



EPD



Environmental Product Declaration

Medium-voltage gas-insulated switchgear ZX2 Feeder-36.12.31

Production site: Brno, Czech Republic



DOCUMENT KIND Environmental Product Declaration	IN COMPLIANCE WITH ISO 14025 and EN 50693			
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REGISTRATION NUMBER OF THE PROGRAM OPERATOR NEPD-7702-7041-EN	ISSUE DATE 2024-09-30			
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OWNING ORGANIZATION ABB Switzerland Ltd, Group Technology Management	ABB DOCUMENT ID 1VLG101234	REV. A	LANG. EN	PAGE 1/16

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		
Company contact	Alexander Troeger – alexander.troeger@de.abb.com Global Product Manager		
Program operator	The Norwegian EPD Foundation Post Box 5250 Majorstuen, 0303 Oslo, Norway phone: +47 23 08 80 00, email: post@epd-norge.no		
Declared product	Medium-voltage gas-insulated switchgear ZX2 36.12.31		
Product description	ZX2 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 36 kV, use rate of 100% and a load rate of 35 %, during a service life of 20 years in Europe.		
Reference flow	A single ZX2 36.12.31 SF ₆ gas-insulated switchgear, including related accessories and packaging.		
Independent verification	Independent verification of the declaration and data, according to ISO 14025:2010 <input type="checkbox"/> INTERNAL <input checked="" type="checkbox"/> EXTERNAL Independent verifier approved by EPD-Norge: Elisabet Amat		
	 Signature: ELISABET AMAT		
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 1VLG101233		
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.		

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Sustainability at ABB

ABB is a leading global technology company that energizes the transformation of society and industry to achieve a more productive, sustainable future. By connecting software to its electrification, robotics, automation, and motion portfolio, ABB pushes the boundaries of technology to drive performance to new levels.

At ABB, we actively contribute to a more sustainable world, leading by example in our own operations and partnering with customers and suppliers to enable a low-carbon society, preserve resources, and promote social progress.

Learn more on our website global.abb/group/en/sustainability or scan the QR code.



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General Information

This Environmental Product Declaration is a “specific product EPD”, and the declared product is the ZX2 36.12.31, including related accessories and packaging.

The ZX2 36.12.31 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 ZX2 36.12.31 are presented below.

Technical information		
	Description	ZX2 36.12.31 Incoming/Outgoing Feeder, outer cone, single bus bar
Configuration	Voltage Sensor	KEVA 40.5 C2
	Current Sensor	KECA 80 85 C
Size	Width [mm]	600
	Height	2.3 m
	Depth	1.86 m
	Weight [kg]	896.2
Ratings	Rated Voltage [kV]	36
	Rated feeder current [A]	1250
	Rated bus bar current [A]	2500
	Rated short circuit current [kA]	31.5
	Rated short circuit current duration [s]	3
	Rated power frequency withstand voltage (Ud) [kV]	70
	Rated lightning impulse withstand voltage (Up) [kV]	170
Rated short-time withstand current (Ik) [kA]	31.5	

The ZX2 36.12.31 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

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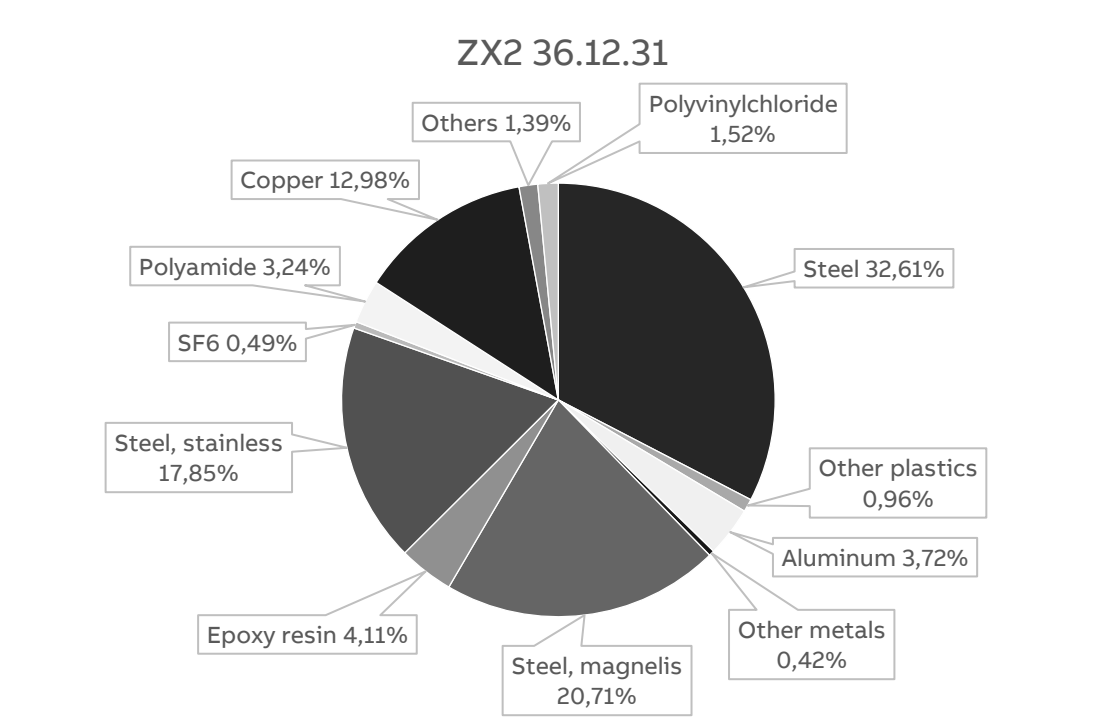


Constituent Materials

The constituent materials of ZX2 36.12.31 are presented below.

Table 2 – Constituent materials of ZX2 36.12.31

Type	Material	Weight [kg]	Weight %
Metals	Steel	292.27	32.61
	Steel, magnelis	185.63	20.71
	Steel, stainless	159.96	17.85
	Copper	116.30	12.98
	Aluminum	33.37	3.72
	Other metals	3.72	0.41
Plastics	Polyamide	29.03	3.24
	Polyvinylchloride	13.59	1.52
	Other plastics	8.62	0.96
Others	Epoxy resin	36.80	4.11
	SF ₆	4.42	0.49
	Others	12.46	1.39
Total		896.17	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 (mix)	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

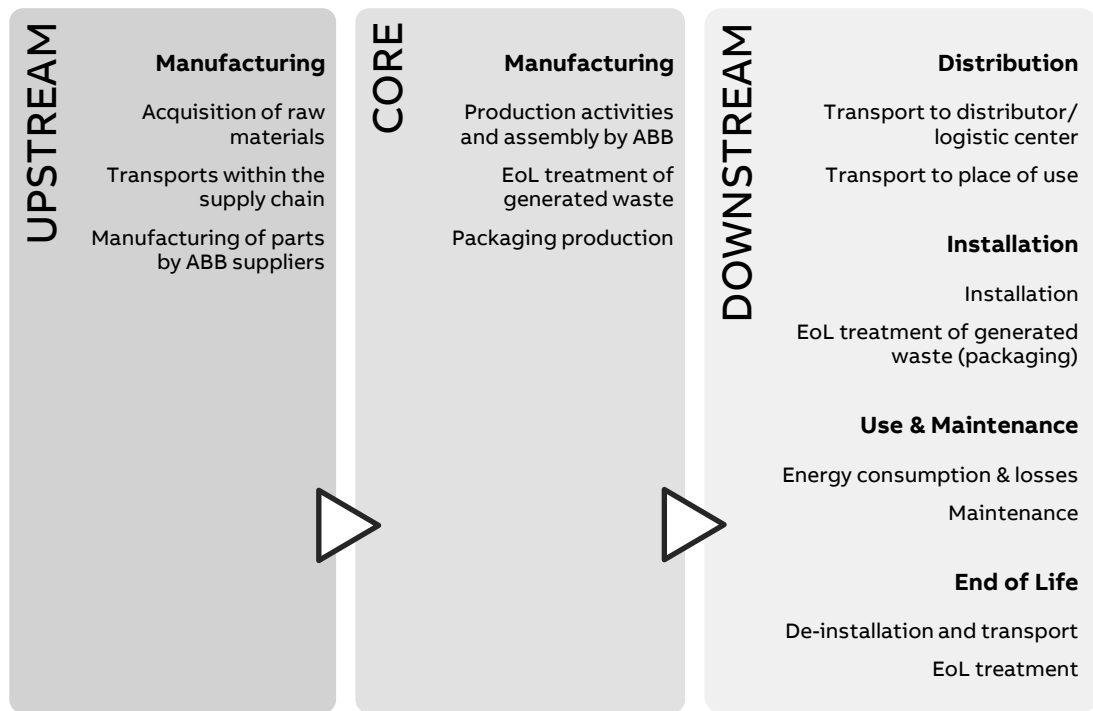
Functional Unit

The functional unit of this study is to protect, control and meter electricity, with nominal voltage of 36 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 ZX2 36.12.31 SF₆ gas-insulated switchgear, 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.

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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 total weight. In this LCA, tape, stickers, 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.

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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:

- 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 EPDIItaly015, 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

*Due to lack of data from Eurostat, 100% landfill is assumed for ceramics (e.g., bentonite)

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Use

The use stage considers the reference power consumption, power losses and SF₆ losses over the reference service life as defined in the functional unit. This is calculated using the following formula, according to PCR EPDItaly007:

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

$$E_{use} = \frac{[28.46 + 3 * (0.00148 + 0.9617)] W * 8760 \text{ hours} * 20 \text{ years} * 100 \%}{1000} = 5\,492.44 \text{ kWh}$$

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
- $P_{use,s}$ = Reference power consumption of the sensors in watts; the ZX2 36.12.31 panel contains 3 current and 3 voltage sensors
- 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	<i>Electricity, medium voltage {RER}/ market group for electricity, medium voltage Cut-off, S</i>	0.362	kg CO ₂ -eq./kWh	Europe
SF₆ losses	Custom process with emission to air	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 SF₆ 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.

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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.

ZX2 36.12.31

Impact category	Unit	Total	Cradle-to-grave					
			UPSTREAM	CORE	DOWNSTREAM			
			Manufacturing		Distribution	Installation	Use and maintenance	End-of-life
GWP – total	kg CO ₂ eq.	1.10E+04	6.56E+03	-5.51E+01	6.01E+01	8.70E+01	4.21E+03	1.25E+02
GWP – fossil	kg CO ₂ eq.	1.10E+04	6.55E+03	1.66E+02	6.00E+01	7.07E+00	4.14E+03	9.81E+01
GWP – biogenic	kg CO ₂ eq.	-4.84E+01	-3.98E+00	-2.21E+02	5.46E-02	7.99E+01	7.05E+01	2.64E+01
GWP – luluc	kg CO ₂ eq.	1.27E+01	7.23E+00	5.01E-01	2.93E-02	2.58E-03	4.78E+00	1.18E-01
ODP	kg CFC-11 eq.	2.01E-04	1.51E-04	1.33E-05	1.31E-06	1.06E-07	3.43E-05	1.08E-06
AP	mol H+ eq.	1.18E+02	1.07E+02	9.56E-01	2.48E-01	2.83E-02	9.59E+00	4.41E-01
EP – freshwater	kg P eq.	9.97E+00	8.14E+00	5.03E-02	4.23E-03	7.71E-04	1.74E+00	2.99E-02
EP – marine	kg N eq.	1.18E+01	9.40E+00	3.28E-01	9.47E-02	3.51E-02	1.71E+00	2.40E-01
EP – terrestrial	mol N eq.	1.34E+02	1.12E+02	3.67E+00	1.01E+00	1.22E-01	1.50E+01	1.17E+00
POCP	kg NMVOC eq.	4.18E+01	3.51E+01	1.11E+00	3.64E-01	4.06E-02	4.85E+00	3.70E-01
ADP – minerals and metals	kg Sb eq.	1.19E+00	1.18E+00	8.78E-04	1.94E-04	1.48E-05	3.80E-03	7.90E-04
ADP – fossil	MJ, net calorific value	1.22E+05	7.31E+04	2.68E+03	8.56E+02	7.26E+01	4.40E+04	1.08E+03
WDP	m ³ eq.	2.47E+03	1.91E+03	8.88E+01	3.47E+00	3.38E-01	4.49E+02	1.50E+01

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.

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ENVIRONMENTAL PRODUCT DECLARATION

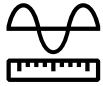
Resource use parameters	Unit	Total	Cradle-to-gate		Cradle-to-grave			
			UPSTREAM	CORE	DOWNSTREAM			
			Manufacturing		Distribution	Installation	Use and maintenance	End-of-life
PENRE	MJ, low cal. value	1.20E+05	7.13E+04	2.61E+03	8.56E+02	7.26E+01	4.40E+04	1.08E+03
PERE	MJ, low cal. value	2.58E+04	1.31E+04	4.18E+03	1.33E+01	1.36E+00	8.44E+03	1.04E+02
PENRM	MJ, low cal. value	1.94E+03	1.88E+03	6.92E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERM	MJ, low cal. value	2.71E+03	3.46E+02	2.37E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRT	MJ, low cal. value	1.22E+05	7.31E+04	2.68E+03	8.56E+02	7.26E+01	4.40E+04	1.08E+03
PERT	MJ, low cal. value	2.85E+04	1.34E+04	6.55E+03	1.33E+01	1.36E+00	8.44E+03	1.04E+02
FW	m ³	9.24E+01	5.46E+01	2.72E+00	1.22E-01	1.40E-02	3.44E+01	5.60E-01
MS	kg	2.69E+02	2.64E+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	5.37E-01	4.59E-01	1.24E-02	5.45E-03	4.23E-04	5.57E-02	4.09E-03
NHWD	kg	2.67E+03	2.23E+03	2.97E+01	4.18E+01	6.77E+01	1.21E+02	1.80E+02
RWD	kg	4.65E-01	1.37E-01	5.56E-03	2.78E-04	2.58E-05	3.20E-01	2.10E-03
MER	kg	8.56E+01	2.63E+01	3.71E+00	0.00E+00	5.14E+01	0.00E+00	4.15E+00
MFR	kg	1.14E+03	2.50E+02	8.95E+01	0.00E+00	5.71E+01	0.00E+00	7.45E+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	3.89E+02	1.29E+02	2.52E+01	0.00E+00	2.10E+02	0.00E+00	2.58E+01
EEE	MJ	2.09E+02	6.51E+01	1.28E+01	0.00E+00	1.17E+02	0.00E+00	1.43E+01

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.

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Extrapolation rules

Due to the large variations in environmental impacts present within the series, extrapolation rules are established according to EN 50693. Besides the representative product, this EPD covers also a build configuration ZX2 36.12.31 with transformer subcomponents KOKM PG03 22 and TJMC 7.0 W. All the analyzed configurations have the same main functionality, product standards and manufacturing technology. The different life cycle stages can be extrapolated to other products of the same homogeneous environmental family by applying a rule of proportionality to the parameters in the following tables, divided by different life cycle stages

Impact category	Unit	UPSTREAM	CORE	DOWNSTREAM			
		Manufacturing	Distribution	Installation	Use and maintenance	End-of-life	
GWP – total	kg CO ₂ eq.	1.125	1.000	1.146	1.000	1.726	1.180
GWP – fossil	kg CO ₂ eq.	1.124	1.000	1.146	1.000	1.711	1.173
GWP – biogenic	kg CO ₂ eq.	0.897	1.000	1.146	1.000	2.539	1.204
GWP – luluc	kg CO ₂ eq.	1.347	1.000	1.146	1.000	2.539	1.156
ODP	kg CFC-11 eq.	1.188	1.000	1.146	1.000	2.539	1.157
AP	mol H+ eq.	1.121	1.000	1.146	1.000	2.539	1.159
EP – freshwater	kg P eq.	1.122	1.000	1.146	1.000	2.539	1.154
EP – marine	kg N eq.	1.162	1.000	1.146	1.000	2.539	1.211
EP – terrestrial	mol N eq.	1.134	1.000	1.146	1.000	2.539	1.165
POCP	kg NMVOC eq.	1.134	1.000	1.146	1.000	2.539	1.167
ADP – minerals and metals	kg Sb eq.	1.110	1.000	1.146	1.000	2.539	1.144
ADP – fossil	MJ, net calorific value	1.158	1.000	1.146	1.000	2.539	1.160
WDP	m ³ eq.	1.277	1.000	1.146	1.000	2.539	1.142

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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 83.08 %. The results are 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
<i>ABB_Electricity mix CZ factory {CZ}_biomass49%_PV30%_Wind21%_2023/ S_SMP_V1</i>	Ecoinvent v3.9.1	0.068	kg CO ₂ -eq/kWh

Dangerous substances

The product complies with REACH and RoHS directive requirements and does not contain any of the listed materials in excess of the authorized proportions. For further information about REACH and RoHS, please visit the ABB webpage: <https://new.abb.com/contact/form>

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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Program Operator and publisher

The Norwegian EPD Foundation	Ph.	+47 23 08 80 00
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	web	www.epd-norge.no



Owner of the declaration

ABB Swizerland Ltd, Group Technology Management		
Brown Boveri Straße 6, 5400 Baden, Switzerland	web	www.abb.com



Author

Pavlina Otrisalova	Ph.	+420 731 668 650
ABB s.r.o	email	pavlina.otrisalova@cz.abb.com
Videnska 117, Brno, Czechia	web	www.abb.com

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