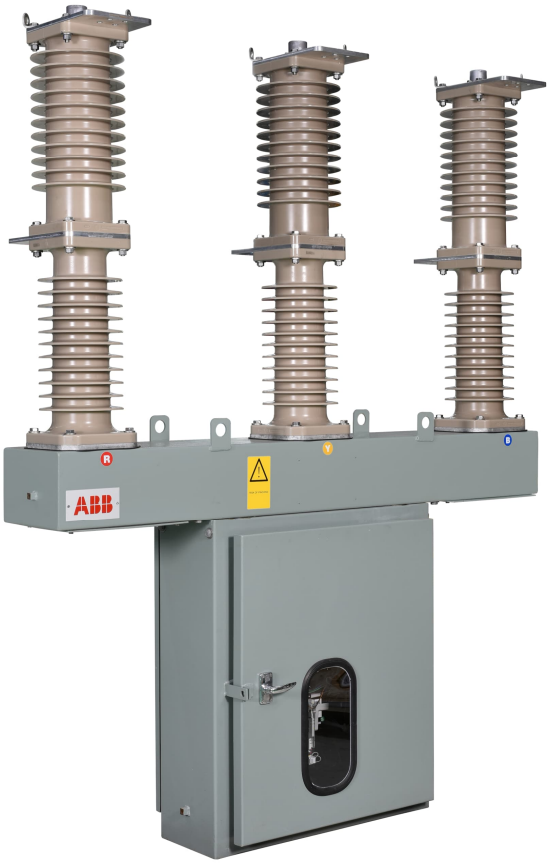
EPD

Environmental Product Declaration

Circuit Breaker OVB-VBF 36.20.32 HCEP variant

Production site: Nashik, India



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-5321-4627-EN	ISSUE DATE 2023-11-03			
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EPD Owner	ABB Switzerland Ltd, Group Technology Management		
Organization No.	CHE-101.538.426		
Manufacturer name and address	ABB India Limited Plot No. 34 Off BSNL office, MIDC Industrial Estate, Satpur Nashik 422007, M.S. INDIA		
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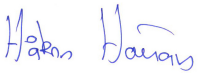
Program operator	The Norwegian EPD Foundation Post Box 5250 Majorstuen, 0303 Oslo, Norway phone: +47 23 08 80 00, email: post@epd-norge.no		
Declared product	OVB-VBF 36.20.32 HCEP variant		
Product description	OVB-VBF breakers are used in electrical distribution for control and protection of cables, overhead lines, transformer and distribution substations, motors, transformers, generators and capacitor banks. The Scope of the Medium voltage circuit breakers is to interrupt an electric current with a mechanical actuator.		
Functional unit	To establish or interrupt the electrical continuity of the circuit to which it is applied, at a use rate/nominal current of 30/50 %, during a service life of 20 years in Europe.		
Reference flow	A single OVB-VBF 36.20.32 circuit breaker, including related accessories, mounting structure 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: 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 3XAA015949 Rev.A		
EPD type	Specific product		
EPD scope	Cradle-to-grave		
Product RSL	20 years		
Geographical representativeness	Manufacturing (suppliers): Global	Manufacturing (ABB): India	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 OVB-VBF 36.20.32 HCEP variant, mounting structure and packaging.

The products declared in this Environmental Product Declaration includes the following device, including related accessories and packaging:

- OVB-VBF 36.20.32 HCEP variant, mounting structure and packaging.

General technical specifications of the product are presented below.

Technical information		
	Unit	Values
Rated voltage:	kV	36
Rated lightning impulse withstand voltage:	kVp	170
Rated power-frequency withstand voltage:	kV rms	70
Rated frequency:	Hz	50/60
Rated normal current:	A	2000
Rated peak withstand current:	kAp	82
Rated short time withstand current:	kA rms	31.5
Rated duration of short-circuit:	s	3
Rated short-circuit making current	kAp	82
Rated short-circuit breaking current	kA	31.5

The OVB-VBF 36.20.32 HCEP variant is manufactured by ABB India Limited, located in Nashik, India.

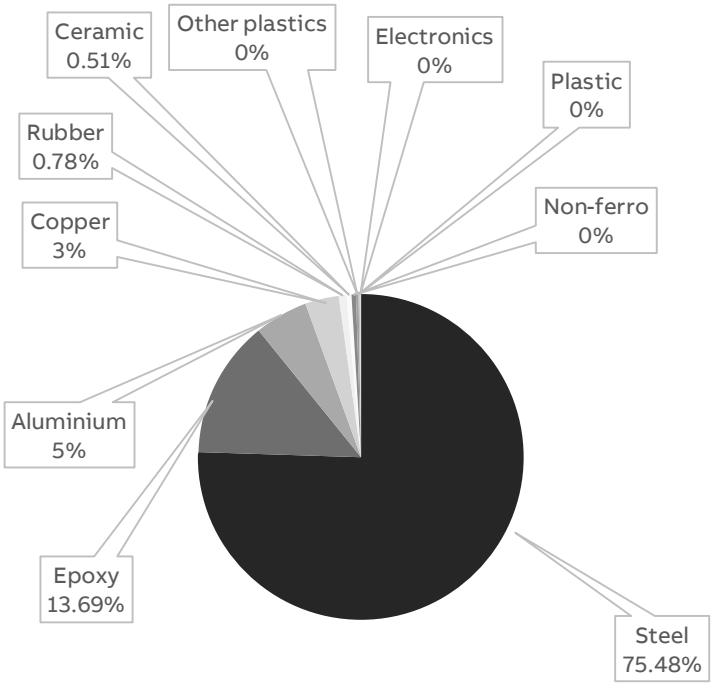
The manufacturing site is certified according to the following standards:

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

Constituent Materials

The Circuit-breaker OVB-VBF 36.20.32 HCEP variant weighs 395 kg, and the constituent materials are presented below.

Materials	Name	Weight [kg]	Weight %
Metals	Steel, low-alloyed	169.64	43.0%
	Steel, chromium	128.43	32.5%
	Aluminum	20.99	5.3%
	Copper	13.15	3.3%
	Non-ferro	1.59	0.4%
Epoxy	Outdoor Epoxy	53.60	13.6%
	Resin mix	0.46	0.1%
Rubber	Silicon rubber	1.86	0.5%
	Rubber	1.22	0.3%
Ceramic	Ceramic	2.00	0.5%
Plastics	ABS	0.47	0.1%
	Other plastics	1.05	0.27%
Electronics	PCB	0.26	0.1%
	Switch	0.18	0.05%
	Total	**394.91 [kg]**	**100 %**



The packaging materials and accessories weigh 151.57 kg, and the constituent materials are presented below.

Description	Material	Weight [kg]	Weight %
Packaging box	Wooden pallet	140.94	93
Steel	Steel	10.63	7
	Total	**151.57**	**100**

LCA Background Information

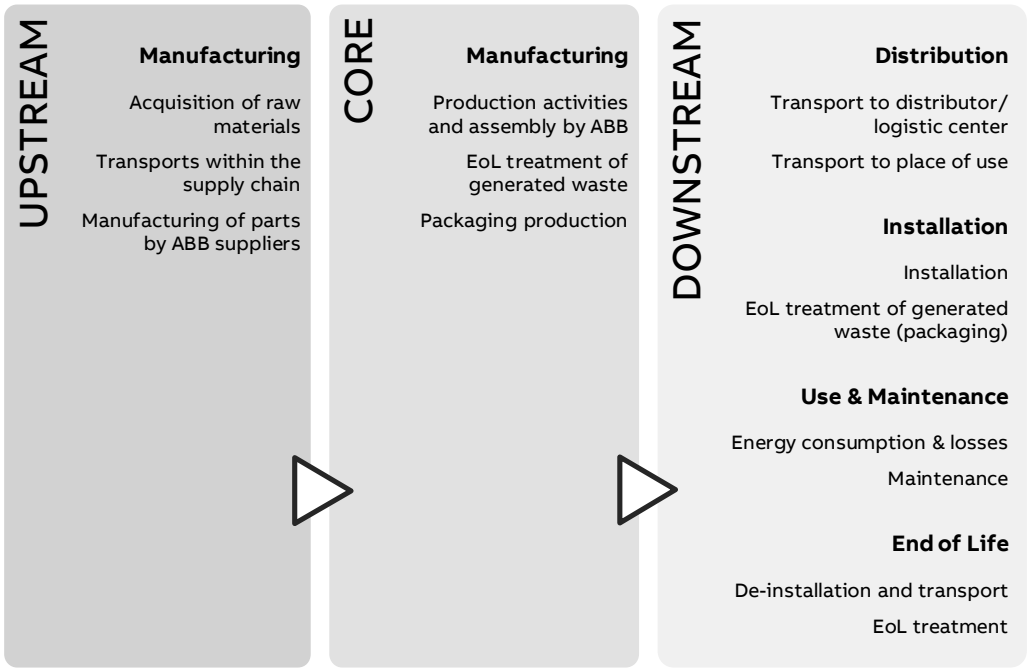
Functional Unit

The functional unit of this study is to establish or interrupt the electrical continuity of the circuit to which it is applied, at a nominal current of 50 %, during a service life of 20 years in Europe, with a use rate of 30 %. The reference flow is a single OVB-VBF 36.20.32 HCEP variant, including mounting structure 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 Circuit-breaker VBF 36.20.32 HCEP variant, 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/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. Auxiliary wiring used differs from customer to customer, hence that is 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 Circuit-breaker OVB-VBF 36.20.32 HCEP variant 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, while site specific foreground data are provided by ABB.

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 OVB-VBF 36.20.32 HCEP variant by using allocation rules. This is done by multiplying the resources used by the plant by the allocation key derived on the basis of volumes of the products produced in same factory.

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 EPDItaly012 the cut-off criteria can be set to a maximum of 2% of the total weight of the device. In this LCA, stickers have been excluded as their weights are negligible. Manganese-Phosphating treatment performed on steel part has been excluded due to the unavailability of data and complexity of modelling. The production process of nitrogen gas, as well as its release into the atmosphere, are excluded because of the negligible mass used in the product.

Inventory Analysis

Manufacturing stage

As presented in chapter Constituent Materials, low-alloyed steel and stainless-steel are the most frequently used materials, followed by outdoor epoxy-resin.

Using the ecoinvent database, the low-alloyed steels are mainly modelled with Metal working, average for steel product manufacturing {GLO}| market for metal working, average for steel product manufacturing | Cut-off, S and the stainless-steel is mainly modelled with Metal working, average for chromium steel product manufacturing {GLO}| market for metal working, average for chromium steel product manufacturing | 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 are ABB_Powder coat steel (GLO)_SMP_V1_IN 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 *ABB_IN_Transport_freight_lorry_3.5_7.5_metric_ton_euro4_{RoW}* for lorry and *ABB_IN_Transport_freight_sea_container_ship_{GLO}* for sea transport *and ABB_IN_Transport_freight _aircraft_unspecified_{GLO}* for the air transportation.

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 OVB-VBF 36.20.32 HCEP variant 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 the ABB manufacturing site to the site of installation is assumed to be 8200 km over sea, 500 km over land; this is considering 200 km land transportation from factory to Mumbai Sea port; sea shipment from Mumbai sea port to sea port at customer end and 300 km land-transportation till customer site.

The selected ecoinvent process is *ABB_IN_Transport_freight_sea_container_ship_{GLO}* for sea-shipment, *Transport, freight, lorry 3.5-7.5 metric ton, EURO4 {ROW}* for local travel 200 km; and *Transport, freight, lorry 16-32 metric ton, EURO4 {RER}* for transportation till customer site.

Installation

The installation phase implies manual one-time activity, and energy consumption would not be significant. 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 3469 kWh over the reference service life of 20 years as defined in the functional unit. This is calculated using the following formula, according to PCR:

$$E_{use}[kWh] = \frac{P_{use} * 8760 * RSL * \alpha}{1000} = \frac{66\ \text{W} * 8760\ \text{hours} * 20\ \text{years} * 30\ \%}{1000} = 3469\ kWh$$

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	0.368	kg CO_2-eq/kWh

Maintenance is not considered because it implies manual activities only, and no energy is consumed.

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 using the rates given for materials that go through a separation process, except for electronics for which selective treatment and ceramics 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}| market for transport, freight, lorry 16-32 metric ton, EURO4 | Cut-off, S”.

Environmental Indicators

OVB-VBF 36.20.32 HCEP variant

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.	4.07E+03	2.49E+03	4.48E+01	1.38E+02	6.80E+01	1.27E+03	5.39E+01
GWP – fossil	kg CO_2 eq.	4.05E+03	2.60E+03	4.42E+01	1.37E+02	4.29E+00	1.23E+03	4.12E+01
GWP – biogenic	kg CO_2 eq.	3.42E+00	-1.18E+02	5.36E-01	5.62E-02	6.37E+01	4.41E+01	1.26E+01
GWP – luluc	kg CO_2 eq.	7.16E+00	3.86E+00	7.97E-02	8.93E-02	2.19E-03	3.07E+00	5.18E-02
ODP	kg CFC-11 eq.	2.96E-04	2.70E-04	3.20E-07	2.29E-06	9.02E-08	2.20E-05	4.59E-07
AP	mol H+ eq.	3.36E+01	2.53E+01	2.25E-01	1.70E+00	2.38E-02	6.16E+00	1.92E-01
EP – freshwater	kg P eq.	3.10E+00	1.92E+00	3.87E-02	9.63E-03	6.71E-04	1.12E+00	1.31E-02
EP – marine	kg N eq.	5.07E+00	3.37E+00	4.72E-02	4.67E-01	2.82E-02	1.09E+00	6.48E-02
EP – terrestrial	mol N eq.	6.08E+01	4.50E+01	4.50E-01	5.11E+00	1.02E-01	9.65E+00	5.11E-01
POCP	kg NMVOC eq.	1.68E+01	1.19E+01	1.27E-01	1.50E+00	3.39E-02	3.11E+00	1.60E-01
ADP – minerals and metals	kg Sb eq.	2.55E-01	2.51E-01	3.51E-04	4.08E-04	1.48E-05	2.41E-03	3.43E-04
ADP – fossil	MJ, net calorific value	6.24E+04	3.14E+04	5.01E+02	1.84E+03	6.11E+01	2.81E+04	4.67E+02
WDP	m^3 eq.	9.25E+02	5.86E+02	3.90E+01	6.89E+00	2.98E-01	2.88E+02	5.49E+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	6.23E+04	3.14E+04	5.00E+02	1.84E+03	6.11E+01	2.81E+04	4.67E+02
PERE	MJ, low cal. value	1.23E+04	6.86E+03	1.46E+02	2.48E+01	1.25E+00	5.24E+03	4.56E+01
PENRM	MJ, low cal. value	8.50E+01	8.40E+01	1.05E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERM	MJ, low cal. value	1.95E+03	1.95E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRT	MJ, low cal. value	6.24E+04	3.14E+04	5.01E+02	1.84E+03	6.11E+01	2.81E+04	4.67E+02
PERT	MJ, low cal. value	1.43E+04	8.80E+03	1.46E+02	2.48E+01	1.25E+00	5.24E+03	4.56E+01
FW	m^3	4.27E+01	1.95E+01	1.35E+00	2.33E-01	1.21E-02	2.14E+01	2.13E-01
MS	kg	1.32E+02	1.31E+02	2.92E-01	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	2.85E-01	2.35E-01	1.81E-03	1.10E-02	3.60E-04	3.57E-02	1.75E-03
NHWD	kg	1.51E+03	1.23E+03	3.98E+00	4.99E+01	5.76E+01	7.69E+01	9.55E+01
RWD	kg	2.53E-01	4.79E-02	4.99E-04	4.07E-04	2.50E-05	2.03E-01	9.23E-04
MER	kg	5.19E+01	8.18E+00	3.31E-02	0.00E+00	4.05E+01	0.00E+00	3.16E+00
MFR	kg	4.65E+02	7.74E+01	2.31E+01	0.00E+00	5.25E+01	0.00E+00	3.12E+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	2.03E+02	2.99E+01	1.36E-01	0.00E+00	1.61E+02	0.00E+00	1.22E+01
EEE	MJ	1.13E+02	1.66E+01	7.53E-02	0.00E+00	8.93E+01	0.00E+00	6.80E+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

Apart from the configuration assessed so far, there is another configuration of the product, that uses 2.5 mm mild-steel sheet metal for enclosers instead of stainless-steel sheets of 3 mm.

Sensitivity analysis was done for this second variant and presented in 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.	3.59E+03	2.02E+03	4.48E+01	1.35E+02	6.80E+01	1.27E+03	5.28E+01
GWP – fossil	kg CO_2 eq.	3.59E+03	2.14E+03	4.42E+01	1.35E+02	4.29E+00	1.23E+03	4.03E+01
GWP – biogenic	kg CO_2 eq.	-5.13E+00	-1.26E+02	5.36E-01	5.53E-02	6.37E+01	4.41E+01	1.24E+01
GWP – luluc	kg CO_2 eq.	6.57E+00	3.28E+00	7.97E-02	8.80E-02	2.19E-03	3.07E+00	5.06E-02
ODP	kg CFC-11 eq.	2.93E-04	2.68E-04	3.20E-07	2.25E-06	9.02E-08	2.20E-05	4.49E-07
AP	mol H+ eq.	3.06E+01	2.24E+01	2.25E-01	1.68E+00	2.38E-02	6.16E+00	1.88E-01
EP – freshwater	kg P eq.	2.98E+00	1.80E+00	3.87E-02	9.48E-03	6.71E-04	1.12E+00	1.28E-02
EP – marine	kg N eq.	4.58E+00	2.89E+00	4.72E-02	4.60E-01	2.82E-02	1.09E+00	6.35E-02
EP – terrestrial	mol N eq.	5.56E+01	3.98E+01	4.50E-01	5.03E+00	1.02E-01	9.65E+00	5.00E-01
POCP	kg NMVOC eq.	1.54E+01	1.05E+01	1.27E-01	1.48E+00	3.39E-02	3.11E+00	1.57E-01
ADP – minerals and metals	kg Sb eq.	2.38E-01	2.35E-01	3.51E-04	4.02E-04	1.48E-05	2.41E-03	3.35E-04
ADP – fossil	MJ, net calorific value	5.71E+04	2.62E+04	5.01E+02	1.81E+03	6.11E+01	2.81E+04	4.57E+02
WDP	m^3 eq.	7.09E+02	3.70E+02	3.90E+01	6.78E+00	2.98E-01	2.88E+02	5.37E+00

Additional Environmental Information

Recyclability potential

The recyclability potential of the OVB-VBF 36.20.32 HCEP variantis 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 77.4 %.

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, and the electricity from own solar panel.

Energy mix	Data source	Amount	Unit
Electricity, medium voltage {IN}| market group for electricity, medium voltage | Cut-off, S	Ecoinvent v3.9.1	1.34	kg CO_2-eq/kWh
Electricity, low voltage {IN-MH}| electricity production, photovoltaic, 3kWp slanted-roof installation, multi-Si, panel, mounted | Cut-off, S	Ecoinvent v3.9.1	0.059	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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