

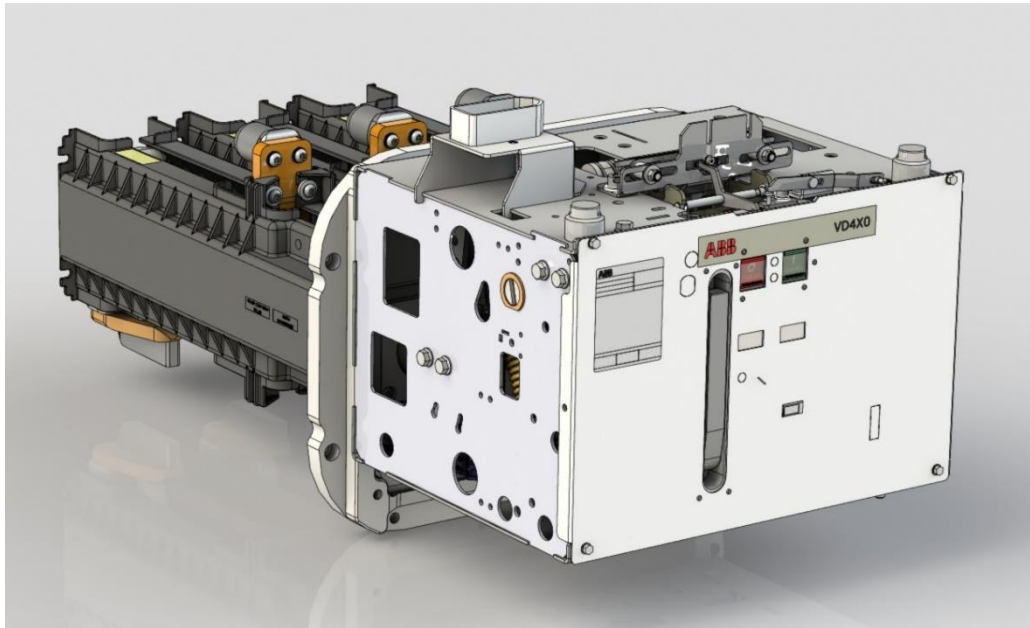
EPD

Environmental Product Declaration



Circuit breaker VD4X0/BEU 12-17-24.06-12.25 (P.140)

Direct replacement solution for ABB SF6 HA1-2 circuit breakers in UniSystem BEU3 switchgear

Production site: ABB Dalmine



DOCUMENT KIND Environmental Product Declaration	IN COMPLIANCE WITH ISO 14025 and EN 50693			
PROGRAM OPERATOR The Norwegian EPD Foundation	PUBLISHER The Norwegian EPD Foundation			
REGISTRATION NUMBER OF THE PROGRAM OPERATOR NEPD-7621-6999-EN	ISSUE DATE 2024-09-20			
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OWNING ORGANIZATION ABB Switzerland Ltd, Group Technology Management	ABB DOCUMENT ID 1VCD900070R0001	REV. S2831	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.p.A. Via Friuli, 4, 24044 Dalmine, Italy		
Company contact	Stefano Magoni – stefano.magoni@it.abb.com ELSE R&D IT Apparatus & Service 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	VD4X0/BEU 12-17-24.06-12.25 (P.140)		
Product description	VD4X0/BEU 12-17-24.06-12.25 (P.140) breakers are used in electrical distribution for control and protection of cables, overhead lines, transformer and distribution substations, motors, transformers, generators and capacitor banks from damage caused by overload or short circuit thanks to the interruption of an electric current with a mechanical actuator. It can be equipped with three embedded poles (PG05 B133 VG4-Ki 1250A), that are used to provide dielectric strength and protection of the vacuum interrupter.		
Functional unit	To manage and protect the electrical continuity of the circuit to which it is applied, at a use rate of 30% of service life and load factor of 50% of the rated current, during a service life of 20 years in Europe.		
Reference flow	A single VD4X0/BEU 24.12.25 (P.140) circuit breaker, 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: 		
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. EPDItaly012 – Electronic and Electrical Products and Systems – Switches, Rev. 0, 2020/03/16.		
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 1VCD900069R0001.		
EPD type	Specific product with extrapolation rules		
EPD scope	Cradle-to-grave		
Product RSL	20 years		
Geographical representativeness	Manufacturing (suppliers): Global	Manufacturing (ABB): Italy	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” with extrapolation rules. A representative product configuration is declared as reference product, and the results can be extrapolated for other configurations according to the provided extrapolation rules. The EPD covers the following devices of the VD4X0/BEU 12-17-24.12.25 P140, including related accessories and packaging:

- VD4X0/BEU 12-17-24.06-12.25 P140 with cubicle upgrade
- VD4X0/BEU 12-17-24.06-12.25 P140

General technical information of the products are presented below.

Description		VD4X0/BEU 12-17-24.12.25 (P140)	VD4X0/BEU 12-17-24.12.25 (P140)
Size	Weight	174.57 kg	117.44 kg
Ratings	Rated voltage [kV]	12-17.5-24	12-17.5-24
	Rated current [A]	630-1250	630-1250
	Rated short circuit breaking current [kA]	25	25
Configuration	Cubicle upgrade	yes	no

The reference product is VD4X0/BEU 24.12.25 with cubicle upgrade. All other configurations will be studied with extrapolation rules.

The products are manufactured by ABB ELSE located in Dalmine. 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
- ISO 50001:2018 – Energy management systems

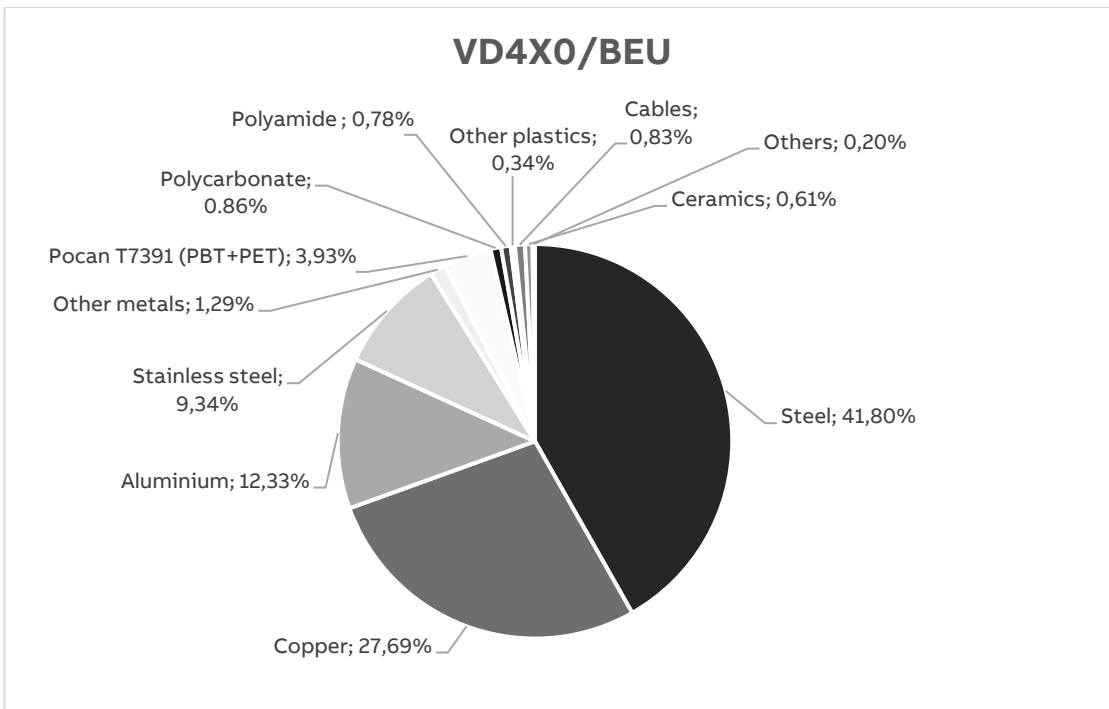
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Constituent Materials

The constituent materials of the reference Product are presented below.

Type	Material	Weight [kg]	Weight %
Metals	Steel, low-alloyed	62.71	41.80%
	Steel, stainless	14.01	9.34%
	Copper	41.55	27.69%
	Aluminum	18.50	12.33%
	Other metals	1.93	1.29%
Plastics	Pocan T7391 (PBT+PET)	5.90	3.93%
	Polycarbonate	1.30	0.86%
	Polyamide	1.17	0.78%
	Other plastics	0.51	0.34%
Others	Cables	1.24	0.83%
	Ceramics	0.92	0.61%
	Others	0.30	0.20%
Total		150.04	100



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

Description	Material	Weight [kg]	Weight %
Base	Wood	23.4	95.39
Lateral protections			
Bag	PE-LD	0.83	3.38
Band	PP	0.05	0.20
Other	Silica sand	0.25	1.02
		24.53	100



LCA Background Information

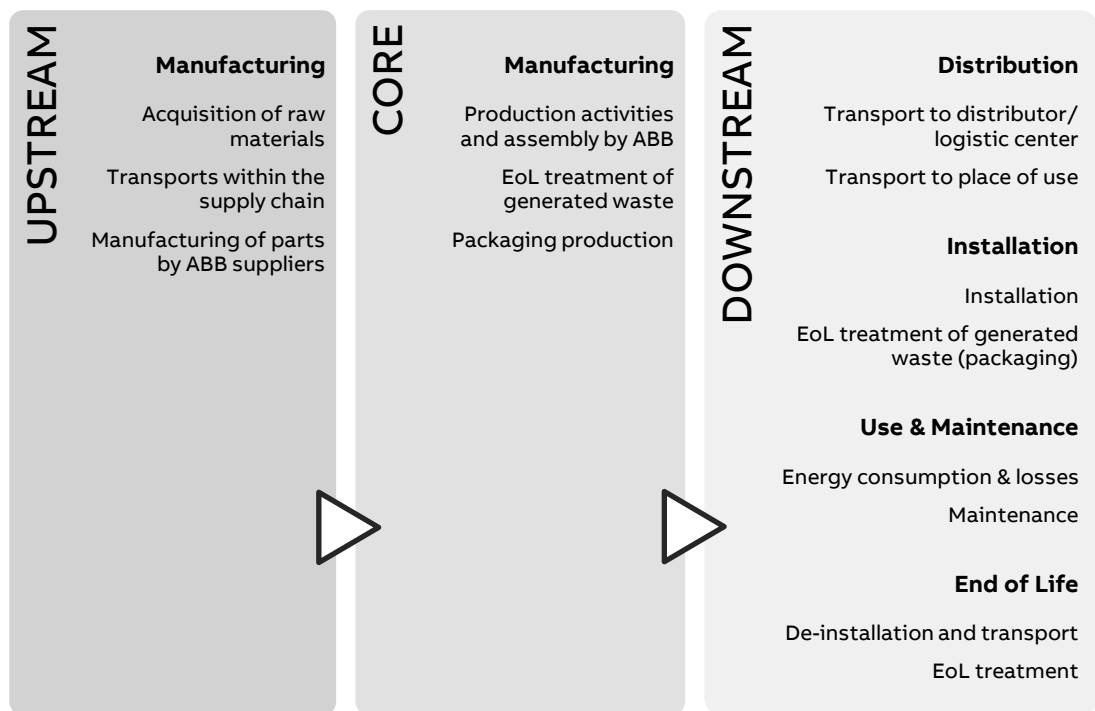
Functional Unit

To manage and protect the electrical continuity of the circuit to which it is applied, at a use rate of 30% of service life and load factor of 50% of the rated current, during a service life of 20 years in Europe. The reference flow is single VD4X0/BEU 12-17-24.06-12.25 (P.140) circuit breaker, 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 (BOM), CAD-files, 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 materials

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electrogalvanized steel and polyoxymethylene. 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 or Standard, the cut-off criteria can be set to a maximum of 5% of the overall environmental impacts. In this LCA, grease and stickers have been excluded as their weights are negligible. In addition, production, use and disposal of the packaging of components and semi-finished intermediates have been excluded, according to PCR EPDItaly012.

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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.

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 inecoinvent'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 ABB manufacturing site through Cancellation Statement.

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 EPDItaly012, as the actual distance is unknown.

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

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	<i>Packaging waste by waste management operations (Eurostat, 2021)*</i>	100 km by lorry (assumption)	Europe

*Due to lack of data from Eurostat, 100% landfill is assumed for silica sand

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Use

The use stage considers the reference power consumption over the reference service life as defined in the functional unit. This is calculated using the following formula, according to PCR EPDItaly012:

$$E_{use}[kWh] = \frac{P_{use} * 8760 * RSL * \alpha}{1000} = \frac{41.01 \text{ W} * 8760 \text{ hours} * 20 \text{ years} * 30 \%}{1000} = 2155.78 \text{ kWh}$$

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

	Dataset	Amount	Unit	Represent.
Energy	European energy mix; <i>Electricity, medium voltage {RER} market group for / Cut-off, S</i>	Ecoinvent v3.9.1	0.362	kg CO ₂ -eq/kWh

As far as maintenance is concerned, it is assumed that there are no scheduled interventions during the product's service life, according to PCR EPDItaly012.

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.

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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.

Reference Product at 1250A

Impact category	Unit	Total	Cradle-to-gate					
			UPSTREAM	CORE	DOWNSTREAM			
			Manufacturing		Distribution	Installation	Use and maintenance	End-of-life
GWP – total	kg CO ₂ eq.	2.02E+03	1.22E+03	-1.55E+01	1.01E+01	1.28E+01	7.79E+02	1.98E+01
GWP – fossil	kg CO ₂ eq.	1.99E+03	1.19E+03	1.61E+01	1.01E+01	1.75E+00	7.50E+02	1.58E+01
GWP – biogenic	kg CO ₂ eq.	2.99E+01	1.88E+01	-3.16E+01	9.18E-03	1.10E+01	2.77E+01	4.00E+00
GWP – luluc	kg CO ₂ eq.	4.28E+00	2.31E+00	6.77E-02	4.93E-03	4.24E-04	1.88E+00	1.87E-02
ODP	kg CFC-11 eq.	3.35E-05	1.93E-05	4.02E-07	2.21E-07	1.59E-08	1.35E-05	1.65E-07
AP	mol H+ eq.	3.47E+01	3.07E+01	1.25E-01	4.18E-02	4.27E-03	3.76E+00	6.97E-02
EP – freshwater	kg P eq.	3.08E+00	2.38E+00	7.31E-03	7.11E-04	1.19E-04	6.84E-01	4.70E-03
EP – marine	kg N eq.	3.04E+00	2.27E+00	4.45E-02	1.59E-02	5.27E-03	6.69E-01	3.87E-02
EP – terrestrial	mol N eq.	3.47E+01	2.80E+01	4.80E-01	1.70E-01	1.83E-02	5.90E+00	1.86E-01
POCP	kg NMVOC eq.	1.07E+01	8.49E+00	1.52E-01	6.11E-02	6.06E-03	1.90E+00	5.86E-02
ADP – minerals and metals	kg Sb eq.	3.82E-01	3.80E-01	9.01E-05	3.26E-05	2.38E-06	1.49E-03	1.25E-04
ADP – fossil	MJ, net calorific value	3.20E+04	1.41E+04	3.45E+02	1.44E+02	1.12E+01	1.73E+04	1.70E+02
WDP	m ³ eq.	6.90E+02	4.93E+02	1.85E+01	5.84E-01	5.93E-02	1.76E+02	2.08E+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.

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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	3.18E+04	1.39E+04	3.08E+02	1.44E+02	1.12E+01	1.73E+04	1.70E+02
PERE	MJ, low cal. value	6.13E+03	2.33E+03	4.72E+02	2.23E+00	2.35E-01	3.31E+03	1.65E+01
PENRM	MJ, low cal. value	2.17E+02	1.80E+02	3.68E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERM	MJ, low cal. value	3.45E+02	1.26E+01	3.32E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRT	MJ, low cal. value	3.20E+04	1.41E+04	3.45E+02	1.44E+02	1.12E+01	1.73E+04	1.70E+02
PERT	MJ, low cal. value	6.48E+03	2.34E+03	8.04E+02	2.23E+00	2.35E-01	3.31E+03	1.65E+01
FW	m ³	2.82E+01	1.41E+01	5.35E-01	2.05E-02	2.33E-03	1.35E+01	7.97E-02
MS	kg	3.92E+01	3.92E+01	0.00E+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	5.91E-01	5.66E-01	1.02E-03	9.16E-04	6.35E-05	2.19E-02	6.44E-04
NHWD	kg	4.92E+02	3.97E+02	3.14E+00	7.03E+00	9.54E+00	4.74E+01	2.75E+01
RWD	kg	1.51E-01	2.36E-02	9.87E-04	4.68E-05	4.42E-06	1.26E-01	3.33E-04
MER	kg	7.90E+00	4.70E-02	1.40E-02	0.00E+00	7.35E+00	0.00E+00	4.97E-01
MFR	kg	1.58E+02	3.12E+01	1.54E+00	0.00E+00	7.88E+00	0.00E+00	1.18E+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	3.64E+01	3.56E-01	1.01E-01	0.00E+00	3.19E+01	0.00E+00	4.09E+00
EEE	MJ	2.02E+01	1.98E-01	5.61E-02	0.00E+00	1.77E+01	0.00E+00	2.27E+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.

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Extrapolation rules

Due to the variations in environmental impacts present within the products, extrapolation rules are established according to EN 50693. In order to calculate the environmental impacts of the circuit breakers listed in the following table, it is necessary to use the following formula:

$$EI_{n,m} = a_{n,m} * EI_{rp,m}$$

Where:

- EI_{nm} is the “m” environmental impact category of the “n” listed circuit breaker
- $a_{n,m}$ is a multiplicative coefficient of the “m” environmental impact category specified for the “n” listed circuit breaker
- $EI_{rp,m}$ is the “m” environmental impact category of the reference product “rp”

Product			Impact category												
Circuit breaker	Ratings	Cubicle upgrade	Climate change - Total [kg CO2 eq]	Climate change - Fossil [kg CO2 eq]	Climate change - Biogenic [kg CO2 eq]	Climate change - Land use and LU change [kg CO2 eq]	Ozone depletion [kg CFC11 eq]	Acidification [mol H+ eq]	Eutrophication aquatic freshwater [kg P eq]	Eutrophication aquatic marine [kg N eq]	Eutrophication terrestrial [mol N eq]	Photochemical ozone formation [kg NMVOC eq]	Dep of ab res - minerals and metals [kg Sb eq]	Dep of ab res - fossils [MJ]	Water use [m3]
VD4X0/BEU	12.06.25		0.52	0.52	0.04	0.51	0.54	0.42	0.39	0.50	0.48	0.49	0.41	0.45	0.42
VD4X0/BEU	12.06.25	V	0.71	0.72	0.30	0.67	0.70	0.92	0.83	0.84	0.87	0.87	1.00	0.60	0.81
VD4X0/BEU	12.12.25		0.80	0.80	0.74	0.84	0.84	0.50	0.55	0.66	0.61	0.63	0.42	0.85	0.61
VD4X0/BEU	12.12.25	V	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
VD4X0/BEU	17.06.25		0.52	0.52	0.04	0.51	0.54	0.42	0.39	0.50	0.48	0.49	0.41	0.45	0.42
VD4X0/BEU	17.06.25	V	0.71	0.72	0.30	0.67	0.70	0.92	0.83	0.84	0.87	0.87	1.00	0.60	0.81
VD4X0/BEU	17.12.25		0.80	0.80	0.74	0.84	0.84	0.50	0.55	0.66	0.61	0.63	0.42	0.85	0.61
VD4X0/BEU	17.12.25	V	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
VD4X0/BEU	24.06.25		0.52	0.52	0.04	0.51	0.54	0.42	0.39	0.50	0.48	0.49	0.41	0.45	0.42
VD4X0/BEU	24.06.25	V	0.71	0.72	0.30	0.67	0.70	0.92	0.83	0.84	0.87	0.87	1.00	0.60	0.81
VD4X0/BEU	24.12.25		0.80	0.80	0.74	0.84	0.84	0.50	0.55	0.66	0.61	0.63	0.42	0.85	0.61
*VD4X0/BEU	24.12.25	V	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

*Reference product

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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 78%. The result is representative for Europe according to IEC/TR 62635.

The recyclability potential of the packaging is calculated by dividing “MFR: material for recycling” in the installation stage by the total weight of the packaging. As a result, the recyclability potential of the product is 32%. The recyclability potential is representative for Europe according to Eurostat (2021).

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

The ABB manufacturing site uses 100 % renewable energy, procured through Guarantees of Origins (GO's) and internal photovoltaic panels for the electricity.

Energy mix	Source	Amount	Unit
<i>ABB_electricity mix 2023, Dalmine factory (80% hydro-20%solar)_ V1</i>	Ecoinvent v3.9.1	0.024	kg CO ₂ -eq/kWh

Dangerous substances

The product contains no substances given by the REACH Regulation (EC 1907/2006).

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 web www.abb.com
 Baden, Switzerland



Author

Stefano Palazzi
 ABB S.p.A. email EPD_ELSE@abb.com
 Via Friuli 4, Dalmine, Italy web www.abb.com

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