EPD

Environmental Product Declaration

VD4 and VD4/P 24.06.25 p.210 medium voltage vacuum circuit breaker

Production site: Dalmine, Italy

DOCUMENT KIND Environmental Product Declaration	IN COMPLIANCE WITH ISO 14025 and EN 50693			
PROGRAM OPERATOR The Norwegian EPD Foundation	PUBLISHER The Norwegian EPD Foundation			
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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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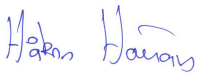
Program operator	The Norwegian EPD Foundation Post Box 5250 Majorstuen, 0303 Oslo, Norway phone: +47 23 08 80 00, email: post@epd-norge.no		
Declared product	VD4/P 24.06.25 p.210		
Product description	The VD4 is a medium voltage tripolar circuit breaker. It is an automatically operated electrical device 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 (P4 VG4S), that are used to provide dielectric strength and protection of the vacuum interrupter. The VD4/P is the withdrawable version, to be used in a switchgear, while the VD4 is for stand-alone applications.		
Functional unit	To manage and protect the electrical continuity of the circuit to which it is applied, at a use rate of 30% and load factor of 50%. The functional unit of this study is the production and downstream of the product during a service life of 20 years in Europe		
Reference flow	One single withdrawable VD4/P 24.06.25 p.210, including the related accessories and packaging.		
CPC code	46211 - Electrical apparatus for switching or protecting electrical circuits, or for making connections to or in electrical circuits, 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: Vito d'Incognito 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 1VCD601869R0001.		
EPD type	Specific product		
EPD scope	Cradle-to-grave		
Product RSL	20 years		
Geographical representativeness	Manufacturing (suppliers): Global	Manufacturing (ABB): Italy	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 products declared in this Environmental Product Declaration includes the following devices, including related accessories and packaging:

- VD4/P 24.06.25 p.210
- VD4 24.06.25 p.210 (extrapolation rules)

It can be equipped with three embedded poles (P4 VG4S), that are used to provide dielectric strength and protection of the vacuum interrupter.

General technical specifications of the reference product are presented below.

	Unit	VD4/P 24.06.25 p.210
Rated voltage	kV	24
Rated current	A	630
Short-circuit current	kA	25

In the following table are represented the differences in configuration between the two devices.

	Unit	VD4/P 24.06.25 p.210
Circuit Breaker	kg	42,81
Accessories	kg	46,97
P4/VG4S Poles assembly	kg	31,59

The manufacturing of the medium voltage circuit breakers VD4/P p.210 is located in ABB Apparatus factory, where circuit breakers are assembled in the One Primary Line.

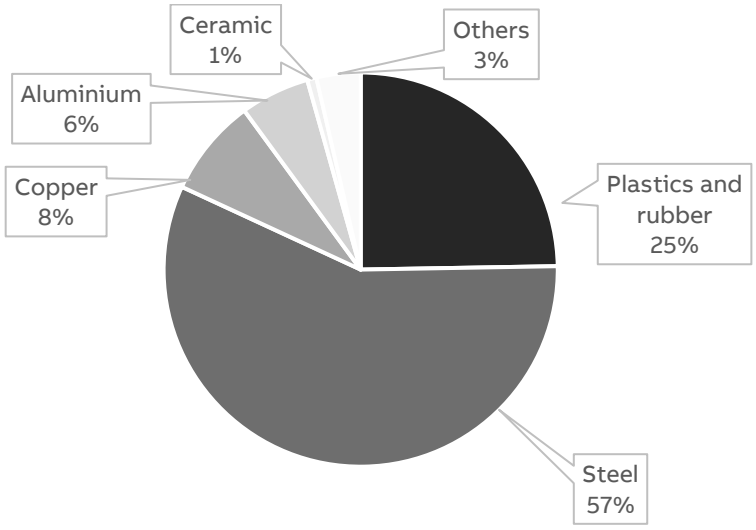
The manufacturing site is certified according to the following standards:

- 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 VD4/P 24.06.25 p.210 weighs 121,38 kg, and the constituent materials are presented below.

		VD4/P 24.06.25 p.210	
Materials	Name	Weight [kg]	Weight %
Plastics	Polyamide glass filled	8,67	7,11%
	Other plastics and rubbers	21,47	17,61%
Metals	Steel	69,70	57,17%
	Copper	9,81	8,05%
	Aluminium	6,93	5,68%
	Stainless steel	0,63	0,52%
	Brass	2,89	2,37%
	Other metals	0,40	0,33%
	Ceramics	0,92	0,76%
	Others	0,48	0,39%
Total		**121,91**	**100,00%**



The packaging materials and accessories associated with the product are also included in the study, as part of the core manufacturing stage. These are presented in below. Both the devices under analysis use the same type of packaging.

Description	Material	Weight [kg]	Weight %
Packaging box	Cardboard	15,20	26,38
Wood box	Plywood	22,4	38,89
Brackets	Steel	2	3,48
Pallet	Wood	18	31,25
Total		**57,60**	**100**

LCA Background Information

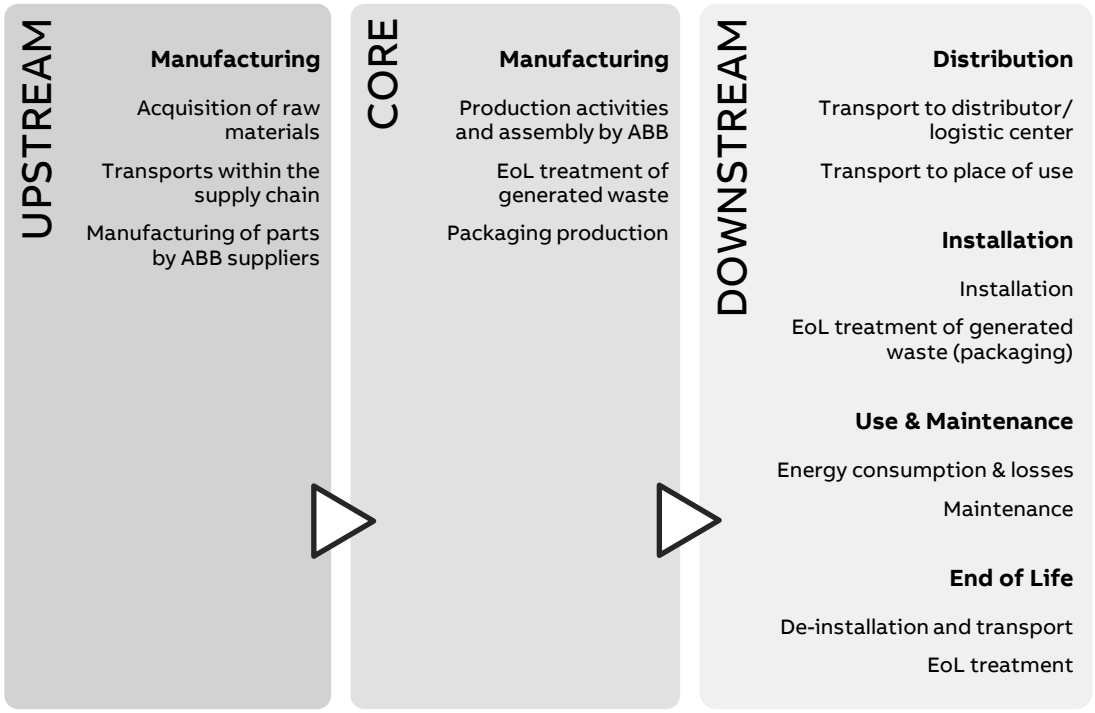
Functional Unit

The function of the system is to manage and protect the electrical continuity of the circuit to which it is applied, at a use rate of 30% and load factor of 50%. The functional unit of this study is the production and downstream of the product during a service life of 20 years in Europe. The reference flow consists in one VD4/P 24.06.25 p.210 devices, including the 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 VD4/P 24.06.25 p.210, 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 Standard and PCR, capital goods such as machinery, tools, buildings, infrastructure, packaging for internal transports, 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 VD4/P 24.06.25 p.210 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. 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. This information is extracted from: 1) SAP – the enterprise resource planning system, 2) SmarTeam – the product data management system, and 3) WCD, a document virtual archiving database. Site specific foreground data are provided by the Production Manager and the Health, Safety & Environment Manager. Furthermore, information and data obtained from other LCA studies are also used. This includes the LCA of Product embedded pole P4/VG4-S.

For all other processes for which primary data are not available, generic data originating from the ecoinvent v3.9 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 of ABB’s plant in the manufacturing stage are allocated to the production of one VD4/P 24.06.25 p.210 by using allocation rules. This is done by allocating electricity to surface area and production volume, heating, and waste to surface area. Water is allocated directly to the employees of the line involved in the study.

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 EDPItaly007 “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 allies 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 unavailability of data and the negligible amount of the involved surfaces (less than 1,1%).

Inventory Analysis

Manufacturing stage

Zinc-coated steel parts and Aluminum alloy are the most frequently used materials in the product, followed by Glass-filled polyamide and simple polyamide.

Using the ecoinvent database, the steels are mainly modelled with *Steel, low-alloyed {GLO}| market for steel, low-alloyed | Cut-off, S* and the aluminum is mainly modelled with ecoinvent material *Aluminium, cast alloy {GLO}| market for aluminium, cast alloy | Cut-off, S*. To account for the production activities of metal and plastic parts, Metal working, average and Injection molding are the most frequently used processes. Surface treatments are also included, and the most common surface treatments is ecoinvent process *Zinc coat, pieces {GLO}| market for zinc coat, pieces | Cut-off, S.*

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.

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 VD4/P 24.06.25 p.210 according to the defined allocation rules. The packaging materials and accessories associated with the product are also considered in the core manufacturing stage.

Distribution

The transport distance from ABB's plant to the site of installation is assumed to be 1500 km over land as average estimated distance between ABB Dalmine and the main customer countries, as the actual distance is unknown. The selected ecoinvent process is *transport, freight, lorry 16-32 metric ton, EURO4 {RER}*.

Installation

The installation phase implies manual activities as well as the support of a lifting machinery, whose energy consumption is negligible. 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. The waste is assumed to be sorted by hand when disposed, and possible losses in the separation processes are assumed to be negligible. Finally, because the actual transportation of waste is unknown, a transport distance of 100 km is assumed with the ecoinvent process *transport, freight, lorry 16-32 metric ton, EURO4 {RER}*.

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/standard:

$$P_{use} = R_{int} * (I_{nom} * LF)^2 * n_{poles} = 76\ \mu\Omega * (630\ A * 0.5)^2 * 3 = 22{,}62\ W$$

$$E_{use}[kWh] = \frac{P_{use} * 8760 * RSL * \alpha}{1000} = \frac{22{,}62\ \text{W} * 8760\ \text{hours} * 20\ \text{years} * 100\ \%}{1000} = 1189{,}08\ kWh$$

Where:

- E_{use} = Total energy use over the reference service life
- P_{use} = Reference power consumption in watts
- 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 the 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 see following table.

Energy mix	Source	Amount	Unit
European energy mix; *Electricity, medium voltage {RER}| market group for | Cut-off, S*	Ecoinvent v3.9	0,367	kg CO_2-eq/kWh

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 based on 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 and this includes the losses in the separation processes. Exceptions include electronics and copper cables which requires selective treatment and chemicals, for which 100 % landfill is assumed. Finally, because the actual transportation of waste is unknown, a transport distance of 100 km is assumed with the ecoinvent process *transport, freight, lorry 16-32 metric ton, EURO4 {RER}*.

Environmental Indicators

VD4/P 24.06.25 p.210

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.	1,22E+03	7,12E+02	-2,07E+01	5,17E+01	2,05E+01	4,38E+02	1,78E+01
GWP – fossil	kg CO_2 eq.	1,22E+03	7,05E+02	3,11E+01	5,17E+01	1,28E+00	4,21E+02	1,39E+01
GWP – biogenic	kg CO_2 eq.	-6,58E+00	6,27E+00	-5,20E+01	5,09E-02	1,92E+01	1,59E+01	3,94E+00
GWP – luluc	kg CO_2 eq.	1,97E+00	7,99E-01	1,00E-01	2,48E-02	6,35E-04	1,04E+00	1,59E-02
ODP	kg CFC-11 eq.	4,14E-05	3,18E-05	8,75E-07	1,10E-06	2,62E-08	7,43E-06	1,83E-07
AP	mol H+ eq.	1,29E+01	1,04E+01	1,87E-01	2,08E-01	6,92E-03	2,08E+00	5,93E-02
EP – freshwater	kg P eq.	1,22E+00	8,17E-01	1,34E-02	3,55E-03	1,92E-04	3,77E-01	3,96E-03
EP – marine	kg N eq.	1,54E+00	9,92E-01	6,10E-02	7,95E-02	8,45E-03	3,69E-01	2,72E-02
EP – terrestrial	mol N eq.	1,75E+01	1,25E+01	6,59E-01	8,49E-01	2,98E-02	3,26E+00	1,60E-01
POCP	kg NMVOC eq.	5,41E+00	3,78E+00	2,20E-01	3,05E-01	9,91E-03	1,05E+00	5,03E-02
ADP – minerals and metals	kg Sb eq.	1,32E-01	1,31E-01	1,95E-04	1,63E-04	4,07E-06	8,23E-04	1,04E-04
ADP – fossil	MJ, net calorific value	1,94E+04	8,50E+03	4,90E+02	7,18E+02	1,78E+01	9,52E+03	1,47E+02
WDP	m^3 eq.	3,10E+02	1,88E+02	2,01E+01	2,92E+00	8,50E-02	9,73E+01	1,81E+00

GWP-fossil: Global Warming Potential fossil; GWP-biogenic: Global Warming Potential biogenic; GWP-luluc: Global Warming Potential land use and land use change; ODP: Depletion potential of the stratospheric ozone layer; AP: Acidification potential; EP-freshwater: Eutrophication potential-freshwater compartment; EP-marine: Eutrophication potential-marine compartment; EP-terrestrial: Eutrophication potential-accumulated exceedance; POCP: Formation potential of tropospheric ozone; ADP-minerals & metals: Abiotic Depletion for non-fossil resources potential; ADP-fossil: Abiotic Depletion for fossil resources potential; WDP: Water deprivation potential.

Resource use parameters	Unit	Total	Cradle-to-gate		Cradle-to-grave			
			UPSTREAM	CORE	DOWNSTREAM			
			Manufacturing		Distribution	Installation	Use and maintenance	End-of-life
PENRE	MJ, low cal. value	1,92E+04	8,31E+03	4,90E+02	7,18E+02	1,78E+01	9,52E+03	1,47E+02
PERE	MJ, low cal. value	3,53E+03	1,02E+03	6,55E+02	1,11E+01	3,47E-01	1,83E+03	1,38E+01
PENRM	MJ, low cal. value	1,91E+02	1,91E+02	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
PERM	MJ, low cal. value	5,83E+02	1,27E+01	5,71E+02	0,00E+00	0,00E+00	0,00E+00	0,00E+00
PENRT	MJ, low cal. value	1,94E+04	8,50E+03	4,90E+02	7,18E+02	1,78E+01	9,52E+03	1,47E+02
PERT	MJ, low cal. value	4,11E+03	1,03E+03	1,23E+03	1,11E+01	3,47E-01	1,83E+03	1,38E+01
FW	m^3	1,41E+01	5,73E+00	7,07E-01	1,02E-01	3,47E-03	7,44E+00	6,83E-02
MS	kg	3,64E+01	3,46E+01	1,82E+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	1,48E-01	1,28E-01	2,31E-03	4,57E-03	1,05E-04	1,21E-02	5,44E-04
NHWD	kg	2,97E+02	1,79E+02	8,08E+00	3,51E+01	1,68E+01	2,61E+01	3,26E+01
RWD	kg	8,13E-02	1,02E-02	1,22E-03	2,33E-04	6,86E-06	6,93E-02	2,96E-04
MER	kg	1,77E+01	4,06E+00	5,39E-01	0,00E+00	1,20E+01	0,00E+00	1,15E+00
MFR	kg	1,34E+02	1,59E+01	6,98E+00	0,00E+00	1,54E+01	0,00E+00	9,60E+01
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	7,22E+01	1,68E+01	2,53E+00	0,00E+00	4,77E+01	0,00E+00	5,26E+00
EEE	MJ	3,97E+01	8,93E+00	1,40E+00	0,00E+00	2,65E+01	0,00E+00	2,92E+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.

Sensitivity analysis

Two sensitivity analysis are conducted to understand how a different energy mix for the use phase and a different internal resistance influence the environmental impact for VD4/P and VD4 24.06.25 p.210 produced and sold in different geographical locations.

Internal resistance

A higher value of internal resistance was assumed to cover up to 95,4% of the possible cases. The results are shown in the following table, and the values for the use phase are highlighted since it is the only stage affected by this variation.

			Cradle-to-gate		Cradle-to-grave			
			UPSTREAM	CORE	DOWNSTREAM			
Impact category	Unit	Total	Manufacturing		Distribution	Installation	Use and maintenance	End-of-life
GWP – total	kg CO_2 eq.	1,24E+03	7,12E+02	-2,07E+01	2,05E+01	5,17E+01	**4,63E+02**	1,78E+01
GWP – fossil	kg CO_2 eq.	1,25E+03	7,05E+02	3,11E+01	1,28E+00	5,17E+01	**4,45E+02**	1,39E+01
GWP – biogenic	kg CO_2 eq.	-5,67E+00	6,27E+00	-5,20E+01	1,92E+01	5,09E-02	**1,68E+01**	3,94E+00
GWP – luluc	kg CO_2 eq.	2,03E+00	7,99E-01	1,00E-01	6,35E-04	2,48E-02	**1,09E+00**	1,59E-02
ODP	kg CFC-11 eq.	4,19E-05	3,18E-05	8,75E-07	2,62E-08	1,10E-06	**7,85E-06**	1,83E-07
AP	mol H+ eq.	1,31E+01	1,04E+01	1,87E-01	6,92E-03	2,08E-01	**2,20E+00**	5,93E-02
EP – freshwater	kg P eq.	1,24E+00	8,17E-01	1,34E-02	1,92E-04	3,55E-03	**3,99E-01**	3,96E-03
EP – marine	kg N eq.	1,56E+00	9,92E-01	6,10E-02	8,45E-03	7,95E-02	**3,90E-01**	2,72E-02
EP – terrestrial	mol N eq.	1,77E+01	1,25E+01	6,59E-01	2,98E-02	8,49E-01	**3,44E+00**	1,60E-01
POCP	kg NMVOC eq.	5,47E+00	3,78E+00	2,20E-01	9,91E-03	3,05E-01	**1,11E+00**	5,03E-02
ADP – minerals and metals	kg Sb eq.	1,32E-01	1,31E-01	1,95E-04	4,07E-06	1,63E-04	**8,70E-04**	1,04E-04
ADP – fossil	MJ, net calorific value	1,99E+04	8,50E+03	4,90E+02	1,78E+01	7,18E+02	**1,01E+04**	1,47E+02
WDP	m^3 eq.	3,16E+02	1,88E+02	2,01E+01	8,50E-02	2,92E+00	**1,03E+02**	1,81E+00

Residual energy mix

The use phase was modeled using the European energy mix. However, no residual energy mix was considered. So, in this analysis, electricity consumption in the use phase was modeled as an average of residual energy mixes from four European countries representing the main customers of this product. The results are displayed in the following table.

			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.	1,53E+03	7,12E+02	-2,07E+01	2,05E+01	5,17E+01	**7,44E+02**	1,78E+01
GWP – fossil	kg CO_2 eq.	1,54E+03	7,05E+02	3,11E+01	1,28E+00	5,17E+01	**7,41E+02**	1,39E+01
GWP – biogenic	kg CO_2 eq.	-1,93E+01	6,27E+00	-5,20E+01	1,92E+01	5,09E-02	**3,18E+00**	3,94E+00
GWP – luluc	kg CO_2 eq.	1,05E+00	7,99E-01	1,00E-01	6,35E-04	2,48E-02	**1,14E-01**	1,59E-02
ODP	kg CFC-11 eq.	4,55E-05	3,18E-05	8,75E-07	2,62E-08	1,10E-06	**1,15E-05**	1,83E-07
AP	mol H+ eq.	1,29E+01	1,04E+01	1,87E-01	6,92E-03	2,08E-01	**2,01E+00**	5,93E-02
EP – freshwater	kg P eq.	1,07E+00	8,17E-01	1,34E-02	1,92E-04	3,55E-03	**2,28E-01**	3,96E-03
EP – marine	kg N eq.	1,69E+00	9,92E-01	6,10E-02	8,45E-03	7,95E-02	**5,18E-01**	2,72E-02
EP – terrestrial	mol N eq.	1,95E+01	1,25E+01	6,59E-01	2,98E-02	8,49E-01	**5,26E+00**	1,60E-01
POCP	kg NMVOC eq.	6,13E+00	3,78E+00	2,20E-01	9,91E-03	3,05E-01	**1,77E+00**	5,03E-02
ADP – minerals and metals	kg Sb eq.	1,32E-01	1,31E-01	1,95E-04	4,07E-06	1,63E-04	**7,57E-04**	1,04E-04
ADP – fossil	MJ, net calorific value	2,31E+04	8,50E+03	4,90E+02	1,78E+01	7,18E+02	**1,33E+04**	1,47E+02
WDP	m^3 eq.	3,42E+02	1,88E+02	2,01E+01	8,50E-02	2,92E+00	**1,29E+02**	1,81E+00

Extrapolation rules

Due to the large variations in environmental impacts present within the series, extrapolation rules are established according to EN 50693. This method allows to obtain results with high accuracy for devices with similar configuration.
In this case, the equivalent impact for the fixed configuration (VD4 24.06.25 p.210), are obtained by multiplying the withdrawable configuration value for the correspondent conversion factor. Generally:

$$Value_{fixed} = Value_{withdrawable} * ConversionFactor$$

Where:

- $Value_{withdrawable}$ can be found in the tables in previous chapter;
- $ConversionFactor$ is constant and can be found in the following table.

The conversion factors were calculated by dividing the results obtained in the LCA analysis of the VD4 24.06.25 p.210 for the ones related to the VD4/P 24.06.25 p.210.

			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.	0,563	0,769	1,000	0,850	1,000	0,217	0,735
GWP – fossil	kg CO_2 eq.	0,577	0,768	1,000	0,850	1,000	0,217	0,735
GWP – biogenic	kg CO_2 eq.	15,049	0,831	1,000	0,850	1,000	0,217	0,735
GWP – luluc	kg CO_2 eq.	0,451	0,687	1,000	0,850	1,000	0,217	0,733
ODP	kg CFC-11 eq.	0,798	0,928	1,000	0,850	1,000	0,217	0,810
AP	mol H+ eq.	0,776	0,884	1,000	0,850	1,000	0,217	0,734
EP – freshwater	kg P eq.	0,689	0,902	1,000	0,850	1,000	0,217	0,730
EP – marine	kg N eq.	0,669	0,814	1,000	0,850	1,000	0,217	0,667
EP – terrestrial	mol N eq.	0,711	0,823	1,000	0,850	1,000	0,217	0,736
POCP	kg NMVOC eq.	0,703	0,819	1,000	0,850	1,000	0,217	0,736
ADP – minerals and metals	kg Sb eq.	0,945	0,949	1,000	0,850	1,000	0,217	0,725
ADP – fossil	MJ, net calorific value	0,504	0,791	1,000	0,850	1,000	0,217	0,739
WDP	m^3 eq.	0,664	0,861	1,000	0,850	1,000	0,217	0,746

The resulting impacts and resource depletion related to the product VD4 24.06.25 p.210 can be found in the following tables.

			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.	6,61E+02	5,44E+02	-2,07E+01	8,77E+00	2,05E+01	9,50E+01	1,31E+01
GWP – fossil	kg CO_2 eq.	6,77E+02	5,34E+02	3,11E+01	8,76E+00	1,28E+00	9,13E+01	1,02E+01
GWP – biogenic	kg CO_2 eq.	-1,66E+01	9,80E+00	-5,20E+01	8,63E-03	1,92E+01	3,45E+00	2,89E+00
GWP – luluc	kg CO_2 eq.	8,67E-01	5,26E-01	1,00E-01	4,20E-03	6,35E-04	2,25E-01	1,16E-02
ODP	kg CFC-11 eq.	3,22E-05	2,94E-05	8,75E-07	1,87E-07	2,62E-08	1,61E-06	1,48E-07
AP	mol H+ eq.	9,88E+00	9,15E+00	1,87E-01	3,53E-02	6,92E-03	4,51E-01	4,35E-02
EP – freshwater	kg P eq.	8,32E-01	7,33E-01	1,34E-02	6,01E-04	1,92E-04	8,20E-02	2,89E-03
EP – marine	kg N eq.	9,75E-01	7,94E-01	6,10E-02	1,35E-02	8,45E-03	8,02E-02	1,81E-02
EP – terrestrial	mol N eq.	1,18E+01	1,02E+01	6,59E-01	1,44E-01	2,98E-02	7,07E-01	1,17E-01
POCP	kg NMVOC eq.	3,59E+00	3,05E+00	2,20E-01	5,17E-02	9,91E-03	2,28E-01	3,70E-02
ADP – minerals and metals	kg Sb eq.	1,24E-01	1,24E-01	1,95E-04	2,76E-05	4,07E-06	1,79E-04	7,53E-05
ADP – fossil	MJ, net calorific value	9,42E+03	6,62E+03	4,90E+02	1,22E+02	1,78E+01	2,07E+03	1,09E+02
WDP	m^3 eq.	2,02E+02	1,59E+02	2,01E+01	4,94E-01	8,50E-02	2,11E+01	1,35E+00

Additional Environmental Information

Recyclability potential

The recyclability potentials of the VD4 and VD4/P 24.06.25 p.210 are calculated by dividing “MFR: material for recycling” in the end-of-life stage by the total weight of the products. As a result, the recyclability potentials of the product are presented below:

	Recyclability potential
VD4/P 24.06.25 p.210	68,72 %

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
Dalmine energy mix; *ABB_Electricity mix Dalmine factory {IT}_Bio38%-Solar36%-Hydro23%-Other3%_2022	S_SMP_V1*	Ecoinvent v3.9	0,169	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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