EPD

Environmental Product Declaration

NAL – MV indoor air switch-disconnector

Production site: Przasnysz, Poland

DOCUMENT KIND	IN COMPLIANCE WITH			
Environmental Product Declaration	ISO 14025 and EN 50693			
PROGRAM OPERATOR	PUBLISHER			
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ABB Switzerland Ltd, Group Technology Management	PR23-TC-003	C	EN	1/19

EPD Owner	ABB Switzerland Ltd, Group Technology Management		
Organization No.	CHE-101.538.426		
Manufacturer name and address	ABB Sp. Z o.o. Leszno 59, 06-300 Przasnysz, Poland		
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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	NAL – MV Indoor Air Switch-Disconnector		
Product description	The NAL is able to extinguish electric arcs and enables high switching capacity, they represent breaking element for applications in enclosed switchgear and transformer compact substations. The main areas of application of NAL are as line switch-disconnectors in medium voltage networks.		
Functional unit	The functional unit of this study is to carry, and switch current, at nominal voltage of 24 kV and effective time rate (use rate) is 30% considering that during this time the load is 50%, during a service life of 20 years.		
Reference flow	A single NAL-H 24-6K with pole distance 235mm (P235) switch-disconnector, including g 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: Håkon Hauan		
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 PR23-TC-002.		
EPD type	Specific product		
EPD scope	Cradle-to-grave		
Product RSL	20 years		
Geographical representativeness	Manufacturing (suppliers): Global	Manufacturing (ABB): Poland	Downstream: Europe
Reference year	2022		
LCA software	SimaPro 9.5 (2022)		
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.

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General Information

The products declared in this Environmental Product Declaration includes the following devices of the Product Family, including packaging:

- NAL 12-6/ NAL-H 12-6
- NAL 12-12
- NAL 17-6/ NAL-H 17-6
- NAL 24-6/ NAL-H 24-6
- NAL 36-10

NAL-H is switch-disconnector designed for operation in harsh operating conditions. In this version, insulators have longer creepage distance and they are made of indoor epoxy more resistant against water condensation conditions. The insulators in standard NAL version are made of BMC.
General technical specifications of the product NAL are presented below.

		Technical information				
	Unit	**NAL 12-6/ NAL-H 12-6**	**NAL 12-12**	**NAL 17-6/ NAL-H 17-6**	**NAL 24-6/ NAL-H 24-6**	**NAL 36-10**
Rated voltage	kV	12	12	17	24	36
Rated current	A	630	1250	630	630	1000
Rated continuous current	A	630	1150	630	630	1000
Rated short-circuit making current	kA	67	67	52	52	52
Rated peak withstand current	kA (peak)	82	82	82	82	82
Rated power-frequency withstand voltage	kV	28 / 32	28 / 32	38/45	50 / 60	80 / 88
Rated lightning impulse withstand voltage	kV	75 / 85	75 / 85	95 / 110	125 / 145	170 / 195

The reference flow is a single NAL-H 24-6K P235 device, because this configuration was the most produced in 2022.
The NAL is manufactured by ABB Sp. z o.o. Poland manufacturing site located in Przasnysz.

The manufacturing site is certified according to the following standards:

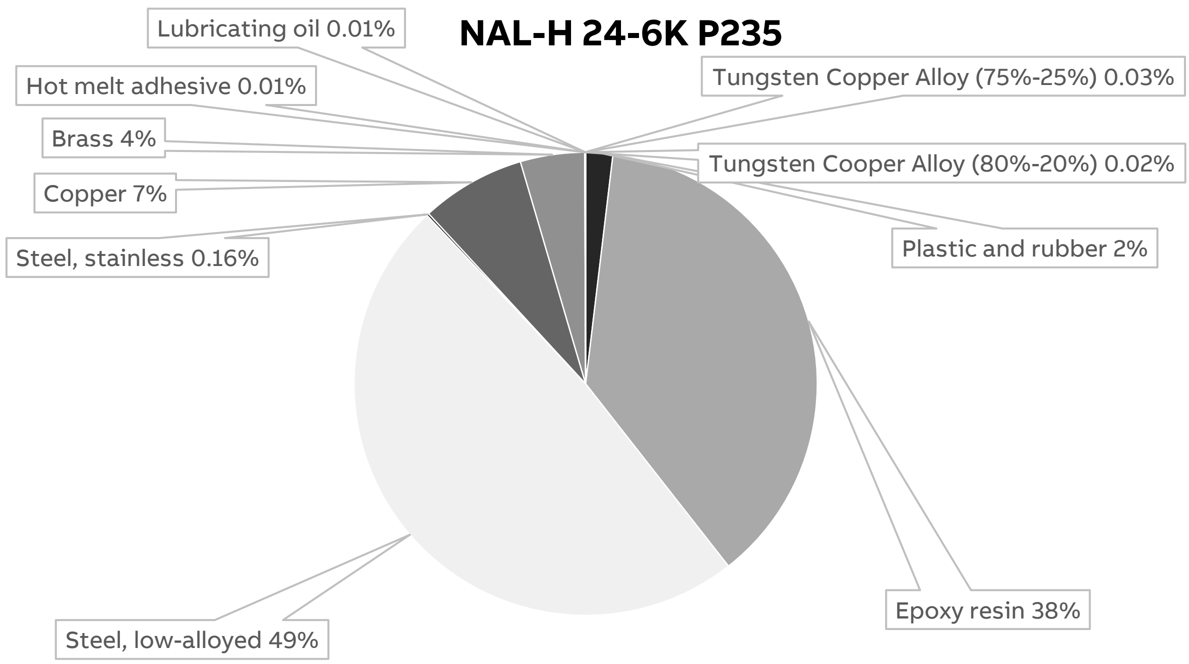
- ISO 9001:2015 – Quality Management Systems
- ISO 14001:2015 – Environmental Management Systems
- ISO 45001:2018 – Occupational Health and Safety Management Systems

The NAL family is produced in two different geographical locations in Przasnysz, Poland and in 10th of Ramadan City, Egypt. The main production site is the plant in Przasnysz, where all configurations of the NAL family are produced, and these relays are sold globally. The plants in 10th of Ramadan City focus on local markets and production includes only a few configurations of the NAL family. However, in this EPD, only the NAL Family manufactured Przasnysz, Poland is considered in the main scenario. Additional scenarios are considered in the Sensitivity Analysis chapter, including NAL manufactured in Egypt.

Constituent Materials

The NAL-H 24-6K P235 weighs 47.03 kg, and the constituent materials are presented below.

Type	Material	Weight [kg]	Weight %
Plastics	Polybutylene	0.050	0.106
	Polyamide	0.552	1.174
	Polyester	0.001	0.002
	Polyoxymethylene	0.165	0.351
	Polypropylene	0.113	0.240
	PTFE Teflon	0.008	0.017
	Epoxy resin	17.652	37.533
Metals	Steel, low-alloyed	22.837	48.557
	Steel, stainless	0.076	0.162
	Copper	3.437	7.308
	Brass	2.106	4.478
Other	Tungsten Copper Alloy (75%-25%)	0.013	0.028
	Tungsten Cooper Alloy (80%-20%)	0.010	0.021
	Lubricating oil	0.006	0.013
	Hot melt adhesive	0.003	0.006
Total		**47.03**	**100**



The packaging materials weighs 11.058 kg, and the constituent materials are presented below.

Description	Material	Weight [kg]	Weight %
Packaging box	Cardboard	7.86	71.08
Pallet	Wood	2.888	26.12
Manuals	Paper	0.31	2.80
Total		**11.058**	**100**

LCA Background Information

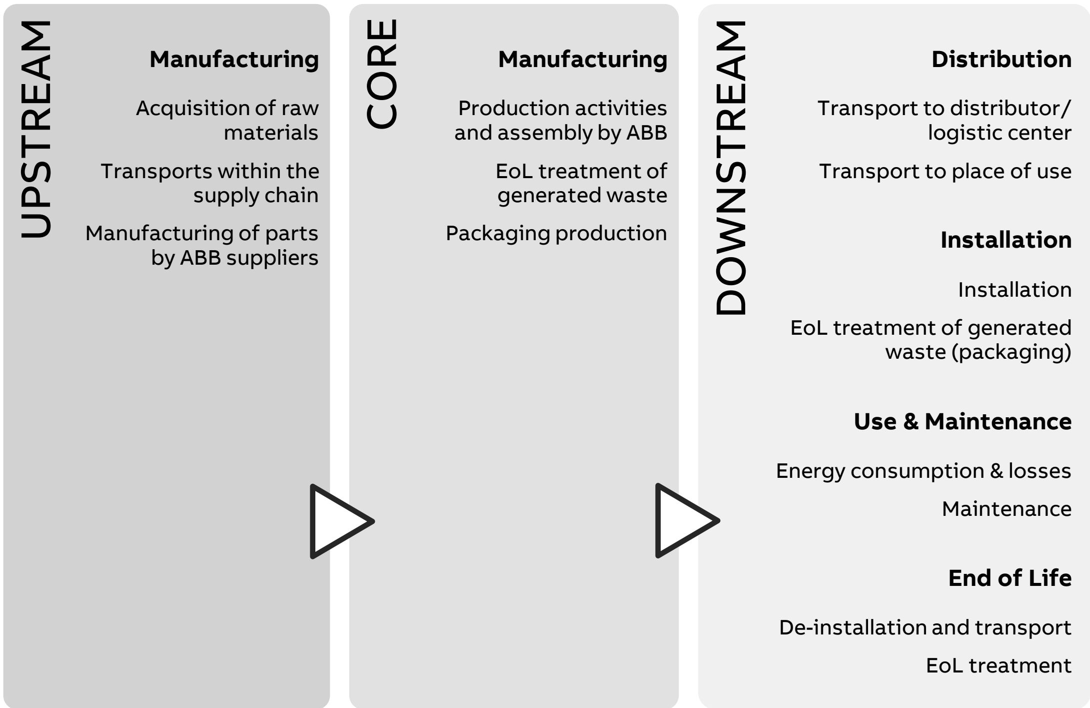
Functional Unit

The functional unit of this study is to carry, and switch current, at nominal voltage of 24 kV, during a service life of 20 years and with an effective time rate (use rate) is 30% considering that during this time the load is 50%. The reference flow is a single NAL-H 24-6K P235 device, including packaging.

Note, the reference service life (RSL) of 20 years is a theoretical period selected for calculation purposes only – this is not representative of the minimum, average, nor actual service life of the product.

System Boundaries

The life cycle assessment of the NAL, 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 PCR, capital goods such as machinery, tools, buildings, infrastructure, packaging for internal transports, and administrative activities, which cannot be allocated directly to the production of the reference product, are excluded.

Infrastructures, when present, such as in processes deriving from the ecoinvent database, have not been excluded. Scraps for metal working and plastic processes are also included when already defined in ecoinvent.

Temporal and geographical boundaries

In terms of temporal boundaries, all primary data collected from ABB are from 2022, which is considered a representative production year. Secondary data are provided by ecoinvent v3.9.1 which was released in 2022.

In terms of geographical boundaries, the materials and components used in the production of the NAL 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 database Industry Data 2.0 is also used for Polyoxymethylene (POM)/EU-27 which is not available by ecoinvent. The LCA software used for the calculations is SimaPro 9.5.

Environmental impact indicators

The information obtained from the inventory analysis is aggregated according to the effects related to the various environmental issues. In accordance with the PCR EPDItaly007, the environmental impact indicators are determined by using the characterization factors and impact assessment methods specified in EN 15804:2012+A2:2019.

Allocation rules

The utility consumption and waste generation of ABB's plant in the manufacturing stage are allocated to the production of one NAL by using allocation rules. Since the factory produces several products (apparatus and switchgears), only a part of the environmental im-pact has been allocated to the NAL production line. Surface area of each product line was chosen as partition coefficient, as most accurate representation of manufacturing and wastes share. The amounts allocated to the production of NAL were multiplied by production volumes.

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 Standard PCR EPDItaly012 , the cut-off criteria can be set to a maximum of 2 % of total weight of the device.

The raw material life cycle stage includes the extraction of raw materials. No cut-off rules were used to hide significant impact.

In this LCA, sticking labels on the packaging have been excluded as their weights are negligible small compared to the whole device.

Surface treatments like silver, nickel and zinc plating have been considered in the LCA model.

Inventory Analysis

Manufacturing stage

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

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

Supply chain transport is 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 NAL- H 24-6K P235 according to the defined allocation rules. The packaging materials 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 suggested by the PCR EPDItaly012, as the actual distance is unknown. 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 the actual location of disposal is unknown.

Use

The use stage considers the reference power consumption over the reference service life of 20 years as defined in the functional unit. This is calculated using the following formula, according to PCR:

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

$$P_{use}[W] = 3 * R * (0{,}5 * I)^2 = 31.256\, W$$

$$E_{use}[kWh] = \frac{31.256 * 8760 * 20 * 0,3}{1000} = 1642.809\ kWh$$

Where:

- E_{use} = Total energy use over the reference service life
- P_{use} = Reference power consumption in watts
- *RSL* = Reference Service Life in years – 20 years
- α = Use time rate – 0,3
- *I = Nominal current – 630 A*
- *R = Internal resistance – 0.000105 Ω*
- 8760 is the number of hours in a year

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

The maintenance happens during the use phase, but it implies manual and visual activities only, from the environmental impacts point of view can be omitted from the analysis.

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

Environmental Indicators

NAL-H 24-6K P235

			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.	9.273E+02	2.902E+02	2.922E+01	3.263E+00	4.266E+00	5.940E+02	6.376E+00
GWP – fossil	kg CO_2 eq.	8.893E+02	2.858E+02	2.368E+01	3.258E+00	2.748E-01	5.715E+02	4.822E+00
GWP – biogenic	kg CO_2 eq.	3.611E+01	4.095E+00	5.386E+00	2.967E-03	3.991E+00	2.108E+01	1.548E+00
GWP – luluc	kg CO_2 eq.	1.931E+00	3.413E-01	1.526E-01	1.593E-03	1.438E-04	1.430E+00	5.927E-03
ODP	kg CFC-11 eq.	5.359E-05	4.267E-05	5.251E-07	7.136E-08	6.312E-09	1.027E-05	5.056E-08
AP	mol H+ eq.	7.694E+00	4.672E+00	1.168E-01	1.349E-02	1.486E-03	2.869E+00	2.163E-02
EP – freshwater	kg P eq.	8.980E-01	3.624E-01	1.230E-02	2.296E-04	3.062E-05	5.215E-01	1.484E-03
EP – marine	kg N eq.	1.009E+00	4.411E-01	4.232E-02	5.147E-03	2.364E-03	5.101E-01	7.668E-03
EP – terrestrial	mol N eq.	1.027E+01	5.331E+00	3.174E-01	5.494E-02	5.906E-03	4.498E+00	5.760E-02
POCP	kg NMVOC eq.	3.283E+00	1.692E+00	1.019E-01	1.975E-02	2.367E-03	1.450E+00	1.798E-02
ADP – minerals and metals	kg Sb eq.	5.527E-02	5.403E-02	6.402E-05	1.053E-05	8.203E-07	1.137E-03	3.607E-05
ADP – fossil	MJ, net calorific value	1.777E+04	4.210E+03	3.031E+02	4.649E+01	3.806E+00	1.316E+04	5.290E+01
WDP	m^3 eq.	2.466E+02	1.056E+02	5.726E+00	1.888E-01	4.881E-02	1.344E+02	6.410E-01

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

Resource use parameters	Unit	Total	Cradle-to-gate / Cradle-to-grave: UPSTREAM	CORE	DOWNSTREAM			
			Manufacturing		Distribution	Installation	Use and maintenance	End-of-life
PENRE	MJ, low cal. value	1.751E+04	3.958E+03	3.032E+02	4.649E+01	3.806E+00	1.315E+04	5.290E+01
PERE	MJ, low cal. value	2.992E+03	4.104E+02	5.045E+01	7.215E-01	7.695E-02	2.526E+03	5.098E+00
PENRM	MJ, low cal. value	2.513E+02	2.513E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
PERM	MJ, low cal. value	1.026E+02	0.000E+00	1.026E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00
PENRT	MJ, low cal. value	1.777E+04	4.210E+03	3.032E+02	4.649E+01	3.806E+00	1.315E+04	5.290E+01
PERT	MJ, low cal. value	3.095E+03	4.104E+02	1.531E+02	7.215E-01	7.695E-02	2.526E+03	5.098E+00
FW	m^3	1.364E+01	2.999E+00	3.286E-01	6.626E-03	1.647E-03	1.028E+01	2.446E-02
MS	kg	1.454E+01	8.327E+00	6.216E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
RSF	MJ	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
NRSF	MJ	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+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	4.563E-02	2.716E-02	1.292E-03	2.960E-04	2.273E-05	1.666E-02	1.946E-04
NHWD	kg	1.325E+02	6.309E+01	7.294E+00	2.272E+00	2.077E+00	3.608E+01	2.169E+01
RWD	kg	1.018E-01	5.620E-03	3.250E-04	1.511E-05	1.487E-06	9.575E-02	1.016E-04
MER	kg	1.090E+01	0.000E+00	8.403E+00	0.000E+00	1.578E+00	0.000E+00	9.226E-01
MFR	kg	4.540E+01	6.555E+00	5.214E+00	0.000E+00	7.580E+00	0.000E+00	2.605E+01
CRU	kg	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
ETE	MJ	4.466E+01	0.000E+00	3.440E+01	0.000E+00	6.688E+00	0.000E+00	3.578E+00
EEE	MJ	2.481E+01	0.000E+00	1.911E+01	0.000E+00	3.716E+00	0.000E+00	1.988E+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

All the analyzed configurations have the same main functionality, product standards and manufacturing technology, so extrapolation rules are established according to EN 50693. The main differences in the NAL family include:

- insulators from indoor epoxy resin (with H letter) or BMC (Bulk Molding Compound)
- current carrying parts - different types and sizes depending on the current and voltage values.
- mechanism K(snap-action mechanism) or A(stored spring energy mechanism)
- frame and shaft with the following pole distances:
    - 12 kV – pole distance 150 mm, 170 mm and 210 mm
    - 17 kV – pole distance 170 mm and 210 mm
    - 24 kV – pole distance 235 mm and 275 mm
    - 36 kV – pole distance 360 mm

Rated currents are from 400 to 1250 A depending on the configuration.

The different life cycle stages can be extrapolated to other configurations of the same product by applying a rule of proportionality to the parameters, presented in the following Table. To calculate the environmental impact Indicators for each NAL configuration, the result for the reference product NAL-H 24-6K P235 should be multiplied by the factor from the following table.

Example for calculation of GWP-total for NAL-H 12-6K P150 configuration in different stages:

- GWP-total in Total stage = (9.23E+02 · 0.715) = 6.60E+02 kg CO2-eq
- GWP-total in Installation stage = (4.27E+00 · 0.695) = 2.97E+00 kg CO2-eq

GWP-total [kg CO2-eq] – Extrapolation factor							
Configuration	Total	UPSTREAM	CORE	DOWNSTREAM			
		Manufacturing		Distribution	Installation	Use and maintenance	End-of-life
NAL-H 12-6K P150	0.714	0.693	0.939	0.682	0.695	0.714	0.698
NAL-H 12-6K P210	0.724	0.723	0.939	0.716	0.695	0.714	0.740
NAL-H 12-6A P150	0.720	0.710	0.939	0.710	0.695	0.714	0.734
NAL-H 12-6A P210	0.725	0.725	0.939	0.746	0.695	0.714	0.775
NAL 12-6K P150	0.680	0.581	0.939	0.639	0.695	0.714	0.841
NAL 12-6K P170	0.683	0.591	0.939	0.650	0.695	0.714	0.855
NAL 12-6K P210	0.690	0.611	0.939	0.673	0.695	0.714	0.883
NAL 12-6A P150	0.686	0.598	0.939	0.669	0.695	0.714	0.877
NAL 12-6A P170	0.689	0.608	0.939	0.680	0.695	0.714	0.891
NAL 12-6A P210	0.695	0.627	0.939	0.703	0.695	0.714	0.918
NAL 12-12K P150	0.954	0.645	0.939	0.672	0.695	1.111	0.879

NAL 12-12K P170	0.958	0.655	0.939	0.683	0.695	1.111	0.893
NAL 12-12K P210	0.964	0.674	0.939	0.706	0.695	1.111	0.921
NAL 12-12A P150	0.960	0.661	0.939	0.701	0.695	1.111	0.915
NAL 12-12A P170	0.963	0.671	0.939	0.712	0.695	1.111	0.929
NAL 12-12A P210	0.970	0.691	0.939	0.735	0.695	1.111	0.956
NAL-H 17-6K P170	0.988	0.965	1	0.959	1	1	0.950
NAL-H 17-6K P210	0.995	0.984	1	0.981	1	1	0.977
NAL-H 17-6A P170	0.994	0.982	1	0.991	1	1	0.990
NAL-H 17-6A P210	1.001	1.002	1	1.014	1	1	1.017
NAL 17-6K P170	0.935	0.790	1	0.900	1	1	1.224
NAL 17-6K P210	0.942	0.809	1	0.922	1	1	1.251
NAL 17-6A P170	0.942	0.808	1	0.932	1	1	1.264
NAL 17-6A P210	0.948	0.828	1	0.955	1	1	1.291
NAL-H 24-6K P235	1	1	1	1	1	1	1
NAL-H 24-6K P275	1.007	1.022	1	1.026	1	1	1.031
NAL-H 24-6A P235	1.006	1.018	1	1.032	1	1	1.040
NAL-H 24-6A P275	1.013	1.041	1	1.058	1	1	1.071
NAL 24-6K P235	0.947	0.825	1	0.941	1	1	1.274
NAL 24-6K P275	0.954	0.848	1	0.967	1	1	1.305
NAL 24-6A P235	0.953	0.844	1	0.974	1	1	1.314
NAL 24-6A P275	1.040	1.121	1	1.000	1	1	1.345
NAL 36-10K P360	1.352	1.434	-0.592	2.125	6.270	1.368	1.432
NAL 36-10A P360	1.359	1.454	-0.592	2.162	6.270	1.368	1.476

Sensitivity analysis

NAL sold for substation applications

A sensitivity analysis is conducted to understand how the impact category "GWP – total" varies for NAL-H 24-6K P235 sold for substation application. Approximately 80% of NAL-H 12-6, NAL-H 17-6 and NAL-H 24-6 switch disconnectors are sold for substation applications. NAL switch disconnectors are installed in substations and work with transformers with power ranging from 50 kVA to 1600 kVA. The calculation of energy consumption depends on the load of NAL. The use stage is changing, the results are presented in the following table.

GWP-total [kg CO_2-eq]							
Scenario	Total	UPSTREAM	CORE	DOWNSTREAM			
		Manufacturing		Distribution	Installation	Use and maintenance	End-of-life
Declared scenario Use stage: Power use depending on the rated current	9.27E+02	2.90E+02	2.92E+01	3.26E+00	4.27E+00	5.94E+02	6.38E+00
Transformer application Use stage: Power use depending on the transformer power	3.33E+02	2.90E+02	2.92E+01	3.26E+00	4.27E+00	2.60E-02	6.38E+00

Manufacturing site in Egypt

This chapter presents the results of a sensitivity analysis in different scenarios, to understand how the impact category "GWP – total" varies for the switch-disconnectors NAL that are produced and sold in different geographical locations. The plant in Egypt focus on local markets and production includes two configuration of the NAL family, NAL- H 12-6K P170 and NAL-H 24-6K P275.

GWP-total [kg CO2-eq]							
Scenario	Total	UPSTREAM	CORE	DOWNSTREAM			
		Manufacturing		Distribution	Installation	Use and maintenance	End-of-life
NAL-H 12 P170 Manufacturing: Egypt Use stage: Africa	1.12E+03	2.04E+02	3.71E+01	2.27E+00	2.96E+00	8.74E+02	4.54E+00
NAL-H 24 P275 **Manufacturing:** Egypt **Use stage**: Africa	1.59E+03	3.15E+02	3.88E+01	3.40E+00	4.27E+00	1.22E+03	6.96E+00

Additional Environmental Information

Recyclability potential

The recyclability potential of the NAL 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 potential of the product is 78.16%

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
Polish energy mix; *Electricity, medium voltage {PL}| market group for | Cut-off, S*	Ecoinvent v3.9.1	0.964	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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