EPD

Environmental Product Declaration

Medium-voltage gas-insulated switchgear ZX0.2 24.06.25

Production site: Brno, Czech Republic

DOCUMENT KIND	IN COMPLIANCE WITH			
Environmental Product Declaration	ISO 14025 and EN 50693			
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EPD Owner	ABB Switzerland Ltd, Group Technology Management
Organization No.	CHE-101.538.426
Manufacturer name and address	ABB s.r.o. Videnska, 117/113a, 691 00 Brno, Czech Republic
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Declared product	Medium-voltage gas-insulated switchgear ZX0.2 24.06.25
Product description	ZX0.2 medium-voltage SF_6 gas-insulated switchgears for single busbar system are used in electrical distribution for control and protection of electricity in a power distribution network. They are used in a variety of demanding applications such as energy supply for public utilities, hospitals, steel work factories, automobile industry, chemical industry, mining, airports, harbors, or railways.
Functional unit	To protect, control and meter electricity, with nominal voltage of 24 kV, use rate of 100% and a load rate of 35 %, during a service life of 20 years in Europe.
Reference flow	A single ZX0.2 24.06.25 SF_6 gas-insulated switchgear, including related accessories and packaging.
Independent verification	Independent verification of the declaration and data, according to ISO 14025:2010 ☐ INTERNAL ☒ EXTERNAL Independent verifier approved by EPD-Norge: Elisabet Amat Signature: 
Approved by	Håkon Hauan, CEO EPD-Norge Signature: 
Reference PCR	EN 50693:2019 – Product Category Rules for Life Cycle Assessments of Electronic and Electrical Products and Systems. EPDItaly007 – Electronic and Electrical Products and Systems, Rev. 3.0, 2023/01/13. EPDItaly015 – Electronic and Electrical Products and Systems – Switchboards, Rev. 1.5, 2022/02/23.
Program instructions	The Norwegian EPD Foundation/EPD-Norge, General Programme Instructions 2019, Version 3.0, 2019/04/24.
LCA study	This EPD is based on the LCA study described in the LCA report 1VLG101200
EPD type	Specific product
EPD scope	Cradle-to-grave
Product RSL	20 years
Geographical representativeness	Manufacturing (suppliers): Global Manufacturing (ABB): Czech Republic Downstream: Europe
Reference year	2023
LCA software	SimaPro 9.5 (2023)
LCI database	Ecoinvent v3.9.1 (2022)
Comparability	EPDs published within the same product category, though originating from 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.
Liability	The owner of the declaration shall be liable for the underlying information and evidence. EPD-Norge shall not be liable with respect to manufacturer, life cycle assessment data, and evidence.

Contents

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General Information

This Environmental Product Declaration is a “specific product EPD”, and the declared product is the ZX0.2 24.06.25, including related accessories and packaging.

The ZX0.2 24.06.25 is a medium-voltage SF6 gas-insulated switchgear for single busbar system which are used in electrical distribution for control and protection of electricity in a power distribution network. They are used in a variety of demanding applications such as energy supply for public utilities, hospitals, steel work factories, automobile industry, chemical industry, mining, airports, harbors, or railways.

General technical specifications of the ZX0.2 24.06.25 are presented below.

Technical information		
	Description	**ZX0.2 Incoming/Outgoing Feeder, outer cone, single bus bar**
Configuration	**Circuit Breaker**	VD4X/PT p150 24kV 630A 25kA
	Voltage Transformer	-
	Current Transformer	KOKM 06 J2 100//1A
		KOKM PG03 22 300//1/1A
	Relay	-
Size	**Width**	600 mm
	Height	2.25 m
	Depth	1.3 m
	Weight	673 kg
Ratings	**Rated Voltage [kV]**	24
	Rated feeder current [A]	630
	Rated bus bar current [A]	2500
	Rated short circuit current [kA]	25
	Rated short circuit current duration [s]	3
	Rated power frequency withstand voltage (Ud) [kV]	50
	Rated lightning impulse withstand voltage (Up) [kV]	125
	Rated short-time withstand current (Ik) [kA]	31.5
	Rated frequency [Hz]	50

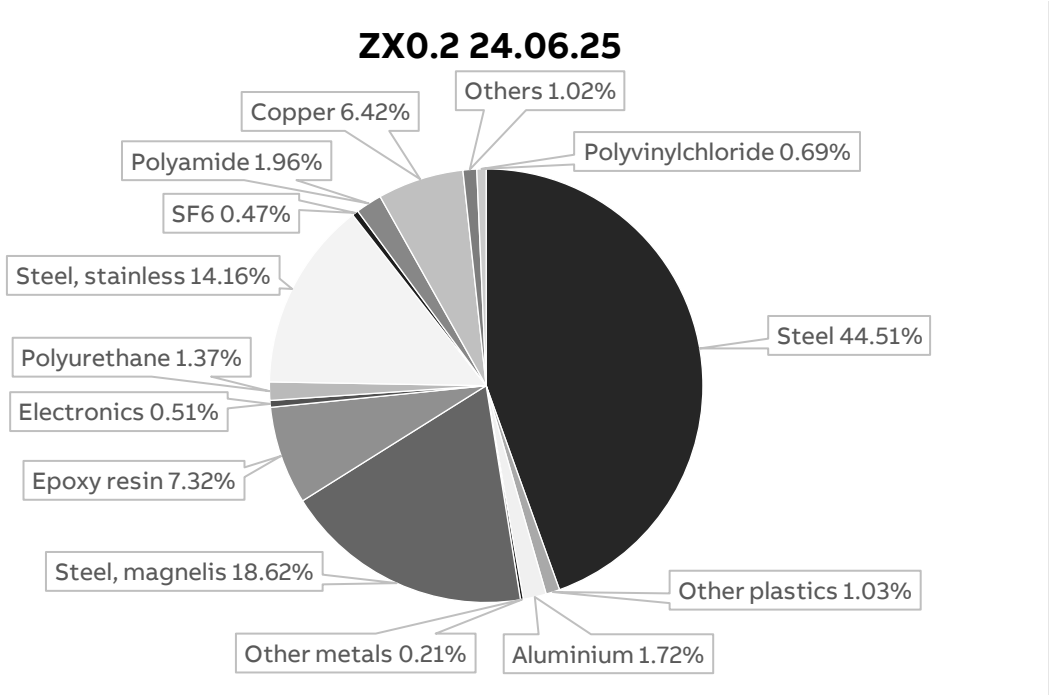
The ZX0.2 24.06.25 is manufactured by the ABB Videnska manufacturing site located in Brno, Czech Republic. The manufacturing site is certified according to the following standards:

- ISO 9001:2015 – Quality Management Systems
- ISO 14001:2015 – Environmental Management Systems
- ISO 45001:2018 – Occupational Health and Safety Management Systems

Constituent Materials

The constituent materials of ZX0.2 24.06.25 are presented below.

Type	Material	Weight [kg]	Weight %
Metals	Steel	299.56	44.51
	Steel, magnelis	125.33	18.62
	Steel, stainless	95.28	14.16
	Copper	43.22	6.42
	Aluminum	11.55	1.72
	Other metals	1.43	0.21
Plastics	Polyamide	13.18	1.96
	Polyurethane	9.19	1.36
	Polyvinylchloride	4.66	0.69
	Other plastics	6.96	1.03
Others	Epoxy resin	49.26	7.32
	Electronic component	3.43	0.51
	SF_6	3.16	0.47
	Others…	6.88	1.02
Total		**673.09**	**100**



The constituent materials of the packaging and accessories are presented below.

Description	Material	Weight [kg]	Weight [%]
Packaging box	Wood	110.21	63.65
	Cardboard	1.73	1.00
	PE	1.36	0.78
	Other plastics	0.49	0.29
	Steel	1.02	0.59
	Aluminum	0.05	0.03
Pallets	Wood	58.29	33.66
Total		**173.15**	**100**

LCA Background Information

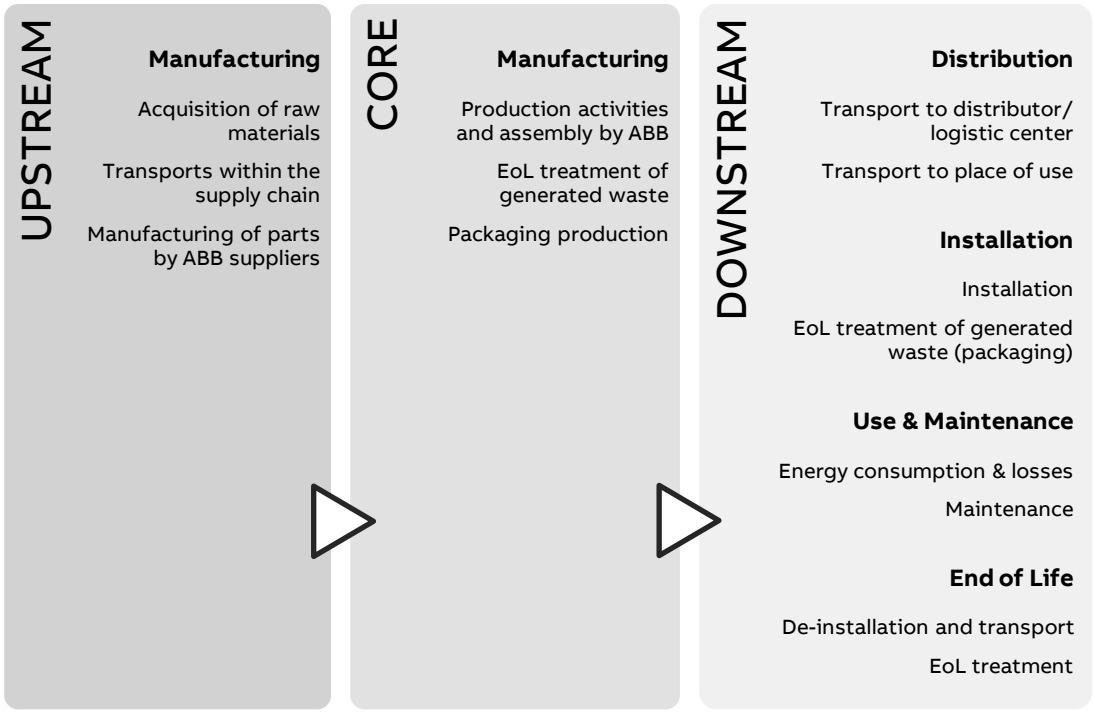
Functional Unit

The functional unit of this study is to protect, control and meter electricity, with nominal voltage of 24 kV, use rate of 100% and a load rate of 35 %, during a service life of 20 years in Europe. The reference flow is a single ZX0.2 24.06.25 SF_6 gas-insulated switchgear, including related accessories and packaging, including related accessories and packaging.

Note, the reference service life (RSL) of 20 years is a theoretical period selected for calculation purposes only – this is not representative for the minimum, average, nor actual service life of the product.

System Boundaries

The life cycle assessment is a “cradle-to-grave” analysis, and the system boundaries are defined according to EN 50693, as required by the PCR. For transparency reasons, the manufacturing stage is further divided into an upstream and core stage.



Data quality

Both primary and secondary data are used. The main sources for primary data are the bill of materials, technical drawings, and site-specific foreground data provided by ABB.

For all processes for which primary data are not available, generic background data originating from the ecoinvent v3.9.1 database, with system model “allocation, cut-off by classification”, are used. The database Industry Data 2.0 is also used for material

Polyoxymethylene (POM)/EU-27 which is not available by ecoinvent. The LCA software used for the calculations is SimaPro 9.5.

Allocation rules

The utility consumption and waste generation by ABB, in the core manufacturing stage, is allocated to the production of one reference product according to applicable rules. For the end-of-life allocation, the “Polluter Pays” principle is adopted according to what is defined in the CEN/TR 16970 standard. However, the potential benefits and avoided loads from recovery and recycling processes are not considered because it is not required by the PCR.

Cut-off criteria

According to PCR EPDItaly-015: “Materials making up the switchboard itself whose total mass does not exceed 2 % of the total weight of the device”, the cut-off criteria can be set to a maximum of 2 % of the total weight. In this LCA, stickers, tape, glue, and adhesive have been excluded as their weights are negligible. Materials like small metal components, light plastic materials or little electronic devices have also been excluded due to the unavailability of data and complexity of modelling.

Inventory Analysis

Manufacturing Stage (upstream)

The life cycle inventory in the upstream manufacturing stage is based on the primary data available from ABB. Datasets are applied accordingly, to the best of our knowledge, to represent each material, manufacturing process, and surface treatment. Modelling decisions and assumptions that are highly relevant to the results are as following:

- Secondary raw materials content is considered when selecting datasets.
- Epoxy is modelled on a chemical level, i.e., each chemical used is considered and mapped with the most representative dataset available.

Additionally, supply chain transports are added as far as data is available between ABB, the suppliers, and sub-suppliers. Only primary suppliers are considered. The rest of the transports are assumed to already be included in ecoinvent's "market for"-processes.

Manufacturing Stage (core)

In the core manufacturing stage, utility consumption and waste generation at the ABB manufacturing site are accounted for. The packaging materials and accessories associated with the product are also considered. Modelling decisions and assumptions that are highly relevant to the results are as following:

- 100% renewable electricity is considered, which is procured by the manufacturing site ABB Videnska through Guarantees of Origins (GO's). This dataset includes electricity inputs produced in this country and from imports and transformed to medium voltage, the transmission voltage, direct emissions to air and electricity losses during transmission. However, due to the lack of life cycle based residual mix data, other electricity mixes in the LCA are not calculated with residual mix.

Distribution

The transport distance from the ABB manufacturing site to the site of installation is assumed to be 300 km by lorry, as suggested by the PCR EPDItaly015, as the actual distance is unknown. The environmental impacts can be multiplied accordingly if the actual distance is known.

	Dataset	Amount	Unit	Represent.
Transport	*Transport, freight, lorry 16-32 metric ton, EURO4 {RER}*	300	km	PCR / Assumption

Installation

The installation phase only implies manual activities, and no energy is consumed. Therefore, this phase only considers the end-of-life of the packaging materials used.

	Scenario	Transport	Representation
Packaging End-of-Life	*Packaging waste by waste management operations* (Eurostat, 2021)	100 km by lorry (assumption)	Europe

Use

The use stage considers the reference power consumption, power losses and SF_6 losses over the reference service life as defined in the functional unit. This is calculated using the following formula, according to PCR EPDItaly007:

$$E_{use}[kWh] = \frac{P_{use} * 8760 * RSL * \alpha}{1000} = \frac{(P_{use,cm} + P_{use,t}) * 8760 * RSL * \alpha}{1000}$$

$$E_{use}[kWh] = \frac{(16.40 + 3 * 7.74)\ \text{W} * 8760\ \text{hours} * 20\ \text{years} * 100\ \%}{1000} = 6\,942.21\ kWh$$

Where:

- E_{use} = Total energy use over the reference service life
- P_{use} = Total reference power consumption in watts
- $P_{use,cm}$ = Reference power consumption of the core module in watts
- $P_{use,t}$ = Reference power consumption of the transformers in watts; the
- *RSL* = Reference Service Life in years
- α = Use time rate
- 8760 is the number of hours in a year
- 1000 is the conversion factor from W to kW

	Dataset	Amount	Unit	Represent.
Energy	*Electricity, medium voltage {RER}| market group for electricity, medium voltage | Cut-off, S*	0.362	kg CO_2-eq./kWh	Europe
SF_6 losses	Custom process with airborne emissions	25 200	kg CO_2-eq./kg SF_6	-

Maintenance is not considered because from the environmental impacts point of view it can be omitted from the analysis because only negligible amount energy is consumed.

The SF_6 leakage over the reference service life is assumed to be 0.1% per year of the total gas masses according to IEC 62271-1, clause 6.16.4.

End of life

Decommissioning of the product only implies manual activities, and no energy is consumed. Therefore, this phase only considers the end-of-life of the product.

	Scenario	Transport	Representation
Product End-of-Life	IEC/TR 62635 (Annex D.3)*	100 km by lorry (assumption)	Europe

*A conservative approach is adopted by considering all parts as either: requiring selective treatment, difficult to process, or going through a separation process; no individual part is considered as a single recyclable material. Also, due to the transformer containing parts difficult to process through separation, these are all modelled as 100 % waste to landfill to represent the typical waste streams within Europe.

Environmental Indicators

In accordance with the PCR EPDItaly007, the environmental impact indicators are determined by using the characterization factors and impact assessment methods specified in EN 15804:2012+A2:2019.

ZX0.2 24.06.25

			Cradle-to-gate		Cradle-to-grave			
Impact category	Unit	Total	UPSTREAM	CORE	DOWNSTREAM			
			Manufacturing		Distribution	Installation	Use and maintenance	End-of-life
GWP – total	kg CO_2 eq.	9.52E+03	5.30E+03	-7.16E+01	2.26E+01	8.70E+01	4.10E+03	7.52E+01
GWP – fossil	kg CO_2 eq.	9.56E+03	5.32E+03	1.50E+02	2.26E+01	7.07E+00	4.01E+03	5.90E+01
GWP – biogenic	kg CO_2 eq.	-5.98E+01	-2.31E+01	-2.22E+02	2.06E-02	7.99E+01	8.91E+01	1.61E+01
GWP – luluc	kg CO_2 eq.	1.37E+01	7.11E+00	4.86E-01	1.11E-02	2.58E-03	6.04E+00	6.98E-02
ODP	kg CFC-11 eq.	1.96E-04	1.39E-04	1.26E-05	4.95E-07	1.06E-07	4.34E-05	6.36E-07
AP	mol H+ eq.	6.73E+01	5.39E+01	8.98E-01	9.36E-02	2.83E-02	1.21E+01	2.62E-01
EP – freshwater	kg P eq.	6.47E+00	4.19E+00	4.82E-02	1.59E-03	7.71E-04	2.20E+00	1.78E-02
EP – marine	kg N eq.	9.19E+00	6.54E+00	3.10E-01	3.57E-02	3.51E-02	2.16E+00	1.07E-01
EP – terrestrial	mol N eq.	9.44E+01	7.07E+01	3.45E+00	3.81E-01	1.22E-01	1.90E+01	6.98E-01
POCP	kg NMVOC eq.	3.12E+01	2.36E+01	1.05E+00	1.37E-01	4.06E-02	6.13E+00	2.19E-01
ADP – minerals and metals	kg Sb eq.	5.60E-01	5.53E-01	7.99E-04	7.31E-05	1.48E-05	4.80E-03	4.72E-04
ADP – fossil	MJ, net calorific value	1.17E+05	5.83E+04	2.48E+03	3.23E+02	7.26E+01	5.56E+04	6.40E+02
WDP	m^3 eq.	1.99E+03	1.32E+03	9.02E+01	1.31E+00	3.38E-01	5.68E+02	8.29E+00

GWP-fossil: Global Warming Potential fossil; 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; EP-freshwater: Eutrophication potential-freshwater compartment; EP-marine: Eutrophication potential-marine compartment; EP-terrestrial: Eutrophication potential-accumulated exceedance; POCP: Formation potential of tropospheric ozone; ADP-minerals & metals: Abiotic Depletion for non-fossil resources potential; ADP-fossil: Abiotic Depletion for fossil resources potential; WDP: Water deprivation potential.

Resource use parameters	Unit	Total	Cradle-to-gate		Cradle-to-grave			
			UPSTREAM	CORE	DOWNSTREAM			
			Manufacturing		Distribution	Installation	Use and maintenance	End-of-life
PENRE	MJ, low cal. value	1.18E+05	5.94E+04	2.41E+03	3.23E+02	7.26E+01	5.56E+04	6.40E+02
PERE	MJ, low cal. value	2.78E+04	1.32E+04	3.86E+03	5.01E+00	1.36E+00	1.07E+04	6.18E+01
PENRM	MJ, low cal. value	1.90E+03	1.83E+03	6.92E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERM	MJ, low cal. value	2.75E+03	3.76E+02	2.37E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRT	MJ, low cal. value	1.20E+05	6.12E+04	2.48E+03	3.23E+02	7.26E+01	5.56E+04	6.40E+02
PERT	MJ, low cal. value	3.05E+04	1.36E+04	6.23E+03	5.01E+00	1.36E+00	1.07E+04	6.18E+01
FW	m^3	9.06E+01	4.41E+01	2.74E+00	4.60E-02	1.40E-02	4.35E+01	3.15E-01
MS	kg	2.37E+02	2.32E+02	5.35E+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

PENRE: Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw material; PERE: Use of renewable primary energy excluding renewable primary energy resources used as raw material; PENRM: Use of non-renewable primary energy resources used as raw material; PERM: Use of renewable primary energy resources used as raw material; PENRT: Total use of non-renewable primary energy resources (primary energy and primary energy resources used as raw materials); PERT: Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials); FW: Net use of fresh water; MS: Use of secondary materials; RFS: Use of renewable secondary fuels; NRSF: Use of non-renewable secondary fuels.

System output indicators	Unit	Total	Cradle-to-gate		Cradle-to-grave			
			UPSTREAM	CORE	DOWNSTREAM			
			Manufacturing		Distribution	Installation	Use and maintenance	End-of-life
HWD	kg	5.30E-01	4.43E-01	1.11E-02	2.05E-03	4.23E-04	7.04E-02	2.42E-03
NHWD	kg	1.97E+03	1.62E+03	2.79E+01	1.58E+01	6.77E+01	1.52E+02	8.77E+01
RWD	kg	5.11E-01	9.96E-02	5.45E-03	1.05E-04	2.58E-05	4.05E-01	1.25E-03
MER	kg	1.09E+02	5.17E+01	2.98E+00	0.00E+00	5.14E+01	0.00E+00	2.88E+00
MFR	kg	8.75E+02	2.87E+02	7.47E+01	0.00E+00	5.71E+01	0.00E+00	4.57E+02
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ETE	MJ	4.73E+02	2.30E+02	2.02E+01	0.00E+00	2.10E+02	0.00E+00	1.23E+01
EEE	MJ	2.54E+02	1.21E+02	1.03E+01	0.00E+00	1.17E+02	0.00E+00	6.85E+00

HWD: hazardous waste disposed; NHWD: non-hazardous waste disposed; RWD: radioactive waste disposed; MER: materials for energy recovery; MFR: material for recycling; CRU: components for reuse; ETE: exported thermal energy; EEE: exported electricity energy.

Additional Environmental Information

Circularity Values

The recyclability potential of the product (excluding packaging) is calculated by dividing “MFR: material for recycling” in the end-of-life stage by the total weight of the product. As a result, the recyclability potential of the product is 67.9 %. The result is representative for Europe according to IEC/TR 62635.

Greenhouse gas emissions from the use of electricity in the manufacturing phase

Production mix from import, medium voltage (production of transmission lines, in addition to direct emissions and losses in grid) of applied electricity for the manufacturing process.

Energy mix	Source	Amount	Unit
ABB_Electricity mix CZ factory {CZ]_biomass49%_PV30%_Wind21%_2023/ S_SMP_V1	Ecoinvent v3.9.1	0.068	kg CO_2-eq/kWh

Dangerous substances

The product contains no substances given by the REACH Candidate list.

Indoor environment

The product meets the requirements for low emissions.

Carbon footprint

Carbon footprint has not been worked out for the product.

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