EPD

Environmental Product Declaration

VD4 Vacuum Circuit Breakers p.275 family with PT2 pole

Production site: Dalmine, Italy

DOCUMENT KIND	IN COMPLIANCE WITH			
Environmental Product Declaration	ISO 14025 and EN 50693			
PROGRAM OPERATOR	PUBLISHER			
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ABB Switzerland Ltd, Group Technology Management	1VCD601911R0001	A	EN	1/19

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
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Declared product	VD4 Vacuum Circuit Breaker p.275 adopting PT2 pole in all its versions.
Product description	The VD4 is a medium voltage tripolar circuit breaker. It is an automatically operated electrical device that is used to control and protect an electrical circuit from damage caused by overload or short circuit. It can be equipped with three embedded poles (PT2), that are used to provide dielectric strength and protection of the vacuum interrupter (VGE4-S).
Functional unit	To manage and protect the electrical continuity of the circuit to which it is applied, at use rate of 30% and load factor of 50% during a service life of 20 years in Europe.
Reference flow	A single average withdrawable VD4 p.275 with PT2 pole and 1600A nominal current.
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. EPDItaly012 – Electronic and Electrical Products and Systems – Switches, Rev. 0, 2020/03/16. 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 1VCD601909R0001.
EPD type	Average product
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.

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.

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General Information

This Environmental Product Declaration is an “average EPD” which declares an average product as the reference product. According to the General Program Instructions of EPD-Norge, the total environmental impacts do not vary more than ± 10 % between the declared products; however, variations may be greater for the other impact categories. The EPD covers the following devices of the VD4 p.275 family with PT2 pole, including related accessories and packaging:

- VD4
- VD4/G
- VD4/GT
- VD4/P
- VD4/P/G
- VD4/P/GT

VD4, VD4/G and VD4/GT stand for fixed configurations, that will be analyzed as sensitivity analysis; while the other p.275 withdrawable devices adopting PT2 pole with nominal current 1600A compose the reference flow, including the related accessories and packaging. The other products (withdrawable devices with 2000A and 2500 nominal current) will be analyzed through extrapolation rules derived from the reference device

General technical information of the VD4 p.275 with PT2 pole are presented below.

Description		VD4 Family
Ratings	**Rated voltage [kV]**	12 to 17.5
	Rated current [A]	1600
	Rated short circuit breaking current [kA]	20 to 31.5

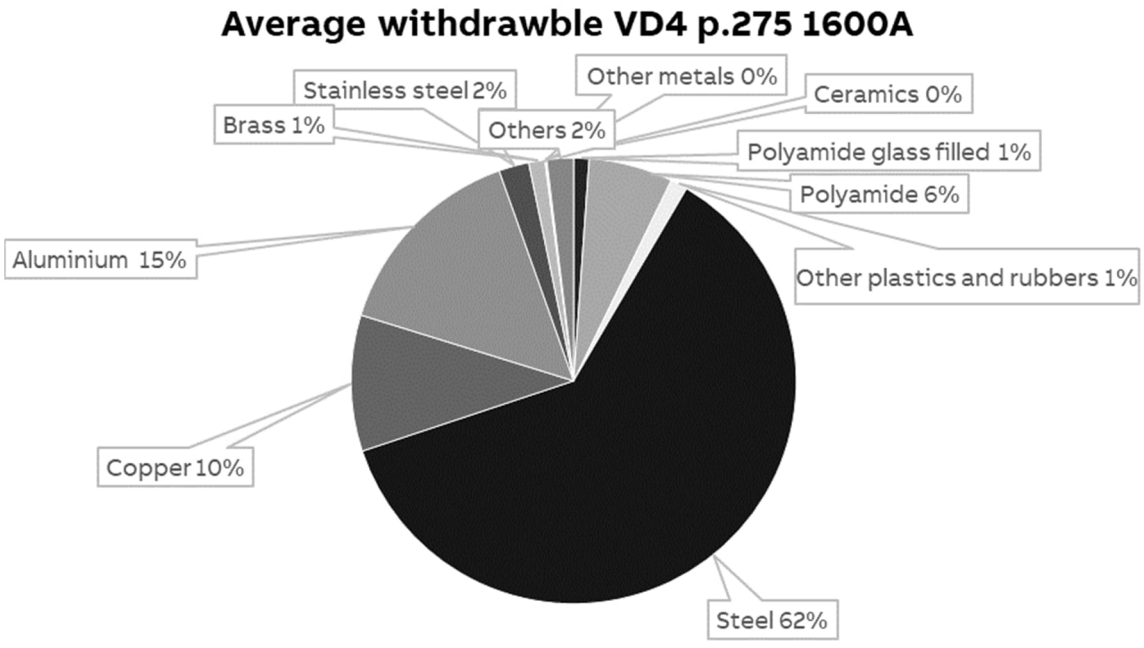
The VD4 p.275 with PT2 pole are manufactured by ABB manufacturing site located in Dalmine, Italy. The manufacturing site is certified according to the following standards:

- 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

Constituent Materials

The constituent materials of the average withdrawable version of VD4 p.275 with PT2 pole 1600A are presented below.

Type	Material	Weight [kg]	Weight %
Metals	Steel	78.71	61.44%
	Stainless Steel	2.81	2.19%
	Copper	12.65	9.87%
	Aluminium	18.96	14.80%
	Brass	1.49	1.17%
	Other metals	0.14	0.11%
Plastics	Polyamide glass filled	1.43	1.12%
	Polyamide	7.82	6.10%
	Other plastics and rubbers	1.58	1.23%
Others	Ceramics	0.03	0.02%
	Others	2.48	1.93%
Total		128.11	100%



The constituent materials of the packaging and accessories are presented below. Both primary packaging (unit) and secondary packaging (bulk) are considered, and 1 piece is assumed per pallet.

	Description	Material	Weight [kg]	Weight %
Unit (1st)	Bag	Paper	0.80	2.11%
	Bracket, Screw, Nut, Washer	Steel	1.16	3.06%
	Belt	Polyamide	0.05	0.13%
	Subtotal		**2.01**	**5.32%**
Bulk (2nd)	Pallet	Wood	35.8	94.68%
	Subtotal		**35.8**	**100%**
	Total		**37.81**	**100%**

LCA Background Information

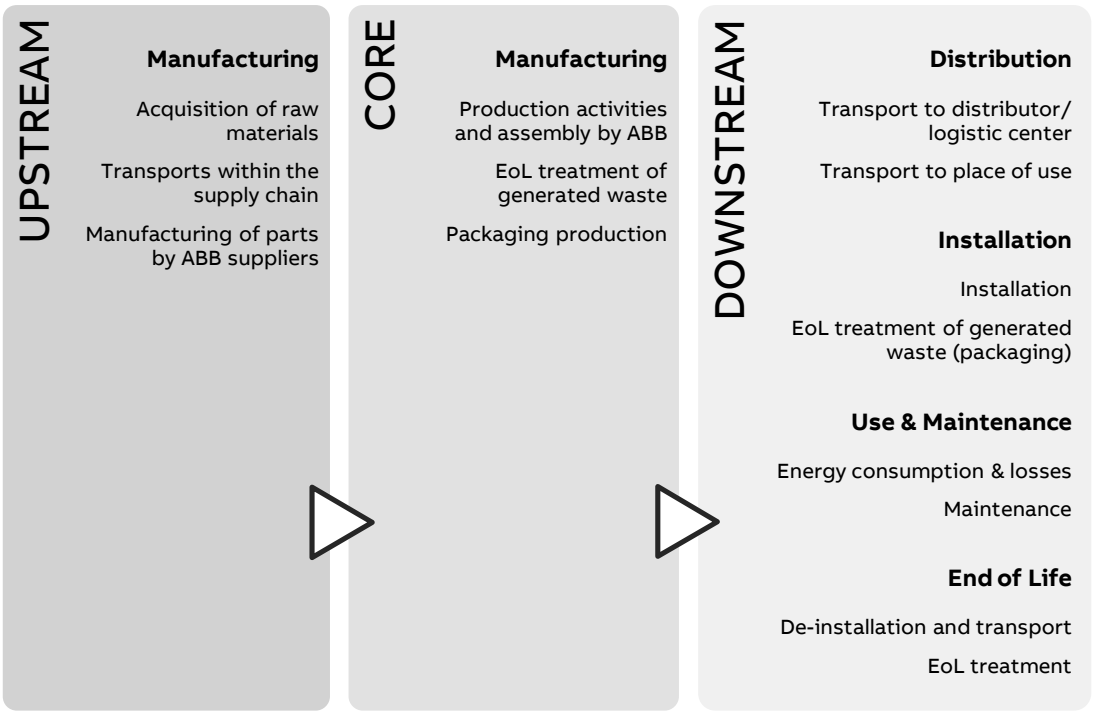
Functional Unit

The functional unit of this study is to manage and protect the electrical continuity of the circuit to which it is applied with a use rate of 30% and a load factor of 50%, during a service life of 20 years in Europe. The reference flow is a single average withdrawable version VD4 p.275 with PT2 pole device in withdrawable version, 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 a withdrawable VD4 p.275 with PT2 pole is a “cradle-to-grave” analysis, and the system boundaries are defined according to EN 50693, as required by the PCR EPDItaly007 “Electronic and electrical products and systems”. 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), technical drawings, and site-specific foreground data provided by ABB. while site specific foreground data are 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 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 EPDItaly007 “Electronic and electrical products and systems”.

Cut-off criteria

According to PCR EPDItaly007 “Electronic and electrical products and systems”, the cut-off criteria can be set to a maximum of 2% of the overall environmental impacts. In this LCA, components like stickers, glue and grease have been excluded as their weights are negligible. The same applies to packaging, where small parts such as sticking labels are even smaller fraction of the total mass. Burnishing, oiling, black oxide, and phosphate surface treatments have also been excluded due to the low amount of surface involved.

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 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 ABB manufacturing site through Guarantees of Origins (GO's). 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 over land, as suggested by the Sub-PCR EPDItaly012 – „Electronic and electrical products and systems – Switches", as the actual customer's distance is unknown. The selected ecoinvent process is *transport, freight, lorry 16-32 metric ton, EURO4 {RER}*.

	Dataset	Amount	Unit	Represent.
Transport	*Transport, freight, lorry 16-32 metric ton, EURO4 {RER}*	300	km	EPDItaly012

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)

Use

The use stage considers the reference power consumption over the reference service life of 20 years as defined in the functional unit. This is calculated using the following formula, according to PCR:

$$P_{use} = R_{int} * (I_{nom} * LF)^2 * n_{poles}$$

$$E_{use}[kWh] = \frac{P_{use} * 8760 * RSL * \alpha}{1000} = 1715{,}56kWh$$

Where:

- E_{use} = Average total energy use over the reference service life
- P_{use} = Average reference power consumption in watts
- I_{nom} = 1600A
- R_{int} = Internal resistance
- *LF =* Load Factor
- n_{poles} = Number of poles
- *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.

Table 6 – Emission factor for the energy mix used in the use stage

Energy mix	Source	Amount	Unit
European energy mix; *Electricity, medium voltage {RER}| market group for | Cut-off, S*	Ecoinvent v3.9.1	0.362	kg CO_2-eq./kWh

Maintenance is not considered because it does not imply any relevant use of material or energy.

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- "Electronic and electrical products and systems", the environmental impact indicators are determined by using the characterization factors and impact assessment methods specified in EN 15804:2012+A2:2019.

Impact category	Unit	Total	Cradle-to-gate		Cradle-to-grave			
			UPSTREAM	CORE	DOWNSTREAM			
			Manufacturing		Distribution	Installation	Use and maintenance	End-of-life
GWP – total	kg CO_2 eq.	1,59E+03	9,44E+02	-2,35E+01	9,33E+00	1,82E+01	6,20E+02	1,88E+01
GWP – fossil	kg CO_2 eq.	1,58E+03	9,31E+02	2,49E+01	9,32E+00	1,07E+00	5,97E+02	1,51E+01
GWP – biogenic	kg CO_2 eq.	6,26E+00	1,19E+01	-4,85E+01	8,47E-03	1,71E+01	2,20E+01	3,64E+00
GWP – luluc	kg CO_2 eq.	3,05E+00	1,44E+00	8,95E-02	4,55E-03	5,35E-04	1,49E+00	1,72E-02
ODP	kg CFC-11 eq.	3,92E-05	2,74E-05	7,19E-07	2,04E-07	2,26E-08	1,07E-05	1,55E-07
AP	mol H+ eq.	1,84E+01	1,51E+01	1,58E-01	3,67E-02	6,00E-03	3,00E+00	6,45E-02
EP – freshwater	kg P eq.	1,78E+00	1,22E+00	1,13E-02	6,56E-04	1,64E-04	5,45E-01	4,35E-03
EP – marine	kg N eq.	2,12E+00	1,46E+00	5,44E-02	1,37E-02	7,39E-03	5,33E-01	4,27E-02
EP – terrestrial	mol N eq.	2,34E+01	1,78E+01	5,80E-01	1,46E-01	2,60E-02	4,70E+00	1,72E-01
POCP	kg NMVOC eq.	7,06E+00	5,24E+00	1,93E-01	5,40E-02	8,62E-03	1,51E+00	5,43E-02
ADP – minerals and metals	kg Sb eq.	2,21E-01	2,19E-01	1,37E-04	3,01E-05	3,29E-06	1,19E-03	1,15E-04
ADP – fossil	MJ, net calorific value	2,52E+04	1,07E+04	4,30E+02	1,33E+02	1,53E+01	1,37E+04	1,58E+02
WDP	m^3 eq.	6,04E+02	4,40E+02	2,06E+01	5,39E-01	6,72E-02	1,40E+02	2,00E+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	2,49E+04	1,04E+04	4,30E+02	1,33E+02	1,53E+01	1,37E+04	1,58E+02
PERE	MJ, low cal. value	4,66E+03	1,38E+03	6,18E+02	2,06E+00	2,85E-01	2,64E+03	1,51E+01
PENRM	MJ, low cal. value	3,31E+02	3,31E+02	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
PERM	MJ, low cal. value	5,26E+02	1,54E+01	5,10E+02	0,00E+00	0,00E+00	0,00E+00	0,00E+00
PENRT	MJ, low cal. value	2,52E+04	1,07E+04	4,30E+02	1,33E+02	1,53E+01	1,37E+04	1,58E+02
PERT	MJ, low cal. value	5,18E+03	1,40E+03	1,13E+03	2,06E+00	2,85E-01	2,64E+03	1,51E+01
FW	m^3	2,69E+01	1,55E+01	6,15E-01	1,89E-02	2,85E-03	1,07E+01	7,56E-02
MS	kg	4,12E+01	4,01E+01	1,11E+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	2,18E-01	1,97E-01	1,88E-03	8,45E-04	9,02E-05	1,74E-02	5,98E-04
NHWD	kg	3,27E+02	2,37E+02	5,70E+00	6,49E+00	1,45E+01	3,77E+01	2,57E+01
RWD	kg	1,17E-01	1,56E-02	1,14E-03	4,32E-05	5,52E-06	1,00E-01	3,05E-04
MER	kg	1,61E+01	4,53E+00	1,34E-01	0,00E+00	1,08E+01	0,00E+00	5,75E-01
MFR	kg	1,43E+02	1,82E+01	4,71E+00	0,00E+00	1,30E+01	0,00E+00	1,08E+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	5,56E+01	6,71E+00	8,11E-01	0,00E+00	4,31E+01	0,00E+00	4,95E+00
EEE	MJ	3,08E+01	3,64E+00	4,50E-01	0,00E+00	2,40E+01	0,00E+00	2,75E+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.

Extrapolation rules

Due to the large variations in environmental impacts present within the series, extrapolation rules are established according to EN 50693 for devices with nominal current of 2000A and 2500A. Those values can be obtained from the results for the reference average withdrawable VD4 p.275 with PT2 pole and 1600A of nominal current, multiplying them for the correspondent conversion factor as shown in the following formulas:

$$Value_{2000A} = Value_{1600A} * ConversionFactor$$

$$Value_{2500A} = Value_{1600A} * ConversionFactor$$

Where:

- $Value_{1600A}$ can be found in the tables in the previous chapter;
- $ConversionFactor$ are constants and they can be found in the following tables.

The conversion factors were calculated by dividing the results obtained in the LCA analysis of the other configurations (2000A and 2500A nominal current) for the ones related to the withdrawable products with 1600A nominal current.

Conversion factors list for the average withdrawable VD4 p.275 with PT2 pole 2000A

Impact category	Unit	Total	UPSTREAM	CORE	DOWNSTREAM			
			Manufacturing		Distribution	Installation	Use and maintenance	End-of-life
GWP – total	kg CO_2 eq.	1,25	1,15	1,00	1,09	1,00	1,42	1,10
GWP – fossil	kg CO_2 eq.	1,25	1,15	1,00	1,09	1,00	1,42	1,09
GWP – biogenic	kg CO_2 eq.	2,92	1,20	1,00	1,09	1,00	1,42	1,11
GWP – luluc	kg CO_2 eq.	1,27	1,13	1,00	1,09	1,00	1,42	1,11
ODP	kg CFC-11 eq.	1,16	1,06	1,00	1,09	1,00	1,42	1,11
AP	mol H+ eq.	1,92	2,03	1,00	1,09	1,00	1,42	1,11
EP – freshwater	kg P eq.	1,82	2,01	1,00	1,09	1,00	1,42	1,11
EP – marine	kg N eq.	1,44	1,48	1,00	1,09	1,00	1,42	1,06
EP – terrestrial	mol N eq.	1,51	1,56	1,00	1,09	1,00	1,42	1,11
POCP	kg NMVOC eq.	1,49	1,54	1,00	1,09	1,00	1,42	1,11
ADP – minerals and metals	kg Sb eq.	1,90	1,91	1,00	1,09	1,00	1,42	1,11
ADP – fossil	MJ, net calorific value	1,31	1,18	1,00	1,09	1,00	1,42	1,11
WDP	m^3 eq.	1,46	1,49	1,00	1,09	1,00	1,42	1,10

Conversion factors list for the average withdrawable VD4 p.275 with PT2 pole 2500A

Impact category	Unit	Total	UPSTREAM	CORE	DOWNSTREAM			
			Manufacturing		Distribution	Installation	Use and maintenance	End-of-life
GWP – total	kg CO_2 eq.	1,83	1,07	1,00	1,07	1,00	3,02	1,08
GWP – fossil	kg CO_2 eq.	1,80	1,07	1,00	1,07	1,00	3,02	1,08
GWP – biogenic	kg CO_2 eq.	8,40	1,14	1,00	1,07	1,00	3,02	1,09
GWP – luluc	kg CO_2 eq.	2,00	1,03	1,00	1,07	1,00	3,02	1,09
ODP	kg CFC-11 eq.	1,59	1,05	1,00	1,07	1,00	3,02	1,09
AP	mol H+ eq.	1,72	1,48	1,00	1,07	1,00	3,02	1,09
EP – freshwater	kg P eq.	1,96	1,49	1,00	1,07	1,00	3,02	1,09
EP – marine	kg N eq.	1,67	1,24	1,00	1,08	1,00	3,02	1,06
EP – terrestrial	mol N eq.	1,61	1,27	1,00	1,08	1,00	3,02	1,09
POCP	kg NMVOC eq.	1,63	1,26	1,00	1,07	1,00	3,02	1,09
ADP – minerals and metals	kg Sb eq.	1,51	1,50	1,00	1,07	1,00	3,02	1,09
ADP – fossil	MJ, net calorific value	2,14	1,09	1,00	1,07	1,00	3,02	1,09
WDP	m^3 eq.	1,64	1,24	1,00	1,07	1,00	3,02	1,08

Sensitivity analysis

A sensitivity analysis is conducted to understand how the environmental impacts vary considering operative condition variations. By changing the accessories of the withdrawable VD4 p.275 with PT2 pole, a fixed configuration can be obtained, and then, by considering a nominal current increase from 1600A to 2500A (along with fundamental components change), other two types of configurations are obtained. Both are similar to the reference flow, since the basic circuit breaker is the same, as well as most of the accessories, but the environmental impact indicators change.

Average Environmental Impact Indicators of fixed VD4 p.275 with PT2 pole 1600A

Impact category	Unit	Total	UPSTREAM	CORE	DOWNSTREAM			
			Manufacturing		Distribution	Installation	Use and maintenance	End-of-life
GWP – total	kg CO_2 eq.	1,14E+03	7,05E+02	-2,35E+01	6,91E+00	1,82E+01	4,20E+02	1,29E+01
GWP – fossil	kg CO_2 eq.	1,14E+03	6,96E+02	2,49E+01	6,90E+00	1,07E+00	4,04E+02	1,05E+01
GWP – biogenic	kg CO_2 eq.	-5,85E+00	8,27E+00	-4,85E+01	6,27E-03	1,71E+01	1,49E+01	2,34E+00
GWP – luluc	kg CO_2 eq.	2,17E+00	1,06E+00	8,95E-02	3,37E-03	5,35E-04	1,01E+00	1,14E-02
ODP	kg CFC-11 eq.	3,26E-05	2,43E-05	7,19E-07	1,51E-07	2,26E-08	7,25E-06	1,06E-07
AP	mol H+ eq.	1,27E+01	1,05E+01	1,58E-01	2,67E-02	6,00E-03	2,03E+00	4,30E-02
EP – freshwater	kg P eq.	1,33E+00	9,50E-01	1,13E-02	4,85E-04	1,64E-04	3,68E-01	2,90E-03
EP – marine	kg N eq.	1,55E+00	1,09E+00	5,44E-02	9,92E-03	7,39E-03	3,60E-01	3,14E-02
EP – terrestrial	mol N eq.	1,72E+01	1,32E+01	5,80E-01	1,06E-01	2,60E-02	3,18E+00	1,15E-01
POCP	kg NMVOC eq.	5,12E+00	3,82E+00	1,93E-01	3,93E-02	8,62E-03	1,02E+00	3,63E-02
ADP – minerals and metals	kg Sb eq.	1,95E-01	1,94E-01	1,37E-04	2,23E-05	3,29E-06	8,03E-04	7,54E-05
ADP – fossil	MJ, net calorific value	1,81E+04	8,16E+03	4,30E+02	9,83E+01	1,53E+01	9,29E+03	1,07E+02
WDP	m^3 eq.	4,70E+02	3,53E+02	2,06E+01	3,99E-01	6,72E-02	9,49E+01	1,40E+00

Average Environmental Impact Indicators of fixed VD4 p.275 with PT2 pole 2000A

Impact category	Unit	Total	UPSTREAM	CORE	DOWNSTREAM			
			Manufacturing		Distribution	Installation	Use and maintenance	End-of-life
GWP – total	kg CO_2 eq.	1,51E+03	7,02E+02	-2,35E+01	6,94E+00	1,82E+01	7,98E+02	1,29E+01
GWP – fossil	kg CO_2 eq.	1,50E+03	6,92E+02	2,49E+01	6,93E+00	1,07E+00	7,68E+02	1,06E+01
GWP – biogenic	kg CO_2 eq.	7,63E+00	8,30E+00	-4,85E+01	6,30E-03	1,71E+01	2,83E+01	2,35E+00
GWP – luluc	kg CO_2 eq.	3,08E+00	1,05E+00	8,95E-02	3,38E-03	5,35E-04	1,92E+00	1,15E-02
ODP	kg CFC-11 eq.	3,91E-05	2,43E-05	7,19E-07	1,51E-07	2,26E-08	1,38E-05	1,06E-07
AP	mol H+ eq.	1,49E+01	1,08E+01	1,58E-01	2,68E-02	6,00E-03	3,86E+00	4,32E-02
EP – freshwater	kg P eq.	1,67E+00	9,51E-01	1,13E-02	4,87E-04	1,64E-04	7,01E-01	2,92E-03
EP – marine	kg N eq.	1,88E+00	1,09E+00	5,44E-02	9,97E-03	7,39E-03	6,85E-01	3,15E-02
EP – terrestrial	mol N eq.	2,01E+01	1,32E+01	5,80E-01	1,06E-01	2,60E-02	6,04E+00	1,15E-01
POCP	kg NMVOC eq.	6,07E+00	3,84E+00	1,93E-01	3,95E-02	8,62E-03	1,95E+00	3,65E-02
ADP – minerals and metals	kg Sb eq.	1,89E-01	1,87E-01	1,37E-04	2,24E-05	3,29E-06	1,53E-03	7,58E-05
ADP – fossil	MJ, net calorific value	2,64E+04	8,11E+03	4,30E+02	9,87E+01	1,53E+01	1,77E+04	1,07E+02
WDP	m^3 eq.	5,60E+02	3,57E+02	2,06E+01	4,01E-01	6,72E-02	1,81E+02	1,41E+00

Average Environmental Impact Indicators of fixed VD4 p.275 with PT2 pole 2500A

Impact category	Unit	Total	UPSTREAM	CORE	DOWNSTREAM			
			Manufacturing		Distribution	Installation	Use and maintenance	End-of-life
GWP – total	kg CO_2 eq.	1,99E+03	7,31E+02	-2,35E+01	7,05E+00	1,82E+01	1,25E+03	1,34E+01
GWP – fossil	kg CO_2 eq.	1,96E+03	7,21E+02	2,49E+01	7,04E+00	1,07E+00	1,20E+03	1,10E+01
GWP – biogenic	kg CO_2 eq.	2,43E+01	8,88E+00	-4,85E+01	6,39E-03	1,71E+01	4,43E+01	2,46E+00
GWP – luluc	kg CO_2 eq.	4,21E+00	1,10E+00	8,95E-02	3,43E-03	5,35E-04	3,00E+00	1,20E-02
ODP	kg CFC-11 eq.	4,72E-05	2,46E-05	7,19E-07	1,54E-07	2,26E-08	2,16E-05	1,11E-07
AP	mol H+ eq.	1,79E+01	1,16E+01	1,58E-01	2,73E-02	6,00E-03	6,02E+00	4,51E-02
EP – freshwater	kg P eq.	2,12E+00	1,01E+00	1,13E-02	4,95E-04	1,64E-04	1,09E+00	3,05E-03
EP – marine	kg N eq.	2,32E+00	1,15E+00	5,44E-02	1,01E-02	7,39E-03	1,07E+00	3,22E-02
EP – terrestrial	mol N eq.	2,42E+01	1,39E+01	5,80E-01	1,08E-01	2,60E-02	9,44E+00	1,20E-01
POCP	kg NMVOC eq.	7,38E+00	4,05E+00	1,93E-01	4,01E-02	8,62E-03	3,04E+00	3,81E-02
ADP – minerals and metals	kg Sb eq.	1,99E-01	1,96E-01	1,37E-04	2,27E-05	3,29E-06	2,39E-03	7,92E-05
ADP – fossil	MJ, net calorific value	3,67E+04	8,44E+03	4,30E+02	1,00E+02	1,53E+01	2,76E+04	1,12E+02
WDP	m^3 eq.	6,74E+02	3,69E+02	2,06E+01	4,07E-01	6,72E-02	2,82E+02	1,47E+00

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 average recyclability potential of the product is 83.91%.

	Recyclability potential
Average withdrawble VD4	83.91%

The recyclability potential of the packaging is calculated by dividing the "MFR: material for recycling" in the installation stage by the total weight of the packaging. The recycled content is based on primary data, and the recyclability potential is representative for Europe according to Eurostat (2021). The results are presented below.

	Recyclability potential
Packaging materials	34.49%

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 2023, Dalmine factory (*80% hydro – 20 %PV*)	Ecoinvent v3.9.1	0.024	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.

References

Scarano. D. (2024). *VD4 p.275 with PT2 pole: Life Cycle Assessment Report* (Report No. 1VCD601909R0001. rev. A). ABB Switzerland Ltd. Group Technology Management.

Deminenko. W. (2024). *PT2 VGE4-S Environmental Product Declaration* (Report No. NEPD-5873-5122 rev. A). ABB Switzerland Ltd. Group Technology Management.

ecoinvent. ecoinvent v3.9.1 (2022). https://ecoinvent.org/the-ecoinvent-database/data-releases/ecoinvent-3-9-1/

European Committee for Standardization. (2019). *Product category rules for life cycle assessments of electronic and electrical products and systems* (EN 50693:2019).

European Committee for Standardization. (2019). *Sustainability of constructions - Environmental product declarations* (EN 15804:2012+A2:2019).

Eurostat. (2020). *Packaging waste by waste management operations.* https://ec.europa.eu/eurostat/databrowser/view/ENV_WASPAC/default/table?lang=en

ICMQ S.p.A. (2023). *PCR EPDItaly007 - Electronic and electrical products and systems.* rev. 3.0 (2023-01-13). EPDItaly. https://www.epditaly.it/en/view-pcr/

ICMQ S.p.A. (2020a). *PCR EPDItaly012 - Electronic and electrical products and systems - switches.* rev. 0 (2020-03-15). EPDItaly. https://www.epditaly.it/en/view-pcr/

ICMQ S.p.A (2020b). *Regulations of the EPDItaly Programme Regulations*. rev. 5.2 (2020-02-16). EPDItaly. https://www.epditaly.it/en/wp-content/uploads/2016/12/EPDITALY-Regulament_rev-5.2_EN.pdf

International Electrotechnical Commission. (2012). *Guidelines for end-of-life information provided by manufacturers and recyclers and for recyclability rate calculation of electrical and electronic equipment.* Edition 1.0 (2012-10-1) (IEC/TR 62635).

International Organization for Standardization. (2006). *Environmental management - Life cycle assessment - Principles and framework* (ISO Standard No. 14040:2006). https://www.iso.org/standard/37456.html

International Organization for Standardization. (2006). *Environmental management - Life cycle assessment - Requirements and guidelines* (ISO Standard No. 14044:2006). https://www.iso.org/standard/38498.html

PRé Sustainability. (2023). SimaPro (version 9.5) [computer software]. https://pre-sustainability.com/solutions/tools/simapro/

SeaRates. (2022). *Shipping Distances & Time Calculator.* https://www.searates.com/services/distances-time

The Norwegian EPD Foundation/EPD-Norge. (2019). *General Programme Instructions 2019.* Version 3.0 (2019-04-24). https://www.epd-norge.no/getfile.php/1340010-1685100696/Dokumenter/GPI%20Det%20norske%20EPD%20programmet%20approved%20240419%20-%20ver3%20updated%20250523.pdf

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