EPD

Environmental Product Declaration

REX640 HMI

Production Site: Vaasa, Finland

DOCUMENT KIND Environmental Product Declaration	IN COMPLIANCE WITH 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	REX640 HMI		
Product description	The REX640 HMI is used for setting, monitoring, and controlling a REX640 protection relay and the related process. It comprises a 7-inch color screen with capacitive touch sensing and a home button at the bottom of the HMI. The HMI must be paired with the protection relay to enable all the functionalities in it. The HMI is an accessory for the relay which is fully operational even without the HMI.		
Functional unit	To set, monitor, and control the REX640 protection relay and the related process, 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 REX640 HMI, including related 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 Signature: 		
Approved by	Håkon Hauan, CEO EPD-Norge Signature: 		
Reference PCR and PSR	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 2RCA058039.		
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 9.4.0.2 (2023)		
LCI database	Ecoinvent v3.8 (2021)		
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 all the variants of REX640 HMI.

The variants differ only regarding software installation and potential conformal coating, whereby 2RCA033008A0001 is used as reference product for the LCA.

The REX640 HMI is used for setting, monitoring, and controlling a REX640 protection relay and the related process. It comprises a 7-inch color screen with capacitive touch sensing and a home button at the bottom of the HMI. The HMI must be paired with the protection relay to enable all the functionalities in it. The HMI is an accessory for the relay which is fully operational even without the HMI.

General technical specifications of the REX640 HMI are presented below.

Description	Value
Width	212.5 mm
Height	177.5 mm
Depth	57.6 mm
Weight	1.5 kg

Description	Value
Nominal auxiliary voltage U_n	100, 110, 120, 220, 240 V AC, 50 and 60 Hz
	24, 48, 60, 110, 125, 220, 250 V DC
Burden of auxiliary voltage supply under quiescent (P_q)/operating condition	AC < 7.0 W (nominal) / < 12.0 W (max.)
	DC < 6.0 W (nominal) / < 14.0 W (max.)

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

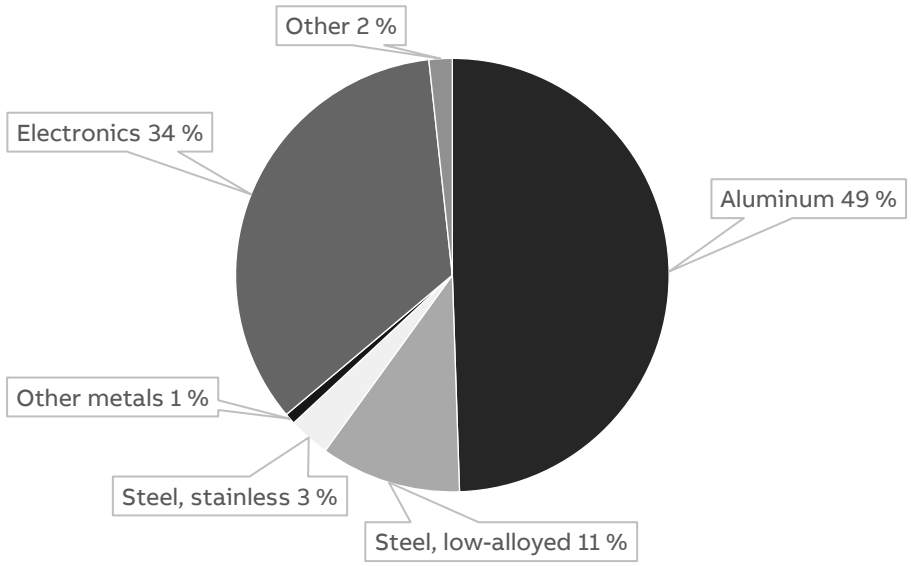
ABB only performs software installation and final testing of the REX640 HMIs. ABB does not manufacture or assembly the product itself. Instead, it is outsourced and purchased from supplier as a ready product.

Constituent Materials

The REX640 HMI reference product weighs 1.5 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]	%
Metals	Aluminum	0.75	49
	Steel, low-alloyed	0.16	11
	Steel, stainless	0.05	3
	Other metals	0.01	1
Others	Electronics	0.52	34
	Other	0.03	2
Total		**1.51**	**100**

REX640 HMI



The packaging materials and accessories of the HMI weighs 0.77 kg in total, of which 0.29 kg is the packaging of the HMI, and 0.48 kg is the bulk packaging per HMI (29 HMIs per pallet). The constituent materials are presented below.

	Description	Material	Weight [g]	Weight %	Secondary material %
HMI	Packaging box	Cardboard	185	24	63
	Cushioning	Molded fiber pulp	97	13	100
	Self-sealing bags	PE	2	<1	0
	Protective foil	Printed paper	3	<1	0
	Subtotal		**287**	**37**	**74**
Pallet (1/29)	Pallet	Wood*	317	41	0
	Packaging box	Cardboard*	86	11	0
	Packaging cover	Cardboard*	38	5	0
	Protective edges	Cardboard	4	<1	85
	Cushioning	Kraft paper	35	5	100
	Plastic straps	PET	3	<1	100
	Subtotal		**482**	**63**	**8**
Total			**769**	**100**	**33**

*FSC- or PEFC-certified

LCA Background Information

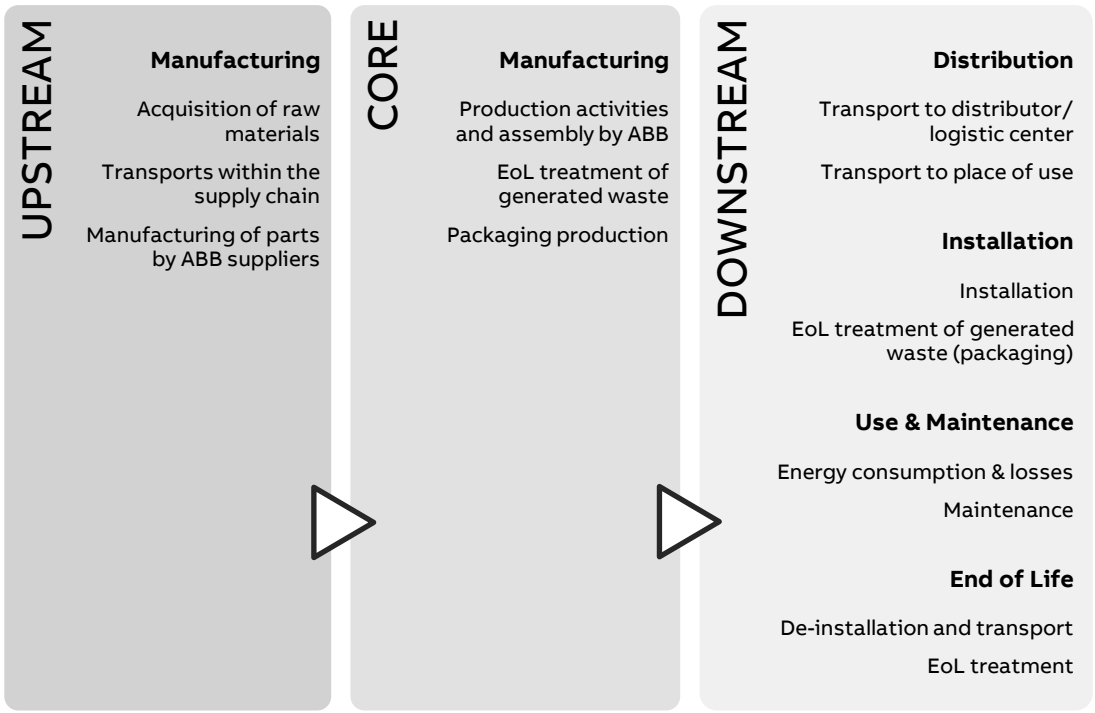
Functional Unit

The functional unit of this study is to set, monitor, and control the REX640 protection relay and the related process, 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 REX640 HMI, including related 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 REX640 HMI, an EEPS (Electronic and Electrical Products and Systems), is a “from 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, the PCR EPDitaly007 refer to chapter 4.2.3.1 in the standard EN 50693 for products that can be easily replaced or recovered. In accordance with EN 50693:2019, 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 v3.8 which was released in 2021.

In terms of geographical boundaries, the materials and components used in the production of the REX640 HMI are globally sourced. The supply chains are often complex and can extend across multiple countries and continents. Therefore, materials 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 v3.8 database, “allocation, cut-off by classification”, are used. The LCA software used for the calculations is SimaPro 9.4.0.2.

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 one HMI by using allocation rules. The plant is focused on relay production, but also handling software installation and final testing of certain “box build” products. Therefore, a part of the total utility and waste of the plant is allocated to these “box-build” products based on production hours. The received amounts are further allocated per “box build” product based on testing volumes. Moreover, utility consumption and waste generation deriving from offices and administrative activities are not excluded because it is not possible to accurately allocate the inventory only for the production. 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, labels and certain adhesives as well as the tape and staples used in the packaging have been excluded as their weights are negligible.

Inventory Analysis

Manufacturing stage

As seen from the constituent materials, aluminum and electronics are the most frequently used materials, followed by low-alloyed and stainless steel.

Using the ecoinvent database, the aluminum is mainly modelled with a pseudo system of *Aluminium alloy, AlMg3 {GLO}| market for*, with an adjusted alloy composition based on primary data, while the steels are mainly modelled with *Steel, low-alloyed {GLO}| market for.* To account for the production activities of metal parts, *Metal working, average* is the most frequently used process. Surface treatments are also included, and the most common is a proxy for passivation, *Anodising, aluminium sheet {GLO}| market for.*

For modelling the electronics, the printed wiring boards (PWB) are modelled on a component level. Thus, all components that are mounted on the PWBs are categorized and grouped into the most corresponding components found in ecoinvent. Furthermore, due to the high impacts of gold, primary data are used to model the specific amounts of gold used in each connector.

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 HMI 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 3500 km intracontinental transport by lorry, as suggested in EN 50693, and the scenario is representative for Europe.

Installation

Except for commissioning testing, the installation stage only implies manual activities, and no energy is consumed. However, commissioning testing is not considered because the time duration is negligible. Therefore, this phase only considers the end-of-life of the packaging materials.

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 measured nominal power consumption at 110 V DC over the reference service life of 10 years as defined in the functional unit. This is calculated using the following formula:

$$E_{use} = 4.6\ \text{W} * 10\ \text{years} * 365\ \text{days} * 24\ \text{hours} = \ 403.0\ \text{kWh}$$

A use rate of 100 % is assumed because the HMI is always powered on in a normal mode during normal operational circumstances. Additional power consumption from active inputs and outputs, e.g., during trip conditions, is therefore considered negligible. Finally, 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 v3.8	0.40	kg CO_2-eq./kWh

Maintenance is not considered because the REX640 HMI does not have any required maintenance within its service life. There is no planned or preventive maintenance for this product. 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

Reference product

Product ID: REX640 Local HMI
Ordering code: 2RCA033008A0001
Nominal power: 4.6 W (at 110 V DC)

Impact category	Unit	Total	UPSTREAM	CORE	DOWNSTREAM			
			Manufacturing		Distribution	Installation	Use and maintenance	End-of-life
GWP – total	kg CO_2 eq.	2,17E+02	4,78E+01	5,81E+00	1,32E+00	3,33E-01	1,61E+02	1,10E+00
GWP – fossil	kg CO_2 eq.	2,11E+02	4,74E+01	6,14E+00	1,31E+00	2,62E-02	1,55E+02	1,07E+00
GWP – biogenic	kg CO_2 eq.	5,50E+00	3,14E-01	-3,49E-01	1,19E-03	3,07E-01	5,19E+00	3,34E-02
GWP – luluc	kg CO_2 eq.	4,66E-01	8,06E-02	1,86E-02	5,21E-04	9,32E-06	3,66E-01	1,76E-04
ODP	kg CFC-11 eq.	1,27E-05	3,27E-06	1,45E-06	3,07E-07	3,80E-09	7,71E-06	1,33E-08
AP	mol H+ eq.	1,25E+00	3,71E-01	3,15E-02	6,66E-03	1,17E-04	8,37E-01	9,53E-04
EP – freshwater	kg P eq.	1,95E-01	3,92E-02	7,18E-04	8,54E-05	2,33E-06	1,55E-01	5,54E-05
EP – marine	kg N eq.	2,81E-01	1,22E-01	1,09E-02	2,29E-03	1,66E-04	1,45E-01	3,71E-04
EP – terrestrial	mol N eq.	2,13E+00	7,22E-01	1,14E-01	2,51E-02	4,51E-04	1,26E+00	3,04E-03
POCP	kg NMVOC eq.	5,83E-01	1,97E-01	3,35E-02	7,15E-03	1,49E-04	3,45E-01	7,85E-04
ADP – minerals and metals	kg Sb eq.	9,51E-03	9,11E-03	2,24E-05	4,61E-06	6,51E-08	3,69E-04	1,93E-06
ADP – fossil	MJ, net calorific value	4,01E+03	5,66E+02	9,44E+01	2,00E+01	2,73E-01	3,33E+03	1,84E+00
WDP	m^3 eq.	5,05E+01	1,37E+01	6,21E-01	6,04E-02	3,31E-03	3,60E+01	3,48E-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	UPSTREAM	CORE	DOWNSTREAM			
			Manufacturing		Distribution	Installation	Use and maintenance	End-of-life
PENRE	MJ, low cal. value	4,00E+03	5,61E+02	9,42E+01	2,00E+01	2,73E-01	3,32E+03	1,84E+00
PERE	MJ, low cal. value	6,70E+02	6,21E+01	1,60E+01	2,82E-01	5,36E-03	5,92E+02	1,62E-01
PENRM	MJ, low cal. value	5,30E+00	5,07E+00	2,27E-01	0	0	0	0
PERM	MJ, low cal. value	1,00E+01	0	1,00E+01	0	0	0	0
PENRT	MJ, low cal. value	4,01E+03	5,66E+02	9,44E+01	2,00E+01	2,73E-01	3,32E+03	1,84E+00
PERT	MJ, low cal. value	6,80E+02	6,21E+01	2,60E+01	2,82E-01	5,36E-03	5,92E+02	1,62E-01
FW	m^3	3,36E+00	4,91E-01	3,45E-02	2,23E-03	1,12E-04	2,83E+00	1,31E-03
MS	kg	8,23E-01	5,69E-01	2,54E-01	0	0	0	0
RSF	MJ	0	0	0	0	0	0	0
NRSF	MJ	0	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	Unit	Total	UPSTREAM	CORE	DOWNSTREAM			
			Manufacturing		Distribution	Installation	Use and maintenance	End-of-life
HWD	kg	5,62E-03	4,16E-03	2,30E-04	5,23E-05	6,42E-07	1,18E-03	3,22E-06
NHWD	kg	2,78E+01	7,19E+00	8,05E+00	1,03E+00	1,77E-01	1,10E+01	3,06E-01
RWD	kg	2,69E-02	1,57E-03	6,06E-04	1,35E-04	1,65E-06	2,45E-02	7,78E-06
MER	kg	6,54E-01	0	2,12E-01	0	1,37E-01	0	3,05E-01
MFR	kg	2,29E+00	2,19E-01	6,34E-01	0	4,68E-01	0	9,69E-01
CRU	kg	0	0	0	0	0	0	0
ETE	MJ	2,14E+00	0	7,11E-01	0	5,80E-01	0	8,48E-01
EEE	MJ	1,18E+00	0	3,91E-01	0	3,22E-01	0	4,71E-01

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 possible variations in power consumption during the usage of the HMIs, an extrapolation rule for environmental impacts in the use stage is established according to EN 50693. As extrapolation rule, environmental impacts in the use stage are proportional to the power consumption. The variation depends mainly on the auxiliary voltage used, and the typical range is 4–6 W.

Example 1: A REX640 HMI has a measured power consumption at 4 W.

- "GWP-total" in use stage = 161 kg CO2-eq * 4 W / 4.6 W = 140 kg CO2-eq

Example 2: A REX640 HMI has a measured power consumption at 6 W.

- "ADP-fossil" in use stage = 3326 MJ * 6 W / 4.6 W = 4338 MJ

The REX640 HMI can also be ordered with conformal coating. While the conformal coating increases the HMI weight with approx. 10g, the impact is less than 1% in all environmental impact categories. Due to the negligible impact, no separate extrapolation for the conformal coating is presented.

Additional Environmental Information

Recyclability potential

The recyclability potential of the REX640 HMI 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 REX640 HMI presented below:

Hardware configuration	Recyclability potential
REX640 HMI	64 %

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 v3.8	0.026	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 the REX640 HMI 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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