{use} of hybrid gas-insulated switchgear is calculated and listed in table 4.5.1.

$$P_{use} = I_r^2 \times R \times 3$$

Table 3.1 Power consumption of hybrid gas-insulated switchgear

Hybrid gas-insulated switchgear	Nominal current, I_n / A	Single phase resistance, $R/\mu\Omega$	P_{use} / W
ZHW58A-72.5	2500	148.25	27.79

For the maintenance of the electric products, the Jiangsu Rugao high-voltage electric equipments are designed to be free of maintenance during its service life. Meanwhile, the hybrid gas-insulated switchgear has reliable sealing performance, thus requires no additional recharge of SF6 during its service life. Therefore, no inputs and outputs are taken place in maintenance stage in this study.
End of Life Stage. This module includes the transportation of the product to the collection site, disassembly operations, distribution and destination of the various material flows to be sent for recycling or disposal. Treatment of SF6 is assumed to be treated before recycled in accordance with literature (Shiojiri et al. 2006).

Table 3.2 Waste treatment of SF6(per kg)

Process	Value
1. Recovery from the device	
Vacuum pump	0.006923077 kWh/kg
Leakage	3%
2. Purification process	
Heating	0.005268327 kWh/kg
Pressurizing	0.020445673 kWh/kg
Cycles	11
Off-gas	0.25%
3. Decomposition process	
Low-temperature plasma	0.766855385 kWh/kg
Evacuation	0.003697222 kWh/kg
Emission of SF6	1.3%

It should be noted that the construction, maintenance and decommissioning of infrastructure, i.e. buildings and machinery, and the occupation of industrial land have not been taken into

account as their contribution to the environmental impact of the reported unit is considered negligible.
The study used data from the BOMs of the specific products whose production started in 2023 (reference year). For factory consumption, the data were taken from the Rugao factory and related to the year 2023 (January - December), which is considered representative (at the time of the study, this is the last full calendar year for which the data are available).
The suppliers of raw materials and semi-finished products are located in China. Where possible, the specific origin of the raw material was investigated and characterised. For the downstream phases, a Ceara scenario was considered, knowing the exact location where the hybrid gas-insulated switchgear will be installed.

3.3. 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. The categories analyzed are therefore:

Table 3.3 Impact categories

Indicator name and abbrevation (EN)	Unit (EN)
Global Warming Potential – fossil fuels (GWP-fossil)	kg CO_2 eq.
Global Warming Potential – biogenic (GWP-biogenic)	kg CO_2 eq.
Global Warming Potential – land use and land use change (GWP-luluc)	kg CO_2 eq.
Global Warming Potential – total (GWP-total)	kg CO_2 eq.
Depletion potential of the stratospheric ozone layer (ODP)	kg CFC-11 eq.
Acidifcation potential, Accumulated Exceedance (AP)	mol H+ eq.
Eutrophication potential – freshwater (EP-freshwater)	kg P eq.
Eutrophication aquatic marine (EP-marine)	kg N eq.
Eutrophication terrestrial (EP-terrestrial)	mol N eq.
Photochemical Ozone Creation Potential (POCP)	kg NMVOC eq.
Abiotic depletion potential – non-fossil resources (ADPE)**	kg Sb eq.
Abiotic depletion potential – fossil resources (ADPF)**	MJ, net calorific value
Water (user) deprivation potential (WDP)**	m^3 eq.

*Please also noted that the EN 15804+A2 method is based on the EF 3.1 version for this study.

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

3.4. Cut-off

According to EPD Italy Regulations and PCR EPDItaly007, the following flows and operations are cut-offed:

- Production, use and disposal of the packaging of components and the packaging of semi-finished intermediates.
- Material and energy flows related to dismantling phase which is performed by adopting manual tools (e.g. screwdrivers, hammers, etc.).

In addition, waste during the manufacturing process is mainly broken manual equipment such as wrenches, and its way less than 1% of the product weight, and they are expected to have a negligible impact on the overall results of the Life Cycle Assessment (LCA) and are therefore cut off from the calculation according to the cut-off principle.

3.5. Allocation Principles

The use of energy and resources per functional unit in the manufacturing stage of the product is calculated by dividing the annual energy or resource consumption by the total output of the company's product, as the energy used for each unit of the product is approximately the same due to similar manufacturing process and time frame. Specifically, the allocation of energy resources for use in factory processing is calculated by dividing the units of hybrid gas-insulated switchgear produced by the total energy and resource consumption of the Jiangsu Rugao factory during the reference period. This allocation method is acceptable because only assembly is required in the manufacturing process and the mass of the product is not related to the energy used in manufacturing. This means that the physical allocation method is used for the allocation.

In addition, the default distribution rule for the environmental impacts and benefits of reuse, recovery and/or recycling is based on the polluter pays principle (PPP), which means that the recovery or reuse beneficiary bears the environmental impacts and benefits associated with the recovery or reuse treatment, and the original product manufacturer does not have to bear this part of the impact burden. It also does not participate in the sharing of benefits (environmental impact of the production of the same product avoided by recycling and reuse).

3.6. Limitation and Assumption

The results are only valid for the situation defined by the assumptions described in the present report, and they are subject to change if these manufacturing conditions change.The following assumptions are used in this assessment:

Table 3.4 – Assumptions for each stage of the life cycle

Life cycle module	Life cycle stage	Assumption
MANUFACTURING STAGE	Upstream Module	• Raw material information is provided by JIANGSU RUGAO according to product's bill of material. • The density of wood package is assumed to be 768kg/m3 as plywood is used.
	Core Module	• China consumption electricity mix 2023 was used in the core module, information of electricity mix was obtained from Statistical Statement of the People's Republic of China on National Economic and Social Development, 2023. • Assume same amount of energy and resource consumption were used to produce each unit of rated power of ZHW58A-72.5 Hybrid Gas-Insulated Switchgear in the manufacturing phase. • Assume same amount of waste were produced to produce each unit of ZHW58A-72.5 Hybrid Gas-Insulated Switchgear in the manufacturing phase.

		• The distance from the JIANGSU RUGAO plant to the downstream waste disposal site is assumed to be 1000km.
DISTRIBUTION STAGE	Downstream Module	• The product is to be used in Ceara. Downstream distribution distances are estimated from the GAODE map and SEARATE website for shipment distances, inland transport is by truck freight and sea transport is by ship. • The distance from port of Ceara to the client is assumed to be 1000km.
INSTALLATION STAGE		• Energy and resources needed during installation are provided by JIANGSU RUGAO, it is assumed the same amount were used to install each unit of ZHW58A-72.5 Hybrid Gas-Insulated Switchgear. • The distance from the user installation site to the downstream waste disposal site is also assumed to be 1000km • In this stage, package of the ZHW58A-72.5 Hybrid Gas-Insulated Switchgearwere disposed, of which 80% of steel and 0% of wood is assumed to be recycled in accordance with en50693 annex G table G.4, 20% of steel is assumed to be landfilled and 100% of waste wood package is assumed to be incinerated.
USE & Maintenance STAGE		• Energy used during the product service life is provided by JIANGSU RUGAO in accordance with PCR EPDItaly018, it is assumed the same amount of energy were used to install each unit of ZHW58A-72.5 Hybrid Gas-Insulated Switchgear. • According to expert judgement and from various users provided by JIANGSU RUGAO, inspection and maintenance do not require replacement parts during the service life, and ZHW58A-72.5 Hybrid Gas-Insulated Switchgear SF6 changes are not necessary or foreseen, therefore are not considered in the study.
END-OF-LIFE STAGE De-installation		• During the end-of-life disposal stage, the product is transported and then manually dismantled into components and then sorted for further processing. Some metals or plastics are recycled according to EN50693 standards, while the remaining materials are either landfilled or incinerated.

3.7. Data quality

Wherever possible, the whole calculation is primarily based on primary data, and secondary data is obtained from life cycle databases or literaturea.

Data quality represents the difference between the target representation of the LCA study and the actual data representation, and four dimensions of data have been used to assess data quality in this report. The consumption and emission inventory data in the model were assessed on four dimensions: Technological-Representativeness, Geographical-Representativeness, Time-Representativeness, and Precision/uncertainty. The use of the associated background database was also evaluated to assess the uncertainty by matching with the upstream background process.

4. Inventory analysis

This EPD uses primary data where available. Where access to this type of data was not possible, datasets from the Ecoinvent v3.9.1 database were used as a reference.
Data collection was carried out by creating a sheet to collect input and output data, in terms of mass, energy consumption within the production site. The data collection sheet was verified and checked through mass balances and reporting of any inconsistencies, which were clarified and resolved.
In the study, SimaPro 9.6.0.1 software was used to establish the model for the life cycle of products and calculate LCA results.
In upstream module, inventory for raw material and its transportation distance are collected.
In core module, inputs are the energy used during production in JIANGSU RUGAO while outputs are the waste generated. The product consumes electricity and water during the manufacturing phase, of which all were being supplied externally. All of JIANGSU RUGAO's electricity consumption comes from grid electricity and no additional green power or green certificates are purchased. According to the China Energy Yearbook, grid electricity is supplied from all major power plants in China, with a mix of fossil, natural gas, wind, solar, and nuclear energy sources. The energy and resources usage per functional unit in the production stage of the product is calculated by dividing the annual energy or resource consumption by the total output of the company’s product.
As for disctribution, the product is manufactured in China and to be used in Brazil, Ceara. Downstream distribution distances are estimated from the GAODE map and SEARATE website for shipment distances, inland transport is by truck freight and sea transport is by ship.
In installation stage, ZHW58A-72.5 Hybrid Gas-Insulated Switch gear is hoisted with a 5T crane with an engine power of 85kW, and the service time is 7.2h. At this stage, as the installation was completed, the product packaging and steel was discarded, of which 80% of steel and 0% of wood is assumed to be recycled in accordance with en50693 annex G table G.4, 20% of steel is assumed to be landfilled as inert material and 100% of waste wood package is assumed to be incinerated.
During the use phase, energy used during the product service life is 1461kWh.
For the maintenance of the electric products, the Jiangsu Rugao high-voltage electric equipments are designed to be free of maintenance during its service life, motor is served as back up and only used in the repairing phase, so electricity consumption related is not considered in this module. Meanwhile, the hybrid gas-insulated switchgear has reliable sealing performance, thus requires no additional recharge of SF6 during its service life. Therefore, no inputs and outputs are taken place in maintenance stage in this study.
According to EN50693, the inputs and outputs associated with all relevant steps from deinstallation to the disposal or the point of substitution, shall be included in the end-of-life stage. In this study, it is assumed that same as installation, a 5T crane with an engine power of 85kW is used, and the service time is 7.2h, and 51kg diesel is needed during deinstallation. After disassembling, it is assumed that the disposal components will be transported to corresponding waste management factory, the distance is assumed to be 1000km by truck. The weight of the waste ZHW58A-72.5 Hybrid Gas-Insulated Switchgear is approximately 5.34ton. During the end-of-life disposal stage, the product is manually dismantled into components and then sorted for further processing. Some metals or plastics are recycled according to EN50693 standards, while the remaining materials are either landfilled or incinerated.

5. Environmental Impact Assessment

Potential Environmental impact of each lifecycle stage are shown below.

Table 5.1 – Environmental impact descriptive parameters

Impact Category	**Unit**	**Total**	**Manufacturing Stage**	**Distribution Stage**	**Installation Stage**	**Use & Maintenance Stage**	**End of Life Stage**
Climate change	kg CO2 eq	6.18E+04	3.38E+04	2.69E+03	1.56E+04	3.18E+02	9.42E+03
Climate change - Fossil	kg CO2 eq	6.16E+04	3.53E+04	2.69E+03	1.40E+04	1.65E+02	9.41E+03
Climate change - Biogenic	kg CO2 eq	1.31E+02	-1.52E+03	2.25E-01	1.52E+03	1.27E+02	5.90E+00
Climate change - Land use and LU change	kg CO2 eq	9.11E+01	6.03E+01	1.73E+00	2.15E+00	2.68E+01	1.49E-01
Ozone depletion	kg CFC11 eq	1.07E-01	1.07E-01	4.17E-05	1.63E-05	4.59E-06	1.50E-06
Acidification	mol H+ eq	4.15E+02	3.56E+02	4.45E+01	1.19E+01	1.17E+00	1.06E+00
Eutrophication, freshwater	kg P eq	2.68E+01	2.60E+01	1.57E-01	5.07E-01	2.80E-02	4.64E-02
Eutrophication, marine	kg N eq	6.05E+01	4.53E+01	1.18E+01	2.69E+00	2.25E-01	4.72E-01
Eutrophication, terrestrial	mol N eq	6.48E+02	4.83E+02	1.30E+02	2.86E+01	2.25E+00	4.32E+00
Photochemical ozone formation	kg NMVOC eq	2.06E+02	1.58E+02	3.69E+01	8.44E+00	6.97E-01	2.11E+00
Resource use, minerals and metals	kg Sb eq	3.17E+00	3.14E+00	5.77E-03	1.93E-02	2.10E-04	4.09E-04
Resource use, fossils	MJ	4.60E+05	4.02E+05	3.56E+04	1.79E+04	2.45E+03	1.27E+03
Water use	m3 depriv.	6.39E+03	5.41E+03	1.23E+02	2.90E+02	5.36E+02	3.64E+01

Parameters describing resource use are shown below.

Table 5.2 – Parameters describing resource use

Parameter	Unit	Total	Manufacturing Stage	Distribution Stage	Installation Stage	Use&Maintenance Stage	End of Life Stage
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw material (PENRE)	MJ, net calorific value	4.48E+05	3.90E+05	3.56E+04	1.79E+04	2.45E+03	1.27E+03
Use of renewable primary energy excluding renewable primary energy resources used as raw material (PERE)	MJ, net calorific value	6.85E+04	6.06E+04	3.65E+02	1.53E+03	5.91E+03	1.15E+02
Use of non-renewable primary energy resources used as raw material (PENRM)	MJ, net calorific value	1.23E+04	1.23E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use of renewable primary energy resources used as raw material (PERM)	MJ, net calorific value	1.49E+04	1.49E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total use of non-renewable primary energy resources (primary energy and primary energy resources used as raw materials) (PENRT)	MJ, net calorific value	4.60E+05	4.03E+05	3.56E+04	1.79E+04	2.45E+03	1.27E+03
Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials) (PERT)	MJ, net calorific value	8.34E+04	7.55E+04	3.65E+02	1.53E+03	5.91E+03	1.15E+02
Net use of fresh water (FW)	m^3	2.55E+02	2.10E+02	4.10E+00	8.96E+00	3.01E+01	1.30E+00
Use of secondary raw materials (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

Waste production descriptive parameters are shown below.

Table 5.3 – Waste production descriptive parameters

Parameter	Unit of measurement	Total	Manufacturing Stage	Distribution Stage	Installation Stage	Use&Maintenance Stage	End of Life Stage
Hazardous waste disposed (HWD)	kg	1.83E+01	1.80E+01	2.07E-01	6.98E-02	8.53E-03	4.35E-03
Non-hazardous waste disposed (NHWD)	kg	1.25E+04	1.02E+04	1.01E+03	2.24E+02	3.03E+01	3.31E+03
Radioactive waste disposed (RWD)	kg	5.44E-01	5.06E-01	5.75E-03	2.49E-02	5.83E-03	2.17E-03
Materials for energy recovery (MER)	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Material for recycling (MFR)	kg	1.90E+03	0.00E+00	0.00E+00	1.75E+01	0.00E+00	1.88E+03
Components for reuse (CRU)	kg	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
Exported electricity energy (EEE)	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

6. References

- ISO 14040:2006 Environmental management — Life cycle assessment — Requirements and guidelines
- ISO 14044:2006 Environmental management — Life cycle assessment — Principles and framework
- EPDItaly007 – PCR for Electronic and electrical products and systems, Rev. 3, 2023/01/13
- EPDItaly012 – Electronic and electrical products and systems – Switchs, Rev. 0, 2020/03/16
- EN 50693:2019 Product category rules for life cycle assessments of electronic and electrical products and systems
- EN 15804:2012+A2:2019 Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products
- Regulations of the EPDItaly Programm Rev.6.0, 2024/01/30
- RUGAO ZHW58A-72.5 HYBRID GAS-INSULATED SWITCHGEAR LCA Report Version 2.0（2024.08.21）
- Shiojiri, K., A. Yamasaki, M. Fujii, F. Kiyono, and Y. Yanagisawa. 2006. “Life Cycle Impact Assessment of Various Treatment Scenarios for Sulfur Hexafluoride (SF6) Used as an Insulating Gas.” Environmental Progress 25 (3):218–27. https://doi.org/10.1002/ep.10147.
- Statistical Statement of the People's Republic of China on National Economic and Social Development, 2023