EPD

Environmental Product Declaration

REX610 Protection and Control Relay

Production site: Vaasa, Finland

DOCUMENT KIND	IN COMPLIANCE WITH			
Environmental Product Declaration	ISO 14025 and EN 50693			
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EPD Owner	ABB Switzerland Ltd, Group Technology Management		
Organization No.	CHE-101.538.426		
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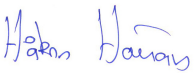
Program operator	The Norwegian EPD Foundation Post Box 5250 Majorstuen, 0303 Oslo, Norway phone: +47 23 08 80 00, email: post@epd-norge.no		
Declared product	REX610 Protection and Control Relay		
Product description	REX610 is a member of the renowned Relion® protection and control family of relays. It is a freely configurable all in one protection relay covering the full range of basic utility, industrial, transport and infrastructure applications for protection, control, measurement, condition monitoring, logging, communication, and supervision of power distribution systems.		
Functional unit	To protect a power system against faults such as short circuit and overload, using an auxiliary voltage of 110 V DC, during a service life of 10 years and with a use rate of 100 % in Europe.		
Reference flow	A single REX610 protection and control relay, including related connectors, accessories, and packaging.		
CPC code	4621 - Electricity distribution or control apparatus		
Independent verification	Independent verification of the declaration and data, according to ISO 14025:2010 ☐ INTERNAL ☒ EXTERNAL Independent verifier approved by EPD-Norge: Elisabet Amat Guasch 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.		
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 2REA071764.		
EPD type	Specific product		
EPD scope	Cradle-to-grave		
Product RSL	10 years		
Geographical representativeness	Manufacturing (suppliers): Global	Manufacturing (ABB): Finland	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 includes all configurations of the REX610 protection and control relay, including related accessories and packaging.

REX610 is a member of the renowned Relion® protection and control family of relays. It is a freely configurable all in one protection relay covering the full range of basic utility, industrial, transport and infrastructure applications for protection, control, measurement, condition monitoring, logging, communication and supervision of power distribution systems. The relays are available in ready-made standard configurations for fast and easy set-up but can also be tailored to meet customer-specific requirements.

General technical specifications of the product REX610 are presented below.

	Description	Value
Width	Frame	150 mm
	Case	128 mm
Height	Frame	160 mm
	Case	156 mm
Depth		203 mm
Weight	Complete relay	max. 2.5 kg
	Plug-in unit only	max. 0.91 kg

REX610	Power supply module
Nominal auxiliary voltage U_n	48-240 V AC, 50 and 60 Hz
	24-250 V DC
Burden of auxiliary voltage supply under quiescent (P_q) / operating condition	9 W (P_q) 19 W/40 VA (P_{max})

The REX610 protection and control relays are produced in Vaasa, Finland, and the relays are sold globally.

The manufacturing site in Vaasa, Finland, uses 100 % renewable energy for the electricity, more specifically, a 50/50 mix of wind and hydro. The plant is also 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

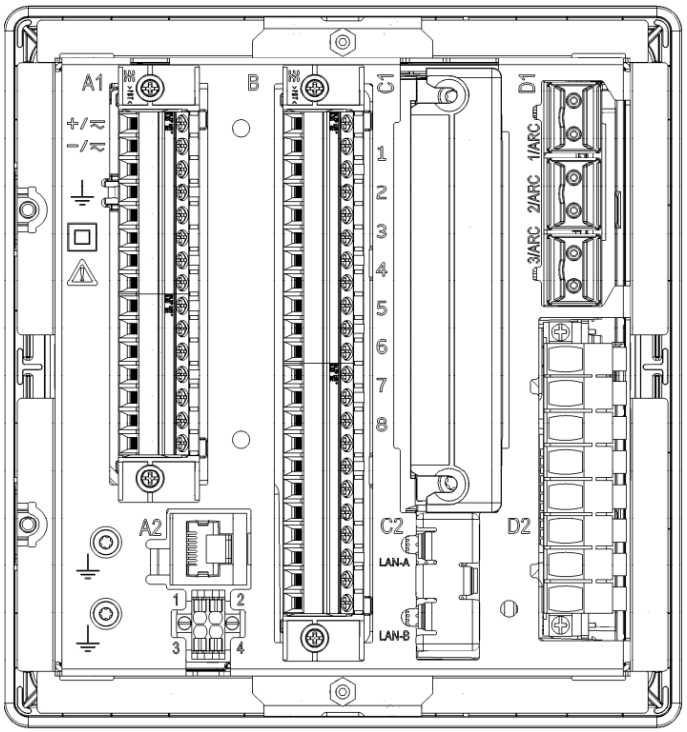
Note, ABB only performs final assembling and testing of the relays. ABB does not manufacture any parts or components themselves. Instead, this is outsourced and purchased from various suppliers. Most of the parts are purchased as sub-assemblies or ready modules.

The relay has mandatory and optional slots. A mandatory slot always contains a module, but an optional slot may be empty, depending on the configuration ordered. The module slots are shown in the table below.

Module	Slot A1	Slot A2	Slot B	Slot C1	Slot C2	Slot D1	Slot D2
AIC2001				o			
AIC2002				o			
AIU2001							o
ARC2001						o	
COM2001		•					
DIO2001			•				
PSU2001	•						

• = Mandatory to have the modules in the slot

o = Optional to have one of the allocated modules in the slot



Due to the configurable nature of the product, there is a significant variation within the REX610 in terms of environmental impacts. A representative relay is therefore selected as reference product and declared in this EPD. The configuration of the reference product has all module slots filled except C2. The results of the study can be extrapolated for other relay configurations according to EN 50693. The extrapolation rules are provided together with the results.

Slot	Module	Reference product
A1	Power supply	PSU2001
A2	Communication	COM2001
B	Binary I/O	DIO2001
C1	Analog I/O CT	AIC2001
C2	-	-
D1	Arc	ARC2001
D2	Analog I/O VT	AIU2001
HMI	HMI	HMI2001
Product ID		REX610
Weight (excl. packaging)		2.53kg
Ordering code		REX6101GMBAANNNA

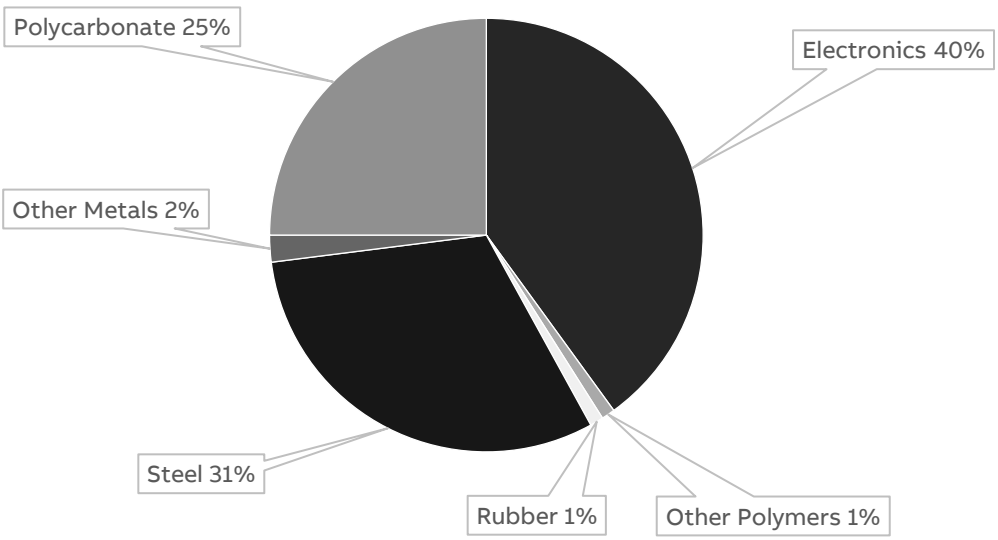
The ordering code is generated based on selected configuration in the ABB's product selection tool.

Constituent Materials

The REX610 reference product weighs 2.54 kg, and the constituent materials are presented below. Due to the complex nature of the electronics, these are presented as a separate category, which includes printed wiring boards, electronic components, connectors, and cables. Electronics are typically composed of various plastics, copper, and precious metals.

Type	Material	Weight [kg]	Weight %
Plastics	Polycarbonate	0.64	25
Metals	Steel, low-alloyed	0.80	31
	Other metals	0.05	2
Others	Electronics	1.01	40
	Rubber	0.02	1
	Other Polymers	0.02	1
Total		**2.54**	**100**

REX610 Reference Product



The packaging materials and accessories of the relay weighs 0.82 kg in total, of which 0.36 kg is the packaging of the relay, and 0.47 kg is the bulk packaging per relay (30 relays per pallet). The constituent materials are presented below.

	Description	Material	Weight [kg]	Weight %	Secondary material %
Relay	Packaging box	Cardboard	0.183	22	63
	Cushioning	Molded fiber pulp	0.131	16	100
	Self-sealing bags	PE	0.008	1	0
	Documentation	Printed paper*	0.036	4	0
	Subtotal		**0.358**	**43**	**69**
Pallet (1/30)	Pallet	Wood*	0.307	37	0
	Packaging box	Cardboard*	0.083	10	0
	Packaging cover	Cardboard*	0.037	4	0
	Protective edges	Cardboard	0.004	1	85
	Cushioning	Kraft paper	0.034	4	100
	Plastic straps	PET	0.002	1	100
	Subtotal		**0.466**	**57**	**8**
Total			**0.824**	**100**	**35**

*FSC- or PEFC-certified

LCA Background Information

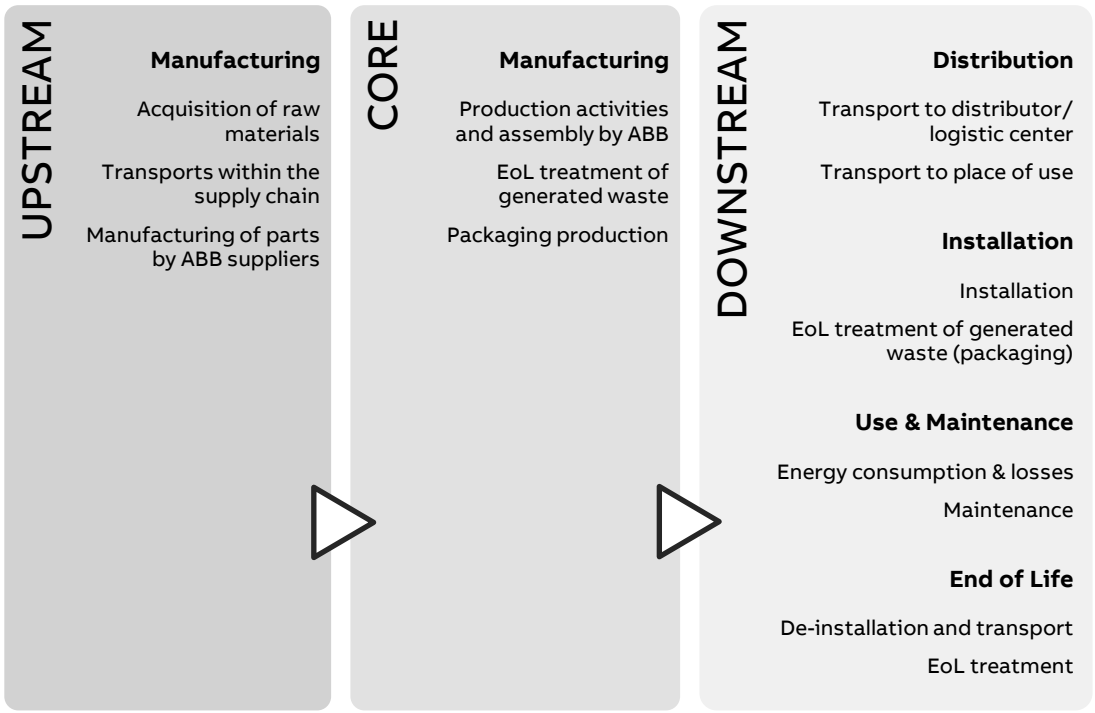
Functional Unit

The functional unit of this study is to protect a power system against faults such as short circuit and overload, using an auxiliary voltage of 110 V DC, during a service life of 10 years and with a use rate of 100 % in Europe. The reference flow is a single REX610 protection and control relay, including related connectors, accessories, and packaging.

Note, the reference service life (RSL) of 10 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 REX610, 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 EN50693, 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 REX610 are globally sourced. The supply chains are often complex and can extend across multiple countries and continents. Therefore, a conservative approach is adopted by mainly using datasets with global representativeness from ecoinvent.

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 of ABB’s manufacturing site are allocated to the production of one REX610 relay by using allocation rules. Because the plant is also handling “box-build” products, a part of the total utility and waste is allocated based on production hours to relevant “box-build” products. The remaining amounts related to the relay production are then allocated per relay based on production volumes. Moreover, utility consumption and waste generation deriving from offices and administrative activities are not excluded and thus, a conservative approach is adopted.

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 EN 50693, the cut-off criteria can be set to a maximum of 5 % of the overall environmental impacts. In this LCA, stickers, labels, tape, and staples used in the packaging have been excluded as their weights are negligible. Thermal paste used in the electronics is also excluded due to the unavailability of data.

Inventory Analysis

Manufacturing stage

As presented in chapter Constituent Materials, electronics and low-alloyed steel are the most frequently used materials, followed by polycarbonate.

Using the ecoinvent database, the steels are mainly modelled with *Steel, low-alloyed {GLO}| market for*. 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 *Zinc coat, pieces {GLO}| market for* and *Zinc coat, coils {GLO}| market for*.

The printed wiring boards (PWB) are modelled on a component level. Empty PWB's are first modelled as *printed wiring board, for surface mounting, PB free surface {GLO}| market for*. Every single component, such as resistors, transistors, etc., is then categorized and grouped into the most corresponding processes found in ecoinvent. Finally, the production efforts are accounted for by using the process *Mounting, surface mount technology, Pb-free solder {GLO}| market for*".

For modelling the connectors, the following process is used: *Electric connector, peripheral component interconnect buss {GLO}| market for*. Due to the high impacts of gold, primary data are used to model the specific amounts of gold used in the connectors.

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 REX610 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 300 km over land, as the actual distance is unknown. The environmental impacts can be multiplied accordingly if the actual distance is known. The selected ecoinvent process is *transport, freight, lorry 16-32 metric ton, EURO4 {RER}*.

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.

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. A transport distance of 100 km by lorry is assumed as actual location of disposal is unknown.

Use

The use stage considers the nominal power consumption over the reference service life of 10 years as defined in the functional unit. This is calculated using the following formula:

$$E_{use}[kWh] = \frac{P_{use} * 8760 * RSL * \alpha}{1000} = \frac{4.2\text{W} * 8760 \text{ hours} * 10 \text{ years} * 100\ \%}{1000} = 367.92\ kWh$$

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
European energy mix; *Electricity, medium voltage {RER}| market group for | Cut-off, S*	Ecoinvent v3.9.1	0.36	kg CO_2-eq./kWh

Maintenance is not included because the REX610 does not have any required maintenance within its service life. The only maintenance that is performed is corrective maintenance if, for example, something breaks or stops working. However, corrective maintenance is unusual, and thus considered negligible.

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 is assumed, and this includes the losses in the separation processes. A transport distance of 100 km by lorry is assumed as actual location of disposal is unknown.

Environmental Indicators

REX610 Reference Product

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.	1.94E+02	5.75E+01	1.55E+00	1.61E-01	7.57E-03	1.33E+02	2.13E+00
GWP – fossil	kg CO_2 eq.	1.89E+02	5.71E+01	1.13E+00	1.61E-01	7.57E-03	1.28E+02	2.10E+00
GWP – biogenic	kg CO_2 eq.	5.43E+00	2.95E-01	3.86E-01	1.47E-04	1.18E-06	4.72E+00	2.65E-02
GWP – luluc	kg CO_2 eq.	4.62E-01	1.03E-01	3.89E-02	7.88E-05	4.36E-06	3.20E-01	3.14E-04
ODP	kg CFC-11 eq.	4.67E-06	2.34E-06	2.79E-08	3.53E-09	1.57E-10	2.30E-06	3.53E-09
AP	mol H+ eq.	1.27E+00	6.19E-01	5.77E-03	6.68E-04	3.12E-05	6.43E-01	1.60E-03
EP – freshwater	kg P eq.	1.85E-01	6.79E-02	4.75E-04	1.14E-05	6.93E-07	1.17E-01	8.62E-05
EP – marine	kg N eq.	2.09E-01	9.02E-02	1.98E-03	2.55E-04	1.15E-05	1.14E-01	1.96E-03
EP – terrestrial	mol N eq.	2.30E+00	1.27E+00	1.67E-02	2.72E-03	1.22E-04	1.01E+00	5.51E-03
POCP	kg NMVOC eq.	6.32E-01	3.01E-01	4.35E-03	9.77E-04	4.43E-05	3.25E-01	1.53E-03
ADP – minerals and metals	kg Sb eq.	1.88E-02	1.85E-02	1.98E-05	5.21E-07	2.73E-08	2.55E-04	1.81E-06
ADP – fossil	MJ, net calorific value	3.73E+03	7.65E+02	1.19E+01	2.30E+00	1.10E-01	2.95E+03	3.07E+00
WDP	m^3 eq.	4.45E+01	1.42E+01	1.35E-01	9.34E-03	5.70E-04	3.01E+01	6.97E-02

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	3.70E+03	7.35E+02	1.16E+01	2.30E+00	1.10E-01	2.94E+03	3.07E+00
PERE	MJ, low cal. value	6.79E+02	8.02E+01	3.33E+01	3.57E-02	2.36E-03	5.66E+02	2.80E-01
PENRM	MJ, low cal. value	2.99E+01	2.97E+01	2.14E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERM	MJ, low cal. value	4.36E+00	0.00E+00	4.36E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRT	MJ, low cal. value	3.73E+03	7.65E+02	1.19E+01	2.30E+00	1.10E-01	2.94E+03	3.07E+00
PERT	MJ, low cal. value	6.84E+02	8.02E+01	3.76E+01	3.57E-02	2.36E-03	5.66E+02	2.80E-01
FW	m^3	2.86E+00	5.10E-01	3.96E-02	3.28E-04	1.90E-05	2.30E+00	2.39E-03
MS	kg	5.40E-01	2.91E-01	2.48E-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	1.13E-02	7.46E-03	5.66E-05	1.46E-05	6.45E-07	3.73E-03	1.29E-05
NHWD	kg	1.77E+01	8.11E+00	3.48E-01	1.12E-01	5.22E-03	8.08E+00	1.04E+00
RWD	kg	2.29E-02	1.47E-03	2.28E-05	7.48E-07	4.71E-08	2.14E-02	5.04E-06
MER	kg	1.14E+00	0.00E+00	5.29E-01	0.00E+00	0.00E+00	0.00E+00	6.08E-01
MFR	kg	3.08E+00	2.13E-01	1.58E+00	0.00E+00	3.41E-01	0.00E+00	9.49E-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	3.66E+00	0.00E+00	1.77E+00	0.00E+00	0.00E+00	0.00E+00	1.88E+00
EEE	MJ	2.02E+00	0.00E+00	9.76E-01	0.00E+00	0.00E+00	0.00E+00	1.05E+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, extrapolation rules are established according to EN 50693. This allows for estimating more precise impacts of other relay configurations. The extrapolation rules are based on linear regression from the LCIA results of the reference product and a minimum variant. Other relay configurations have been tested to ensure an accuracy of within ± 10% of the total environmental impacts. As a result, the following rules are established:

1. The upstream manufacturing stage, distribution stage, and end-of-life stage can be extrapolated based on an extrapolation key and changes in percentage.

    - Formula: $Value_{refproduct} * (1 + change\% * (x_{extrapolationkey} - 1))$

      where $x_{extrapolationkey} = \sum a_{moduleslotconstant}$

    - For every optional module present in the relay configuration, sum the module slot constants accordingly:

Module Slot	$a_{moduleslotconstant}$
C1	0.33
C2	-
D1	0.22
D2	0.45

2. The use stage is proportional to the actual, measured power consumption.
    - Formula: $Value_{refproduct} * (\frac{P_{actual}}{P_{reference}})$

      where $P_{reference} = 4.2$ W

    - Typical range (DC): 3–6 W
    - Typical range (AC): 4–19 W

3. The recyclability potential can be extrapolated with the following formula:
    - Formula: $37\ \% + (5\ \% * (1 - X_{extrapolationkey}))$

Example 1: A REX610 relay that have C1 module slot filled, and a measured power consumption at 3.5 W:

- "GWP-total" in upstream = 57.5 kg CO_2-eq * (1 + 29 % * (0.33 – 1) = 46.3 kg CO_2-eq
- "GWP-total" in use stage = 133 kg CO_2-eq * (3.5 W / 4.2 W) = 111 kg CO_2-eq
- Recyclability potential = 37 % + (5 % * (1 – 0.33)) = 40 %

Example 2: A REX610 relay that have D1 and D2 module slots filled, and a measured power consumption at 4 W.

- "ADP-fossil" in distribution = 2.30 MJ * (1 + 17.5 % * ((0.22 + 0.45) – 1)) = 2.17 MJ
- "ADP-fossil" in use stage = 2950 MJ * (4 W / 4.2 W) = 2810 MJ
- Recyclability potential = 37 % + (5 % * (1 – (0.22 + 0.45)) = 40 %

Impact category	*Change%*					
	Upstream	Core	Distribution	Installation	Use and maintenance	End-of-life
GWP – total	29.0 %	-	17.5 %	-	-	31.6 %
GWP – fossil	29.0 %	-	17.5 %	-	-	31.9 %
GWP – biogenic	26.4 %	-	17.5 %	-	-	3.7 %
GWP – luluc	31.4 %	-	17.5 %	-	-	19.1 %
ODP	36.7 %	-	17.5 %	-	-	22.2 %
AP	30.3 %	-	17.5 %	-	-	23.2 %
EP – freshwater	37.3 %	-	17.5 %	-	-	20.8 %
EP – marine	28.2 %	-	17.5 %	-	-	18.9 %
EP – terrestrial	22.3 %	-	17.5 %	-	-	25.7 %
POCP	27.1 %	-	17.5 %	-	-	24.3 %
ADP – minerals and metals	34.1 %	-	17.5 %	-	-	17.9 %
ADP – fossil	28.3 %	-	17.5 %	-	-	19.9 %
WDP	30.1 %	-	17.5 %	-	-	25.1 %

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	*Change%*					
	Upstream	Core	Distribution	Installation	Use and maintenance	End-of-life
PENRE	28.6 %	-	17.5 %	-	-	19.9 %
PERE	31.6 %	-	17.5 %	-	-	19.7 %
PENRM	19.7 %	-	0.0 %	-	-	0.0 %
PERM	0.0 %	-	0.0 %	-	-	0.0 %
PENRT	28.3 %	-	17.5 %	-	-	19.9 %
PERT	31.6 %	-	17.5 %	-	-	19.7 %
FW	31.0 %	-	17.5 %	-	-	24.7 %
MS	6.4 %	-	0.0 %	-	-	0.0 %
RSF	0.0 %	-	0.0 %	-	-	0.0 %
NRSF	0.0 %	-	0.0 %	-	-	0.0 %

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	*Change%*					
	Upstream	Core	Distribution	Installation	Use and maintenance	End-of-life
HWD	26.3 %	-	17.5 %	-	-	21.5 %
NHWD	23.9 %	-	17.5 %	-	-	20.8 %
RWD	31.8 %	-	17.5 %	-	-	18.0 %
MER	0.0 %	-	0.0 %	-	-	33.8 %
MFR	10.3 %	-	0.0 %	-	-	9.4 %
CRU	0.0 %	-	0.0 %	-	-	0.0 %
ETE	0.0 %	-	0.0 %	-	-	31.9 %
EEE	0.0 %	-	0.0 %	-	-	31.9 %

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.

An Excel tool for the extrapolation rules of the REX610 is available at:
https://search.abb.com/library/Download.aspx?DocumentID=2REA071766&LanguageCode=en&DocumentPartId=&Action=Launch

Sensitivity analysis

This chapter presents the results of a sensitivity analysis in different scenarios, to understand how the impact category “GWP – total” varies for REX610 that are used in different geographical locations. The results are presented in table below.

Scenario	Total [kg CO_2 eq.]	UPSTREAM	CORE	DOWNSTREAM			
		Manufacturing		Distribution	Installation	Use and maintenance	End-of-life
Declared scenario (Europe) Manufacturing site: Finland Distribution: 300 km by lorry Use stage: Europe	1.94E+02	5.75E+01	1.55E+00	1.61E-01	7.57E-03	1.33E+02[1]	2.13E+00
Pakistan Manufacturing site: Finland Distribution: 300 km by lorry Use stage: Pakistan	2.64E+02	5.75E+01	1.55E+00	1.61E-01	7.57E-03	2.03E+02[2]	2.13E+00
Indonesia Manufacturing site: Finland Distribution: 300 km by lorry Use stage: Indonesia	4.96E+02	5.75E+01	1.55E+00	1.61E-01	7.57E-03	4.35E+02[3]	2.13E+00

Emission factors for the energy mixes used in the sensitivity analysis are presented below.

#	Electricity mix	Data source	Amount	Unit
1	European energy mix; *Electricity, medium voltage {RER}| market group for | Cut-off, S*	Ecoinvent v3.9.1	0.36	kg CO_2-eq/kWh
2	Pakistan energy mix; *Electricity, medium voltage {PK}| market for | Cut-off, S*	Ecoinvent v3.9.1	0.55	kg CO_2-eq/kWh
3	Indonesia energy mix; *Electricity, medium voltage {ID}| market for electricity, medium voltage | Cut-off, S*	Ecoinvent v3.9.1	1.18	kg CO_2-eq/kWh

Additional Environmental Information

Recyclability potential

The recyclability potential of the REX610 is calculated by dividing “MFR: material for recycling” in the end-of-life stage by the total weight of the product. As a result, the recyclability potentials of the product are presented below:

Product variants with optional module slots	Recyclability potential
C1+D1+D2 (Reference)	37 %
C1 (Extrapolated)	40 %
C2 (Extrapolated)	-
D1 (Extrapolated)	41 %
D2 (Extrapolated)	40 %
None (Min. variant)	42 %

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	Data source	Amount	Unit
ABB FI energy mix; 50 % wind + 50 % hydro	Ecoinvent v3.9.1	0.0259	kg CO_2-eq/kWh

Dangerous substances

As part of ABB’s values, and in alignment with the Supplier Code of Conduct, we seek to work with companies who contribute to a sustainable development and are ethically, socially, environmentally, and economically responsible.

ABB is responsible for ensuring that our products comply with legal requirements. There are also other sets of environmental requirements not necessarily originating from legislation, but which are of great importance as ABB customers are demanding compliance with them.

ABB Distribution Solutions has contacted suppliers of REX610 to collect component and material information. This information includes, but is not limited to:

- Full Material Disclosure
- RoHS compliance certificate
- REACH compliance certificate
- Component lifecycle status

Thus, the purpose is to avoid chemicals, materials, and substances that

- may represent hazards to the environment, or
- the health of workers, customers, consumers, and other stakeholders, or
- could negatively influence end-of-life properties.

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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