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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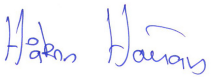
EPD Owner	ABB Switzerland Ltd, Group Technology Management		
Organization No.	CHE-101.538.426		
Manufacturer name and address	ABB s.r.o. Videnska, 117/113a, 691 00 Brno, Czech Republic		
Company contact	Seila Rodriguez Vilches – seila.rodriguez-vilches@ch.abb.com Sustainability Product Manager		
Program 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 Feeder-36.12.31		
Product description	ZX2 medium-voltage SF_6 gas-insulated switchgears for single or double 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, steel work factories, automobile industry, airports, harbors, or railways.		
Functional unit	Power distribution switchgear with main function of protecting, controlling and metering 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 Feeder-36.12.31 SF_6 gas-insulated switchgear, including related accessories and packaging.		
CPC code	46214 – Boards, consoles, cabinets and other bases, equipped with electrical switching etc. apparatus, for electric control or the distribution of electricity, for a voltage exceeding 1000 V		
Independent verification	Independent verification of the declaration and data, according to ISO 14025:2010 ☐ INTERNAL ☒ EXTERNAL Independent verifier approved by EPD-Norge: Elisabeth 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 1VLG101118.		
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	2022		
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

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.

General Information

The product declared in this Environmental Product Declaration is the ZX2 Feeder-36.12.31, including related accessories and packaging.

The ZX2 Feeder-36.12.31 is a medium-voltage SF_6 gas-insulated switchgear for single or double 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, steel work factories, automobile industry, airports, harbors, or railways.

General technical specifications of the product are presented below.

Technical information	
	ZX2 Incoming/Outgoing Feeder, outer cone, single bus bar
Rated voltage [kV]	36
Rated power frequency withstand voltage (Ud) [kV]	70
Rated lightning impulse withstand voltage (Up) [kV]	170
Rated busbar current [A]	2500
Rated feeder current [A]	1250
Rated short circuit breaking current [kA]	31.5
Rated frequency [Hz]	50
Rated short circuit current [kA]	31.5
Rated short circuit current duration [s]	3
Current sensor	KECA 80 C85
Voltage sensor	KEVA 40.5 C2
Panel width [mm]	600

The ZX2 Feeder-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:

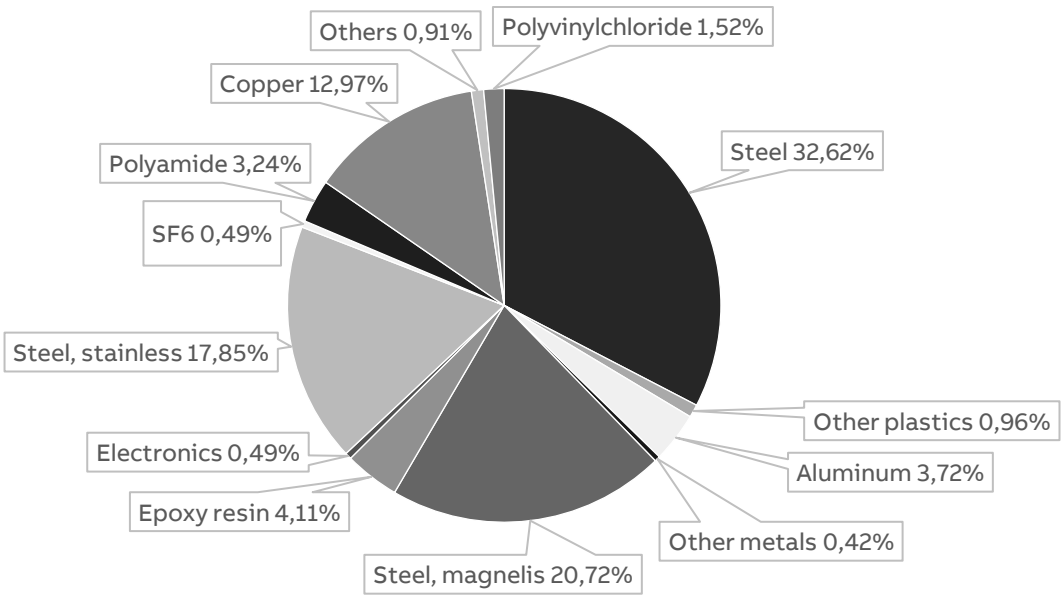
- ISO 9001:2015 – Quality Management Systems
- ISO 14001:2015 – Environmental Management Systems
- ISO 45001:2018 – Occupational Health and Safety Management Systems

Constituent Materials

The ZX2 Feeder-36.12.31 weighs 896.03 kg, and the constituent materials are presented below.

Type	Material	Weight [kg]	Weight %
Plastics	Polyamide	28.99	3.24
	Polyvinylchloride	13.59	1.52
	Other plastics	8.62	0.96
Metals	Steel	292.27	32.62
	Steel, magnelis	185.63	20.72
	Steel, stainless	159.96	17.85
	Copper	116.18	12.97
	Aluminum	33.37	3.72
	Other metals	3.72	0.42
Others	Epoxy resin	36.79	4.11
	SF_6	4.42	0.49
	Electronics	4.35	0.49
	Others	8.14	0.91
Total		**896.03**	**100**

ZX2 Feeder-36.12.31



The packaging materials and accessories weighs 138.97 kg, and the constituent materials are presented below.

Description	Material	Weight [kg]	Weight %
Packaging box	Wood	82.82	59.60
	Cardboard	2.00	1.44
	PE	1.83	1.32
	Other plastics (mix)	0.35	0.25
	Steel	0.81	0.58
	Aluminum	0.23	0.17
Pallets	Wood	50.93	36.65
Total		**138.97**	**100**

LCA Background Information

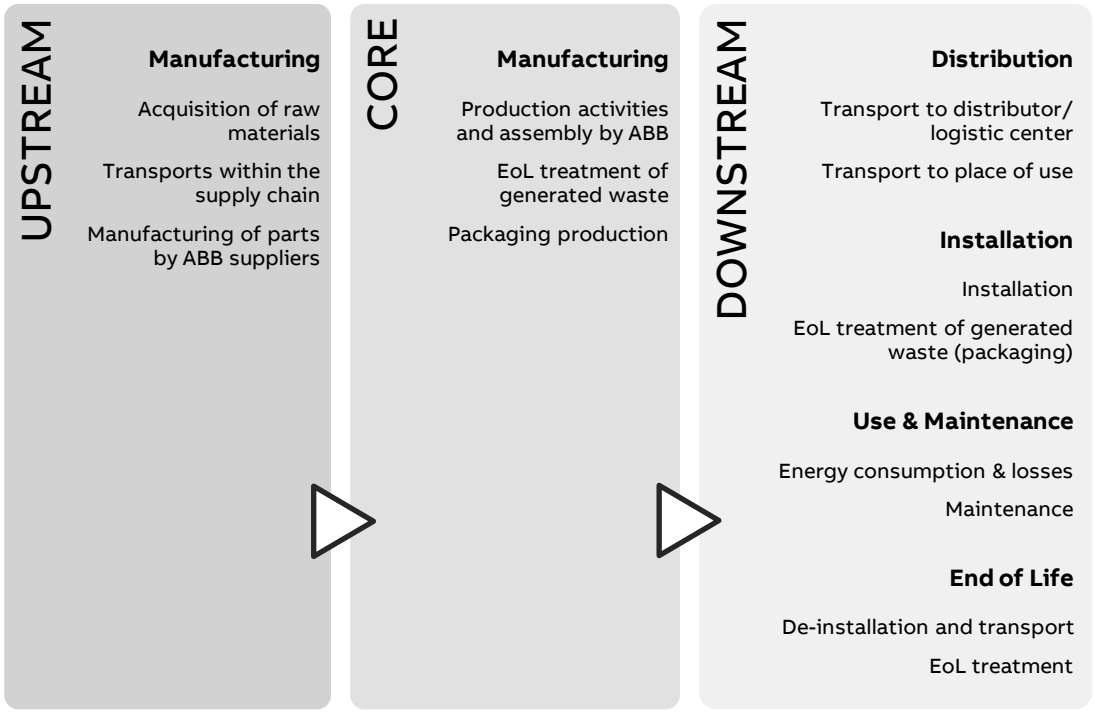
Functional Unit

The functional unit of this study is power distribution switchgear with main function of protecting, controlling and metering 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 SF_6 gas-insulated ZX2 Feeder-36.12.31 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 of the ZX2 Feeder-36.12.31, an EEPS (Electronic and Electrical Products and Systems), is a "cradle-to-grave" analysis. The figure below shows the product life cycle stages and the information considered in the LCA.



In terms of exclusions from the system boundary, according to PCR EPDItaly015, capital goods such as machinery, tools, buildings, infrastructure, and administrative activities, which cannot be allocated directly to the production of the reference product, are excluded.

Infrastructures, when present, such as in processes deriving from the ecoinvent database, have not been excluded. Scraps for metal working and plastic processes are also included when already defined in ecoinvent.

Temporal and geographical boundaries

In terms of temporal boundaries, all primary data collected from ABB are from 2022, which is considered a representative production year. Secondary data are provided by ecoinvent v3.9.1 which was released in 2022.

In terms of geographical boundaries, the materials and components used in the production of the ZX2 Feeder-36.12.31 are globally sourced. The supply chains are often complex and can extend across multiple countries and continents. Therefore, materials and background processes with global representativeness are selected from ecoinvent due to the unclear origin of each material. Thus, a conservative approach is adopted.

Data quality

Both primary and secondary data are used. The main sources for primary data are the bill of materials and technical drawings, while site specific foreground data are provided by ABB. Furthermore, information and data obtained from other LCA and EPD studies are also used. The data collection for core module, circuit breaker, enclosure and sensors is done by dedicated survey to the ABB factories in Germany, Italy and Czech Republic respectively.

For all processes for which primary data are not available, generic data originating from the ecoinvent v3.9.1 database, “allocation, cut-off by classification”, are used. The LCA software used for the calculations is SimaPro 9.5.

Environmental impact indicators

The information obtained from the inventory analysis is aggregated according to the effects related to the various environmental issues. 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.

Allocation rules

The utility consumption and waste generation at the ABB manufacturing site is allocated to the production of one ZX2 Feeder-36.12.31 by using allocation rules. This is done by final assembly of the switchgear in Brno, the factory waste and consumptions are allocated based on mass and production volume.

For the end-of-life allocation, the “Polluter Pays” principle is adopted according to what is defined in the CEN/TR 16970 standard, as required by the PCR EPDItaly007. This means, waste treatment processes are allocated to the product system that generates the waste until the end-of-waste state is reached. The environmental burdens of recycling and energy recovery processes are therefore allocated to the product system that generates the waste, while the product system that uses the exported energy and recycled materials receives it burden-free. However, the potential benefits and avoided loads from recovery and recycling processes are not considered because it is not required by EPDItaly007.

Cut-off criteria

According to PCR EPDItaly015: “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. Therefore stickers, grease and adhesive have been excluded from the LCA model as their weights are negligible. The same applies for packaging, where small parts such as sticking labels and grease are even a smaller fraction of the total mass.

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. Surface treatments like zinc plating have been considered in the LCA model.

Inventory Analysis

Manufacturing stage

As presented in chapter Constituent Materials, steel and magnelis are the most frequently used materials, followed by stainless steel and copper.

Using the ecoinvent database, the steels are mainly modelled with *Steel, low-alloyed {GLO}| market for*, *ABB, Magnelis, metal sheet (EPD)* and *Steel, chromium steel 18/8 {GLO}| market for* and the copper is modelled with mainly *Copper, cathode {GLO}| market for*. To account for the production activities of metal and plastic parts, *Metal working, average* and *Injection molding* is the most frequently used processes. Surface treatments are also included, and the most common surface treatments are *ABB_Zinc coat pieces (GLO)_SMP_V2* and *ABB_Zinc coat coils (GLO)_SMP_V2*.

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. The selected ecoinvent processes are *transport, freight, lorry 7.5-16 metric ton, EURO4 {RER}* for lorry and *transport, freight, sea, container ship {GLO}* for sea transport.

For the ABB manufacturing site, which is considered in the core manufacturing stage, utility consumption and waste generation are allocated to the production of one ZX2 Feeder-36.12.31 according to the defined allocation rules. The packaging materials and accessories associated with the product are also considered in the core manufacturing stage.

The energy mix used for the production is representative for ABB Videnska factory based on the guarantee of origin (GO) energy certificate. 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.

Electricity	Source	Amount	Unit
ABB_Electricity mix Brno factory {CZ}_2022 | S_SMP_V1	Ecoinvent v3.9.1	0.50	kg CO_2-eq/kWh

Distribution

The transport distance from the ABB manufacturing site to the site of installation is assumed to be 300 km over land, as suggested by the PCR EPDItaly015, as the actual distance is unknown. The selected ecoinvent process is *transport, freight, lorry 16-32 metric ton, EURO4 {RER}*.

Installation

The installation phase only implies manual activities, and negligible amount of energy is consumed. Therefore, this phase only considers the end-of-life of the packaging materials used.

The end-of-life scenario for packaging materials is based on *Packaging waste by waste management operations* by Eurostat (2020), which is representative for Europe. A transport distance of 100 km by lorry is assumed as actual location of disposal is unknown.

Use

The use stage considers the reference power consumption, power losses and SF_6 losses over the reference service life of 20 years as defined in the functional unit. A load rate of 35 % and a use rate of 100 % is assumed. It is calculated using the following formula, according to PCR EPDItaly015:

$$E_{use}[kWh] = \frac{P_{use} * 8760 * RSL * \alpha}{1000} = \frac{31.35\ \text{W} * 8760\ \text{hours} * 20\ \text{years} * 100\ \%}{1000} = 5492.81\ kWh$$

Where:

- E_{use} = Total energy use over the reference service life
- P_{use} = Reference power consumption in watts
- *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

Because this product is sold globally and is not limited to any specific country, the latest energy mix of the European Union is adopted as suggested by the standard EN 50693. The emission factor of the energy mix is presented below.

Energy mix	Source	Amount	Unit
Electricity, medium voltage {RER}| market group for electricity, medium voltage | Cut-off, S	Ecoinvent v3.9.1	0.36	kg CO_2-eq./kWh

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.

The end-of-life scenario for the product is modelled according to PCR EPDItaly015 and IEC/TR 62635. The percentages for end-of-life treatments are taken from IEC/TR 62635 (Annex D.3), which is representative for Europe. A conservative approach is adopted by mainly using rates given for materials that go through a separation process (table D.8), and this includes the losses in the separation processes. Exceptions include electronics and copper cables which requires selective treatment (table D.5) and ceramics for which 100 % landfill is assumed. A transport distance of 100 km by lorry is assumed as actual location of disposal is unknown.

Environmental Indicators

The following tables show the environmental impact indicators of the life cycle of medium-voltage gas-insulated switchgear ZX2 Feeder-36.12.31 as requested by PCR EPDItaly007, PCR EPDItaly015 and EN 50693:2019. The indicators are divided into the contribution of the processes to the different modules (upstream, core and downstream) and stages (manufacturing, distribution, installation, use and end-of-life).

ZX2 Feeder-36.12.31

			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.	1.08E+04	6.52E+03	6.34E+01	2.39E+01	6.86E+01	4.03E+03	1.25E+02
GWP – fossil	kg CO_2 eq.	1.07E+03	6.49E+03	1.68E+02	2.38E+01	6.81E+00	3.96E+03	9.81E+01
GWP – biogenic	kg CO_2 eq.	3.71E+00	2.74E+01	-1.76E+02	2.17E-02	6.18E+01	6.40E+01	2.64E+01
GWP – luluc	kg CO_2 eq.	8.78E+01	1.19E+01	7.14E+01	1.17E-02	2.17E-03	4.34E+00	1.18E-01
ODP	kg CFC-11 eq.	1.97E-04	1.51E-04	1.32E-05	5.22E-07	8.67E-08	3.12E-05	1.08E-06
AP	mol H+ eq.	1.20E+02	1.10E+02	1.20E+00	9.87E-02	2.30E-02	8.71E+00	4.41E-01
EP – freshwater	kg P eq.	9.82E+00	8.16E+00	4.36E-02	1.68E-03	6.28E-04	1.58E+00	3.00E-02
EP – marine	kg N eq.	1.30E+01	9.18E+00	1.96E+00	3.77E-02	2.94E-02	1.55E+00	2.40E-01
EP – terrestrial	mol N eq.	1.48E+02	1.24E+02	8.50E+00	4.02E-01	9.92E-02	1.37E+01	1.18E+00
POCP	kg NMVOC eq.	4.30E+01	3.38E+01	4.18E+00	1.45E-01	3.31E-02	4.40E+00	3.71E-01
ADP – minerals and metals	kg Sb eq.	1.19E+00	1.18E+00	8.32E-04	7.71E-05	1.24E-05	3.45E-03	7.90E-04
ADP – fossil	MJ, net calorific value	1.14E+05	6.96E+04	2.55E+03	3.40E+02	5.98E+01	3.99E+04	1.08E+03
WDP	m^3 eq.	2.46E+03	1.93E+03	1.05E+02	1.38E+00	3.29E-01	4.08E+02	1.51E+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.

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	1.16E+05	7.23E+04	2.54E+03	3.40E+02	5.98E+01	3.99E+04	1.08E+03
PERE	MJ, low cal. value	2.52E+04	1.31E+04	4.41E+03	5.28E+00	1.16E+00	7.67E+03	1.04E+02
PENRM	MJ, low cal. value	1.73E+03	1.64E+03	9.02E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERM	MJ, low cal. value	1.89E+03	3.76E-06	1.89E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRT	MJ, low cal. value	1.18E+05	7.40E+04	2.63E+03	3.40E+02	5.98E+01	3.99E+04	1.08E+03
PERT	MJ, low cal. value	2.71E+04	1.31E+04	6.30E+03	5.28E+00	1.16E+00	8.44E+03	1.05E+02
FW	m^3	9.16E+01	5.63E+01	3.47E+00	4.85E-02	1.27E-02	3.12E+01	5.62E-01
MS	kg	2.46E+02	2.41E+02	5.13E+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.

Waste production indicators	Unit	Total	Cradle-to-gate		Cradle-to-grave			
			UPSTREAM	CORE	DOWNSTREAM			
			Manufacturing		Distribution	Installation	Use and maintenance	End-of-life
HWD	kg	5.57E-01	4.90E-01	1.00E-02	2.17E-03	3.47E-04	5.06E-02	4.09E-03
NHWD	kg	2.54E+03	2.14E+03	3.56E+01	1.66E+01	5.61E+01	1.10E+02	1.80E+02
RWD	kg	4.55E-01	1.57E-01	4.74E-03	1.11E-04	2.20E-05	2.91E-01	2.10E-03
MER	kg	7.36E+01	2.63E+01	3.29E+00	0.00E+00	3.98E+01	0.00E+00	4.16E+00
MFR	kg	1.10E+03	2.36E+02	7.78E+01	0.00E+00	4.59E+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	3.42E+02	1.29E+02	2.24E+01	0.00E+00	1.65E+02	0.00E+00	2.58E+01
EEE	MJ	1.83E+02	6.51E+01	1.14E+01	0.00E+00	9.18E+01	0.00E+00	1.44E+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.

Additional Environmental Information

Recyclability potential

The recyclability potential of the ZX2 Feeder-36.12.31 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 83.1 %.

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.

Electricity	Source	Amount	Unit
ABB_Electricity mix Brno factory {CZ}_2022 | S_SMP_V1	Ecoinvent v3.9.1	0.50	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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Program Operator and publisher		
The Norwegian EPD Foundation	Ph.	+47 23 08 80 00
Post Box 5250 Majorstuen,	email	post@epd-norge.no
0303 Oslo, Norway	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, Czech Republic	web	www.abb.com