PRODUCT ENVIRONMENTAL PROFILE

Environmental Product Declaration

ABB MCCB Tmax XT XT6 TMA (IT)

XT6 TMA

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PEP ARE COMPLIANT WITH XP C08-100-1 :2016 OR EN 50693:2019 THE ELEMENTS OF THE PRESENT PEP CANNOT BE COMPARED WITH ELEMENTS FROM ANOTHER PROGRAM.	
DOCUMENT IN COMPLIANCE WITH ISO 14025: 2006 « ENVIRONMENTAL LABELS AND DECLARATIONS. TYPE III ENVIRONMENTAL DECLARATIONS »	

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Manufacturer name and address	ABB S.p.A. Via E. Fermi 40 - 03100 Frosinone (FR) - Italy
Company contacts	EPD_ELSP@in.abb.com
Reference product	XT6 3P IEC Circuit breaker equipped with TMA trip unit
Description of the product	ABB's new TMAX XT series of Molded Case circuit-breakers, combine the finest protection that has always characterized ABB's molded case circuit breakers with the most precise metering and connectivity functionalities, providing designers, installers and end-users exclusive solutions for their daily needs. Suitable for applications from 160 A to 1600 A, the TMAX XT offers exceptional breaking capacity for all voltages and applications.
Functional unit	The functional unit to this study is a single circuit breaker (including its packaging and accessories), to protect during 20 years the installation against overloads and short-circuits in circuit with assigned voltage U and rated current In. This protection is ensured in accordance with the following parameters XT6 800 N/S/H - 3P IEC Rated voltage [V]: 690 Rated current [A]: 800 Rated breaking capacity [kA]: 100 Number of poles: 3 Tripping Curve: N, S, H
Other products covered	XT6 Circuit Breakers of types N/S/H/D (both IEC and UL type covered by this study) and ratings 600A to 1000A / 3poles /4poles
Reference lifetime	20 years
Product category	Electrical, Electronic and HVAC-R Products
Use Scenario	The use phase has been modeled based on the sales mix data (2021), and the corresponding low voltage electricity countries mix
Geographical representativeness	Raw materials & Manufacturing: [Europe / Global] Assembly: [Italy] Distribution / Use: [Global] specific sales mix EoL: [Global]
Technological representativeness	Materials and processes data are specific for the production of XT6 circuit breaker
LCA Study	This study is based on the LCA study described in the LCA report 1SDH002258A1001
EPD type	Products family declaration
EPD scope	"Cradle to grave"
Year of reported primary data	2021
LCA software	SimaPro 9.3.0.3 (2022)
LCI database	Ecoinvent v3.8 (2021)
LCIA methodology	EN 15804:2012+A2:2019

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ABB Purpose & Embedding Sustainability

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. With a history of excellence stretching back more than 130 years, ABB's success is driven by about 105 thousand talented employees in over 100 countries.
ABB's Electrification business offers a wide-ranging portfolio of products, digital solutions and services, from substation to socket, enabling safe, smart and sustainable electrification. Offerings encompass digital and connected innovations for low voltage and medium voltage, including EV infrastructure, solar inverters, modular substations, distribution automation, power protection, wiring accessories, switchgear, enclosures, cabling, sensing and control.
ABB is committed to continually promoting and embedding sustainability across its operations and value chain, aspiring to become a role model for others to follow. With its ABB Purpose, ABB is focusing on reducing harmful emissions, preserving natural resources and championing ethical and humane behavior.

General Information

ABB's Frosinone factory represents a centre of excellence in ABB for the development and manufacture of low-voltage circuit breakers. The 150,000 square-meter facility with 800 employees is highly automated and produces more than three million circuit breakers every year. A Lighthouse Plant, selected by the Italian government as a model for digital transformation and Industry 4.0 strategies, Frosinone promotes smart, digitalized, and connected operations, increasing efficiency across the full value chain. Achieving zero production waste to landfill was a whole-factory program. Flexibility, lean production processes, capacity to efficiently and rapidly meet market demands, and process innovation are some of the most significant characteristics of this site

ABB IT-ELSP adopts and implements for its own activities an integrated Quality/Environmental/Health Management System in compliance with the following standards:

- UNI EN ISO 9001/2015 - Quality Management Systems – Requirements
- UNI EN ISO 14001/2015 - Environmental management systems – Specification with guidance for use
- UNI EN ISO 45001:2018 - Occupational Health and Safety Assessment Series – Requirements
- SA 8000:2014 - Social Accountability 8000 – SA 8000

ABB offers a wide range of low voltage Air Circuit Breakers & Molded Case Circuit Breakers for different applications. The primary scope of Low Voltage Circuit Breakers is to isolate parts of an electrical distribution system in the event of abnormal conditions. Abnormal conditions are generally caused by faults on a system which can lead to dangerous situations for both people and the system itself. In addition to providing system protection, circuit breakers enable parts of the electrical distribution to be isolated for operation and maintenance.
In the factory, the different components and subassemblies are assembled on the manufacturing line. All components and subassemblies are produced by ABB's suppliers and are only assembled in the factory.

XT product cluster

ABB's new TMAX XT series of Molded Case circuit-breakers, combine the finest protection that has always characterized ABB's molded case circuit breakers with the most precise me-tering and connectivity functionalities, providing designers, installers and end-users exclusive solutions for their daily needs. Suitable for applications from 160 A to 1600 A, the TMAX XT offers exceptional breaking capacity for all voltages and applications. Combined with high-precision electronic relays of the smallest sizes, the new series protects equipment invest-ments and ensures uninterrupted operation and high availability. Product cluster XT6 analyzed in this LCA includes both IEC and UL types.

XT6

Circuit breaker	XT6 TMA Type
Rated voltage U [V]	690
Rated current In [A]	800
Rated short circuit breaking current Icu [kA]	100
Number of poles	3/4

Table 1: Technical characteristics of IEC/UL circuit breakers (Refer Technical catalogue for complete details).

Packaging for XT6 weigh the following substance composition.

Material weight (g)	XT6
Corrugated Cardboard	932.0
Polyethylene	1.3

Table 2: Weight of materials XT6 - Packaging

Official declarations LB-DT 17-21D [13] and 1SDL000282R1265 [14] states compliance of ABB molded case circuit breakers and air circuit breakers respectively to RoHS II and REACH regulations; annex 1SDL000571R0 [15] provides exemptions considered for RoHS II while annex 1SDL000572R0 [16] lists REACH substances present in a concentration above 0,1% adding reference to products where involved parts are mounted.

Constituent Materials

XT6

The representative product is XT6 800 N/S/H 3P IEC TMA Circuit Breaker which weighs 9.799 kg including its installed accessories, paper documentation and packaging.

Materials	Name	IEC 62474 MC	[g]	Weight %
Metals	Steel	M-119	2207.0	22.5%
	Cu and CU alloys	M-121	2165.2	22.1%
	Stainless Steel	M-100	368.6	3.8%
	Precious metals	M-159	32.2	0.3%
Plastics	Unsaturated polyester (UP)	M-301	3029.6	30.9%
	Polyamide (PA)	M-258	388.8	4.0%
	PC-ABS	M-281	213.0	2.2%
	Polycarbonate (PC)	M-254	155.6	1.6%
	Duromer	M-319	131.0	1.3%
	Acrylonitrile-Butadiene-Styrene (ABS)	M-256	70.6	0.7%
	Other Polymers	N/A	38.3	0.4%
Others	Paper / Cardboard	M-341	999.4	10.2%
Total			9799.3	100.0%

Table 3: Weight of materials XT6 800 N/S/H 3P IEC TMA

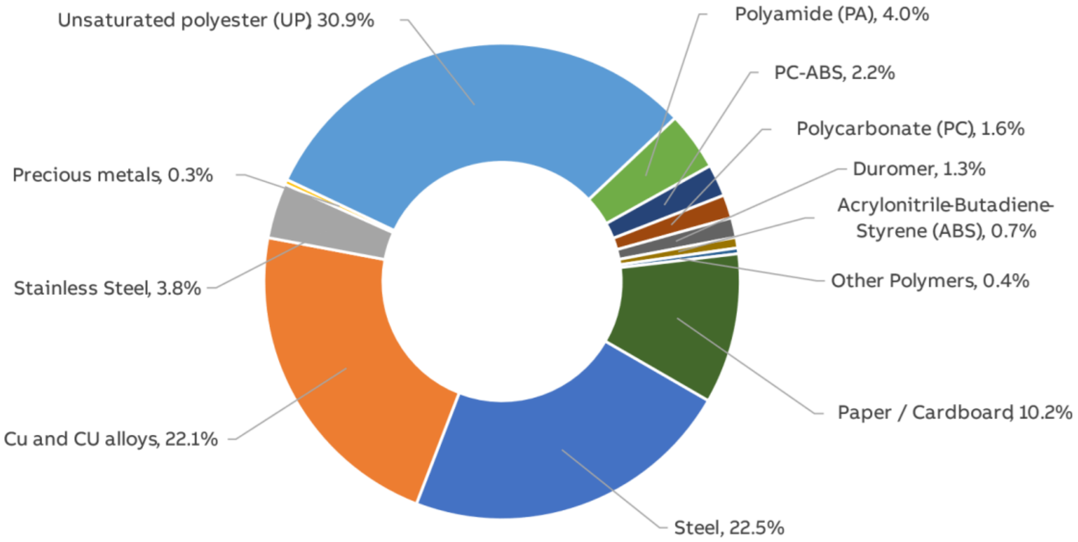

Figure 1: Composition of XT6 800 N/S/H 3P IEC TMA

Along the whole XT6 product cluster (TMA) a set of different build configurations have been covered by this analysis. Main differences consist of the number of poles, short circuit breaking capacity & IEC/UL. The LCA SimaPro model has been fully parametrized to fulfill each different configuration.

LCA background information

Functional unit and Reference Flow

The functional unit is the reference unit used to quantify the performance of the service delivered by a product to the user. The main purpose of the functional unit is to provide a reference to which inputs and outputs are related in the LCA.

The functional unit to this study is a single circuit breaker (including its packaging and accessories), to protect during 20 years the installation against overloads and short-circuits in circuit with assigned voltage U and rated current In (see tables 1). This protection is ensured in accordance with the following parameters

Number of poles	3/4
Rated breaking capacity [kA]	200
Tripping Curve	L, S, I

The Reference Flow of the study is a single circuit breaker (including its packaging and accessories) with mass described in table 3.

System boundaries and life cycle stages

The life cycle of the Low Voltage Circuit Breaker, an EEPS (Electronic and Electrical Products and Systems), is a "from cradle to grave" analysis and covers the following main life cycle stages: manufacturing, including the relevant acquisition of raw material, preparation of semi-finished goods, etc. and processing steps; distribution; installation, including the relevant steps for the preparation of the product for use; use including the required maintenance steps within the RSL (reference service life of the product) associated to the reference product; end-of-life stage, including the necessary steps until final disposal or recovery of the product system.

The following table shows the stages of the product life cycle and the information stages according to EN 50693:2019 [3] for the evaluation of electronic and electrical products and systems.

Manufacturing	Distribution	Installation	Use	End-of-Life (EoL)
Acquisition of raw materials Transport to manufacturing site Components/parts manufacturing Assembly Packaging EoL treatment of generated waste	Transport to distributor/ logistic center Transport to place of use	Installation EoL treatment of generated waste (packaging)	Usage Maintenance	Deinstallation Collection and transport EoL treatment

Table 4: Phases for the evaluation of construction products according to EN50693:2019 [3].

Temporal and geographical boundaries

The ABB component suppliers are sourced all over the world. All primary data collected are from 2021, which is a representative production year. Secondary data are also representative for this year, as provided by ecoinvent [6].

The selected ecoinvent [6] processes in the LCA model have a global representativeness, due to the unclear origin of each component. In this way, a conservative approach has been adopted.

Boundaries in the life cycle

As indicated in the PCR capital goods such as buildings, machinery, tools and infrastructure, the packaging for internal transport which cannot be allocated directly to the production of the reference product, may be excluded from the system boundary.

Infrastructures, when present, such as processes deriving from the ecoinvent [6] database have not been excluded.

Data quality

In this PEP, both primary and secondary data are used. Site specific foreground data have been provided by ABB. Main data sources are the bill of materials & drawings which are available on the ERP (SAP) & Windchill. For all processes for which primary are not available, generic data originating from the ecoinvent database [6], allocation cut-off by classifica-tion, are used. The ecoinvent database available in the SimaPro software [7] is used for the calculations.

The data quality characterized by quantitative and qualitative aspects, is presented in Ap-pen-dix 1. Each data quality parameter has been rated according to DQR tables from Chapter 7.19.2.2 of the Product Environmental Footprint Guide v.6.3 to give an indication of geog-raphy, technology and temporal representativeness.

Environmental impact indicators

The information obtained from the inventory analysis is aggregated according to the effects related to the various environmental issues. According to “PCR-ed4-EN-2021 09 06” and EN 50693 [3] the environmental impact indicators must be determined using the characterization factors and impact assessment methods specified in EN 15804:2012+A2:2019 [8].

PCR-ed4-EN-2021 09 06 and the EN 50693:2019 [3] standard establish four indicators for climate change: Climate change (total) which includes all greenhouse gases; Climate change (fossil fuels); Climate change (biogenic) which includes the emissions and absorption of biogenic carbon dioxide and biogenic carbon stored in the product; Climate change (land use) - land use and land use transformation. Other indicators as per the PCR[1].

Allocation rules

An allocation key is used for consumptions related to the manufacturing process in the production site, as well for company waste. Since the factory produces several products (different ACB and MCCB products) only a part of the environmental impact has been allocated to the XT6 production line. Allocation coefficients are based on the XT6 line’s occupancy area for electricity and methane consumption since, apart from assembly processes, the whole production

line is temperature-regulated throughout the year. The allocation of the total amount of waste generated by the production line as well, has been based on this criterion
The total number of operators was considered for water consumption. All these flows have been allocated and divided by the total number of XT6 circuit breakers produced in 2021.

Limitations and simplifications

Raw materials life cycle stage includes the extraction of raw materials as well as the transport distances to the manufacturing suppliers. These distances are assumed to be 1000 km as per the PCR. This distance has been added to the one already included in the market processes used for the model, as a result of a conservative choice made by the LCA operators.

Application of grease lubricant on the circuit breakers operating mechanism has been excluded since it is negligible. Surface treatments like galvanizing, tin and silver plating as well as their related transport processes (back and forth from the finishing suppliers) have been considered in the LCA model. Specific phosphate surface treatment, Stearate coating have been excluded by operational choice. Scraps for metal working and plastic processes are included when already defined in ecoinvent[6].

Printed circuit boards (PCB) have been modelled with a representative cluster dataset including: every single component, the unpopulated board as well as the surface mounting technology (SMD) process. For some components with no equivalent on ecoinvent database[6], the dataset “Electronic component, passive, unspecified {GLO}| market for | Cut-off, S” was used.

Energy Models

LCA Stage	EN 15804:2012 +A2:2019 module	Energy model	Notes
Raw material extraction and processing	A1-A2	Electricity, {RER}| market group for | Cut-off Electricity, {GLO}| market group for | Cut-off	Based on materials and supplier’s locations
Manufacturing	A3	Electricity, {IT}| market for | Cut-off	Specific Energy model for ABB Frosinone manufacturing plant, 100% renewable
Installation (Packaging EoL)	A5	Electricity, {GLO}| market group for | Cut-off	
Use Stage	B1	Electricity, [country]x | market for | Cut-off, S **	Low voltage, based on 2021 country sales mix
EoL	C1-C4	Electricity, {GLO}| market group for | Cut-off	

Table 5: Energy models used in each LCA stage

** Please refer the use phase for further description

Inventory analysis

In this PEP, both primary and secondary data are used. Site specific foreground data have been provided by ABB. For data collection, Bills of Material (BOM) extracted from ABB's internal SAP software were used. They are a list of all the components and assemblies that constitute the finished product, organized by level. Each item is matched with its code, quantity, weight and supplier. The BOMs were then processed, adding material, surface area and other weight data, taken from technical drawings. Finally, the manufacturing process and surface treatment were assigned, according to information provided by R&D personnel. Road distances between the suppliers and ABB were calculated using Google Maps, and marine distances using Distances & Time (Searates).

All primary data collected from ABB are from 2021, which was a representative production year. The ecoinvent cut-off by classification system processes [6] are used to represent the LCA model

Due to the large amounts of components in the Circuit Breaker, raw material inputs have been modelled with data from ecoinvent[6] representing either a European [RER] or Global [RoW] market coverage based on the supplier’s location. These datasets are assumed to be representative.

Manufacturing stage

The Circuit Breakers are composed of a multitude of components, all of which are made from of numerous materials. Most of the inputs to the products’ manufacturing stage are already produced component parts.

All the circuit breaker’s components have been modelled according to their specific raw materials and manufacturing processes.

The single use packaging as well as paper documentation are also included in the analysis in the manufacturing stage. ABB receives packaging components from outside suppliers and packages the circuit breakers before shipping them.

Most of the inputs to the products’ manufacturing stage are already produced component parts from the supply chain. In the ABB manufacturing plant, the different components and subassemblies are assembled into the circuit breaker. All the semi-finished and ancillary products are produced by ABB’s suppliers

The entire supplier’s network has been modelled with the calculation of each transportation stage, from the first manufacturing supplier to the next.

All the distances from the last subassembly suppliers’ factories to the ABB manufacturing facility have been calculated.
In the ABB factory, the different components and subassemblies are assembled into the circuit breaker. All the semi-finished and ancillary products are produced by ABB’s suppliers.

The energy mix used for the production phase is representative for ABB Frosinone production site and includes renewable energy only (Hydroelectric + Wind + Solar).

The complete energy mix has been modeled considering the GSE report on energy origins provided to ABB for the year 2021.

Distribution

The transport distances from ABB manufacturing plant to the distribution centers (regional distribution centers / local sales organizations) have been calculated considering the specific 2021 sales mix data for XT6 product cluster (SAP ERP sales data as a source).

An additional 10% distance by road has been considered to cover the last distribution stage to the end customer (usage location).

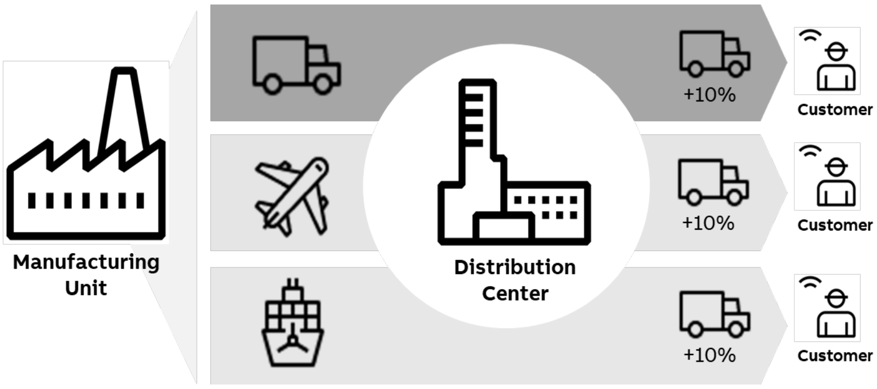

Figure 2: Distribution methodology.

Installation

The installation phase only implies manual activities, and no energy is consumed. This phase also includes the disposal of the packaging of the Low Voltage Circuit Breaker.

All the components needed to install the product have been included in the analysis.

For the disposal of the packaging after installation of the circuit breaker at the end of its life, a transport distance of 1000 km (according to PCR [1]) was assumed.
The actual disposal site is unknown and is managed by the customer. The disposal scenario of the packaging was calculated based on the latest Eurostat data (EU-27) available.

Use

Use and maintenance are modelled according to the PCR [1].

During the use phase, circuit breakers dissipate some electricity due to power losses. They are calculated according to the data provided in the catalogue of the circuit breaker and following the PCR [1] & PSR [2] rules:

Parameters		
Iu	[A]	1000
Iu	[%]	50
h/year	[h]	8760
RSL	[years]	20
Time operating coefficient	[%]	30

Table 6: Use phase parameters

The formula for the calculation of the electricity consumed is shown below and it is described as follows, where P_{use} is the power consumed by the switch at a given value of current:

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

The above calculations have been performed according to the number of poles (3) on which relevant current flows during use phase.

The Energy model used for this phase was built based on the 2021 actual sales mix data for the entire XT6 product range (SAP ERP sales data as a source). This approach has been taken since this list of countries is the most representative also for the other products listed in the extrapolation tables.

From Ecoinvent [6] database, the low voltage electricity country mix for each country(x) has been selected with its respective percentage on the total sales mix (Electricity, low voltage [country]x | market for | Cut-off, S).

Since no maintenance happens during the use phase, the environmental impacts linked to this procedure have been considered as null in the analysis.

End of life

The end-of-life stage is modelled according to PCR [1] and IEC/TR 62635 [9]. The percentages for end-of-life treatments of materials are taken from IEC/TR 62635 [9].

Since no specific data is available, the transport distances from the place of use to the place of disposal are assumed to be 1000 km (local/domestic transport by lorry, according to PCR [1]).

Environmental impacts

XT6

The following table show the environmental impact indicators of the life cycle of a XT6 IEC - 3P 800 N/S/H TMA Circuit Breaker as indicated by PCR [1] and EN 50693:2019 [3]. The indicators are divided into the contribution of the processes to the different stages (manufacturing, distribution, installation, use and end-of-life).

Impact category	Unit	Total	Manufacturing	Distribution	Installation	Use	End of Life
GWP-total	kg CO2 eq	1.18E+03	7.57E+01	1.32E+01	4.07E-01	1.08E+03	3.25E+00
GWP-fossil	kg CO2 eq	1.14E+03	7.50E+01	1.32E+01	9.00E-02	1.05E+03	3.20E+00
GWP-biogenic	kg CO2 eq	3.19E+01	6.42E-01	5.36E-03	3.17E-01	3.09E+01	4.61E-02
GWP-luluc	kg CO2 eq	2.63E+00	7.96E-02	1.24E-03	3.37E-05	2.54E+00	2.02E-03
ODP	kg CFC11 eq	7.54E-05	6.35E-06	3.02E-06	2.07E-08	6.58E-05	2.47E-07
AP	mol H+ eq	5.87E+00	1.41E+00	6.92E-02	4.71E-04	4.38E+00	1.53E-02
EP-freshwater	kg P eq	1.02E+00	1.26E-01	2.46E-04	6.07E-06	8.89E-01	6.71E-04
EP-marine	kg N eq	9.51E-01	1.37E-01	2.50E-02	2.98E-04	7.80E-01	9.72E-03
EP-terrestrial	mol N eq	8.76E+00	1.62E+00	2.73E-01	1.75E-03	6.83E+00	3.40E-02
POCP	kg NMVOC eq	2.47E+00	4.49E-01	7.21E-02	5.58E-04	1.94E+00	9.85E-03
ADP-minerals & metals	kg Sb eq	6.44E-02	5.68E-02	6.53E-06	2.08E-07	7.62E-03	2.75E-06
ADP-fossil	MJ	1.79E+04	1.06E+03	1.87E+02	1.37E+00	1.66E+04	3.09E+01
WDP	m3	3.12E+02	6.06E+01	2.06E-01	8.75E-03	2.51E+02	2.61E-01
PENRE	MJ	1.78E+04	9.73E+02	1.87E+02	1.37E+00	1.66E+04	3.09E+01
PENRM	MJ	8.65E+01	8.65E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRT	MJ	1.78E+04	1.06E+03	1.87E+02	1.37E+00	1.66E+04	3.09E+01
PERE	MJ	3.27E+03	2.06E+02	8.25E-01	1.91E-02	3.06E+03	2.45E+00
PERM	MJ	1.68E+01	1.68E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERT	MJ	3.29E+03	2.23E+02	8.25E-01	1.91E-02	3.06E+03	2.45E+00
SM	kg	2.47E+00	2.47E+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
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m3	1.20E+01	1.73E+00	7.58E-03	2.93E-04	1.02E+01	1.05E-02
HWD	kg	2.22E-02	6.73E-03	4.93E-04	3.27E-06	1.50E-02	3.72E-05
N-HWD	kg	7.73E+01	1.71E+01	2.30E+00	2.02E-01	5.32E+01	4.58E+00
RWD	kg	6.60E-02	2.96E-03	1.32E-03	9.12E-06	6.16E-02	1.34E-04
MfR	kg	1.01E+01	4.01E+00	0.00E+00	7.69E-01	0.00E+00	5.37E+00
MfER	kg	2.64E-01	0.00E+00	0.00E+00	8.90E-02	0.00E+00	1.75E-01
Efp	disease inc.	2.62E-05	5.83E-06	2.97E-07	1.05E-08	1.98E-05	2.56E-07
IrHH	kBq U-235 eq	2.43E+02	7.46E+00	8.53E-01	6.93E-03	2.35E+02	1.99E-01
ETX FW	CTUe	2.61E+04	1.38E+04	1.06E+02	1.56E+00	1.21E+04	5.58E+01
HTX CE	CTUh	6.91E-07	3.47E-07	1.60E-09	3.81E-11	3.39E-07	3.26E-09
HTX N-CE	CTUh	3.49E-05	2.40E-05	1.64E-07	1.74E-09	1.05E-05	1.99E-07
IrLS	Pt	3.90E+03	7.43E+02	4.76E+01	1.56E+00	3.08E+03	2.38E+01

Table 7: Impact indicators for XT6 IEC 3P 800 N/S/H TMA

Impact category	Unit	XT6 IEC 3P 800 N/S/H TMA
Biogenic Carbon content of the product	kg	1.07E+01
Biogenic Carbon content of the as-sociated packaging	kg	1.86E-01

Table 8: Inventory flow other indicators

Environmental impact indicators:

GWP-total	Global Warming Potential total (Climate change)
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 - fraction of nutrients reaching marine end compartment
EP-terrestrial	Eutrophication potential -Accumulated Exceedance
POCP	Formation potential of tropospheric ozone
ADP-m&m	Abiotic Depletion for non-fossil resources potential
ADP-fossil	Abiotic Depletion for fossil resources potential, WDP
WDP	Water deprivation potential.

Resource use indicators

PERE	Use of renewable primary energy excluding renewable primary en-ergy resources used as raw material
PERM	Use of re-newable primary energy resources used as raw material
PERT	Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials)
PENRE	Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw material
PNERM	Use of non-renewable primary energy resources used as raw ma-terial
PENRT	Total use of non-renewable primary energy resources (primary en-ergy and primary energy resources used as raw materi-als)

Secondary materials, water and energy resources

SM	Use of secondary materials
RSF	Use of renewable secondary fuels
NRSF	Use of non-renewable secondary fuels
FW	FW: Net use of fresh water

Waste category indicators

HWD	Hazardous waste disposed
N-HWD	Non-hazardous waste disposed
RWD	Radioactive waste disposed

Output flow indicators

MfR	Materials for recycling
MfER	Materials for energy recovery

Other indicators

Efp	Emissions of Fine particles
IrHH	Ionizing radiation, human health
ETX FW	Ecotoxicity, freshwater
HTX CE	Human toxicity, carcinogenic effects
HTX N-CE	Human toxicity, non-carcinogenic effects
IrLS	Impact related to Land use / soil quality

Extrapolation for Homogeneous environmental family

This LCA covers different build configurations other than the representative products from the IEC and UL types. All the analyzed configurations have the same main functionality, product standards and manufacturing technology

The different life cycle stages can be extrapolated to other products of the same homogeneous environmental family by applying a rule of proportionality to the parameters in the following tables, divided by different life cycle stages

XT6 Extrapolation:

XT6 TMA Extrapolation:

IEC/UL	3P/4P	Trip Unit	Breaking Capacity	GWP-total	GWP-fossil	GWP-biogenic	GWP-luluc	ODP	AP	EP-freshwater	EP-marine	EP-terrestrial	POCP	ADP-m&m	ADP-fossil	WDP
IEC	3	TMA	N-S-H	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
IEC	3	TMA	N-S-H	1.25	1.25	1.30	1.28	1.25	1.32	1.32	1.29	1.30	1.30	1.33	1.26	1.22
IEC	4	Switch	D	0.97	0.97	0.92	0.98	0.96	1.01	1.01	0.99	0.99	0.99	1.01	0.97	0.99
IEC	4	Switch	D	1.22	1.22	1.18	1.25	1.22	1.33	1.34	1.28	1.30	1.29	1.35	1.23	1.21
UL	3	TMA	N-S-H	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
UL	3	TMA	N-S-H	1.24	1.24	1.28	1.27	1.25	1.30	1.31	1.28	1.29	1.28	1.31	1.25	1.20
UL	4	Switch	D	0.97	0.97	0.96	0.98	0.97	0.98	0.99	0.98	0.98	0.98	0.99	0.97	0.99
UL	4	Switch	D	1.22	1.22	1.24	1.25	1.23	1.29	1.30	1.27	1.28	1.27	1.32	1.23	1.20

Table 9: Manufacturing phase Extrapolation factors for XT6 TMA
Reference product: XT6 IEC 3P 800 N/S/H TMA

IEC/UL	3P/4P	Trip Unit	Breaking Capacity	LCA Phase	All
IEC	3	TMA	N-S-H	Distribution	1.00
IEC	3	TMA	N-S-H		1.25
IEC	4	Switch	D		0.96
IEC	4	Switch	D		1.19
UL	3	TMA	N-S-H		0.99
UL	3	TMA	N-S-H		1.24
UL	4	Switch	D		0.97
UL	4	Switch	D		1.21

Table 10: Distribution phase Extrapolation factors for XT6 TMA
Reference product: XT6 IEC 3P 800 N/S/H TMA

LCA Phase: Installation

Installation phase impacts are common across all variants of the breaker.

Type	In [A]	LCA Phase	Factor
IEC	630	Use	0.63
	800		1.00
UL	600		0.56
	800		1.00

Table 11: Use phase Extrapolation factors for XT6 TMA
Reference product: XT6 IEC 3P 800 N/S/H TMA

IEC/UL	3P/4P	Trip Unit	Breaking Capacity	GWP-total	GWP-fossil	GWP-biogenic	GWP-luluc	ODP	AP	EP-freshwater	EP-marine	EP-terrestrial	POCP	ADP-m&m	ADP-fossil	WDP
IEC	3	TMA	N-S-H	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
IEC	3	TMA	N-S-H	1.31	1.31	1.17	1.32	1.29	1.31	1.33	1.32	1.30	1.30	1.29	1.31	1.32
IEC	4	Switch	D	0.99	0.99	0.93	1.01	0.96	1.00	1.01	0.98	0.98	0.98	0.97	0.99	1.00
IEC	4	Switch	D	1.30	1.30	1.11	1.33	1.24	1.31	1.34	1.29	1.28	1.28	1.25	1.29	1.31
UL	3	TMA	N-S-H	0.99	0.99	1.02	0.99	0.99	0.99	0.99	1.00	0.99	0.99	0.99	0.99	0.99
UL	3	TMA	N-S-H	1.30	1.30	1.19	1.30	1.28	1.30	1.31	1.31	1.29	1.29	1.28	1.29	1.30
UL	4	Switch	D	0.97	0.97	0.94	0.97	0.97	0.97	0.97	0.98	0.97	0.97	0.97	0.97	0.97
UL	4	Switch	D	1.28	1.28	1.10	1.29	1.25	1.28	1.29	1.29	1.26	1.26	1.25	1.27	1.28

Table 12: End of Life phase Extrapolation factors for XT6 TMA
Reference product: XT6 IEC 3P 800 N/S/H TMA

Additional environmental information

According to the waste treatment scenario calculation in Simapro[7], based on the recycling rate in the technical report IEC/TR 62635 Edition 1.0 [9] Table D.6, the following recyclability potentials were calculated. The recyclability potential is calculated based on the product weight (excluding packaging).

	XT6 IEC 3P 800 N/S/H TMA
Recyclability potential	60.5%

Table 13: Recyclability potential of XT6 TMA

References

[1] PCR “PEP-PCR-ed4-EN-2021_09_06” - Product Category Rules for Electrical, Electronic and HVAC-R Products (published: 6th September 2021)

[2] PSR “PSR-0005-ed2-EN-2016 03 29” - SPECIFIC RULES FOR Electrical switchgear and control gear Solutions (Circuit breakers)

[3] EN 50693:2019 - Product category rules for life cycle assessments of electronic and electrical products and systems

[4] ISO 14040:2006 - Environmental management -Life cycle assessment - Principles and framework

[5] ISO 14044:2006 - Environmental management - Life cycle assessment - Requirements and guidelines

[6] ecoinvent v3.8 (2021). ecoinvent database version 3.8 - (https://ecoinvent.org/)

[7] SimaPro Software version 9.3.0.3 - PRé Sustainability

[8] UNI EN 15804:2012+A2:2019: Sustainability of constructions - Environmental product declarations (September 2019)

[9] IEC/TR 62635 - 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

[10] https://www.ecosystemspa.com/

[11] LB-DT 17-21D - RoHS II (MCCBs and ACBs)

[12] 1SDL000282R1265 - REACH (MCCBs and ACBs)