PRODUCT ENVIRONMENTAL PROFILE

Environmental Product Declaration

ABB ReliaGear Lighting Panelboards (Copper Bus)

Production site: Mebane, United States
November 2023

REGISTRATION NUMBER ABBG-00179-V01.01-EN	IN COMPLIANCE WITH PCR-ED4-EN-2021 09 06 SUPPLEMENTED BY PSR-0005-ED2-EN-2016 03 29
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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 »	

EPD Owner	ABB Inc www.abb.com
Manufacturer name and address	ABB Inc 6801 Industrial Drive, Mebane, North Carolina, 27302
Company contacts	EPD_ELSP@in.abb.com
Reference product	ReliaGear lighting panelboards, RQ type Panelboard that contains NEMA 1 enclosure box (AB43B), Front (AF43S) and Interior (AQF3422ABX AXB7) without circuit breakers.
Description of the product	ReliaGear® Lighting Panelboards feature increased breaker density and the superior SACE® FORMULA A2 & SACE® Tmax® XT circuit breakers as mains and sub-feeds in the RQ, RL, RE, and RS to experience XTreme performance. They are the safe, smart, and sustainable solution for small or complex large projects.
Functional unit	Passive products (continuous operation) are traversed by the main current and do not require energy for their main function. They perform the contact, opening or conduction functions in the installation. The reference service life for passive products is set at 20 years. Rated Current (In): 225 A Load Rate: 30% Use time rate: 100%
Other products covered	No
Reference lifetime	20 years
Product category	Electrical, Electronic and HVAC-R Products (Other equipments)
Use Scenario	The use phase has been modeled based on the sales mix data (2022), and the corresponding low voltage electricity countries mix
Geographical representativeness	Raw materials & Manufacturing: [US/ Global] Assembly: [US] Distribution / Use: [Global] specific sales mix EoL: [Global]
Technological representativeness	Materials and processes data are specific for the production of ReliaGear lighting panelboards.
LCA Study	This study is based on the LCA study described in the LCA report 1SQC173001D0201
EPD type	Products family declaration
EPD scope	“Cradle to grave”
Year of reported primary data	2022
LCA software	SimaPro 9.5.0.1 (2023)
LCI database	Ecoinvent v3.9.1 (2023)
LCIA methodology	EN 50693:2019

Contents

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 110 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 human behaviour.

General Information

ABB's Mebane Plant is a global manufacturing center of excellence for the Electrification Business. It is in operational since 1972 with over 600 employees. This facility represents a portion of ABB's growth commitment across the US, including a $40 million investment in a 200,000 square foot manufacturing expansion to meet our customer demands.

At ABB, we continue to optimize and expand our overall US operations to meet growing demand for low-voltage and medium-voltage products and systems that are used to ensure, safe, smart and sustainable electrical distribution.

Located onsite with the factory, the Mebane Customer Experience Center (CXC) serves as a national showcase where customers and suppliers can see, touch and feel our latest products and collaborate on our new technology developments. We use real-time customer feedback to further enhance our offerings and your complete ABB customer experience.

Currently, the facility produces lighting panelboards. The Lighting panelboards are primary use to distribute power for lighting applications in the commercial spac.

ReliaGear Lighting Panelboards Product cluster

ReliaGear lighting panelboards are examples of the high-quality, dependable products that are prepared to meet any problems in the future, the result of more than a century of study and experience. It efficiently and safely distributes energy from the power source to the lighting branch circuits of commercial, light industrial, or advanced heavy-duty applications up to 800A.

ReliaGear® Lighting Panelboards feature increased breaker density and the superior SACE® FORMULA A2 & SACE® Tmax® XT circuit breakers as mains and sub-feeds in the RQ, RL, RE, and

RS to experience XTreme performance. They are the safe, smart, and sustainable solution for small or complex large projects such as Commercial and high-rise buildings, Data centers etc. that demand quick delivery, ease of installation, design flexibility, and greater versatility.

Technical Specifications

- Higher interrupt ratings (up to 200kA), Ekip Hi-Touch, and thermal-magnetic trip units.
- Maximum short circuit rating is equal to 100 kAIC at 240 V AC and 480/277 V AC with series rating of 100 kAIC at 480 V AC and 200 kAIC at 240 V AC.
- Factory assembled on rigid steel frames and equipped with circuit breakers from 15 A to 800A.

Reference Product: ReliaGear lighting panelboards
Product analyzed in this LCA include RQ type Panelboard that contains NEMA 1 enclosure box (AB43B), Front (AF43S) and Interior (AQF3422ABX AXB7) without circuit breakers.

Constituent Materials

ReliaGear lighting panelboards weights about 46.5 kg including its installed accessories, packaging, and paper documentation.

Materials	Name	IEC 62474 MC	[g]	Weight %
Metals	Steel	M-119	31225	67.2%
	Cu and CU alloys	M-121	4136	8.9%
	Aluminum	M-120	314	0.7%
Plastics	Polyphenylene	M-263	612	1.3%
	PBT	M-261	279	0.6%
	Polycarbonate	M-254	140	0.3%
	Polyamide	M-258	86	0.2%
	Other Polymers	N/A	24	<0.1%
Others	Wood	M-340	6350	13.7%
	Paper/Cardboard	M-341	3299	7.1%
	Total		46465	100.0%

Table 1: Weight of materials ReliaGear lighting panelboards

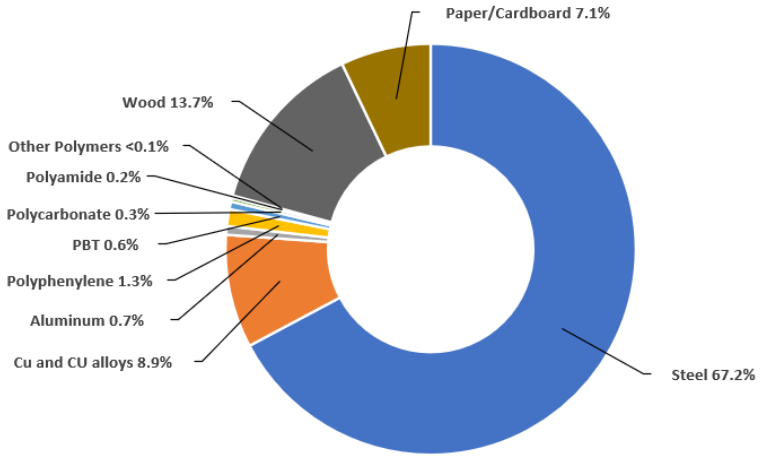

Figure 1: Composition of ReliaGear lighting panelboards

Packaging weight for ReliaGear lighting panelboards and its composition is tabulated below.

Materials	Name	IEC 62474 MC	[g]	%
Other	Wood	M-340	6350	66.4%
	Paper/Cardboard	M-341	3207	33.6%
Total			9557	100.0%

Table 2: Packaging weight of ReliaGear lighting panelboards

LCA background information

Functional unit and Reference Flow

Passive products (continuous operation) are traversed by the main current and do not require energy for their main function. They perform the contact, opening or conduction functions in the installation. The reference service life for passive products is set at 20 years.

The Reference Flow of the study is a single panelboard (including its packaging and accessories) with mass described in chapter 1.3, table 1 & table 2.

System boundaries and life cycle stages

The life cycle of the Panelboard, 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 3: Phases for the evaluation of construction products

Temporal and geographical boundaries

The ABB component suppliers are sourced all over the world. All primary data collected are from 2022, which is a representative production year. Secondary data are also representative for this year, as provided by ecoinvent [4].

The selected ecoinvent [4] 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 [4] database have not been excluded.

Data quality

In this LCA, 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 [4], allocation cut-off by classification, are used. The ecoinvent database available in the SimaPro software [5] is used for the calculations.

The data quality characterized by quantitative and qualitative aspects, is presented in Appendix 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 geography, 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 50693:2019 [3] the environmental impact indicators must be determined using the characterization factors and impact assessment methods specified in EN 15804:2012+A2:2019 [6].

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

Allocation rules

Allocation coefficients are based on Lighting Panel production line occupancy area for electricity consumption, Gas consumption and waste generated in plant. The total number of operators working on the production line is considered for water consumption.

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 assuming no specific data available (PCR-ed4-EN-2021_09_06, ch 2.5.3). 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. Surface treatments like steel powder coating, galvanizing, tin, silver, copper plating as well as their related transport processes (back and forth from the finishing suppliers) have been considered in the LCA model. Scraps for metal working and plastic processes are included when already defined in Ecoinvent [4].

Energy Models

LCA Stage	EN 15804:2012 +A2:2019 module	Energy model	Notes
Raw material extraction and processing	A1-A2	Electricity, {GLO}| market group for | Cut-off Electricity, {RoW}| market group for | Cut-off	Based on materials and supplier's locations
Manufacturing	A3	ABB Mebane energy mix (2022), Low Voltage	Specific Energy model for ABB Mebane manufacturing plant
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 2022 country sales mix
EoL	C1-C4	Electricity, {GLO}| market group for | Cut-off	

Table 4: Energy models used in each LCA stage

Inventory analysis

In this LCA, 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 and Windchill ERP were used. They are a list of all the components and assemblies that constitute the finished product, organized by hierarchy level. Each item is matched with its code, quantity, weight and supplier. The BOMs were then processed, adding material, surface area, volume and weight data, taken from technical drawings/datasheets. 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.

All primary data collected from ABB are from 2022, which was a representative production year. The ecoinvent cut-off by classification system processes [4] are used to represent the LCA model.

Due to the large amounts of components in the Panelboard, raw material inputs have been modelled with data from ecoinvent [4] representing Global [GLO] or Rest of World [RoW] market coverage based on the supplier's location including the corresponding electricity consumption sub-datasets. These datasets are assumed to be representative.

Manufacturing stage

The Panelboards 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.

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 panelboards 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 panelboards. 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 specific distances from the last subassembly suppliers' factories up to the ABB manufacturing facility have been calculated.

The electric energy mix used for the production phase is representative for ABB Mebane production site (year 2022). The complete energy mix has been modeled considering the energy certificate.

Distribution

The transport distances from ABB manufacturing plant to the distribution centers (regional distribution centers / local sales organizations) have been calculated considering the specific reference products sales mix data for 2022 (SAP ERP sales data as a source).

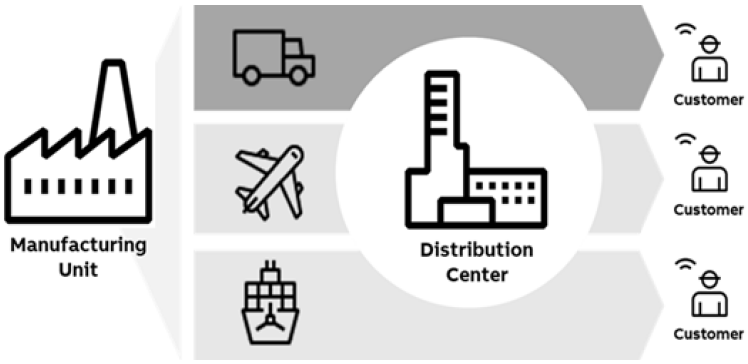

Figure 2: Distribution methodology.

Installation

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

For the disposal of the packaging after installation of the panelboards 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.

Use

During the use phase, panelboards dissipate some electricity due to power losses in the bus. The respective energy for each specific configuration of the entire product family has been calculated following the PCR [1] & PSR [2] rules:

Parameters		
In	[A]	225
Load rate	[%]	30
h/year	[h]	8760
RSL	[years]	20
Utilization time, α	[%]	100

Table 5: 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 panelboard at a given value of current:

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

The Energy model used for this phase has been modeled based on the 2022 actual sales mix data (SAP ERP sales data as a source). From the Ecoinvent [4] 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 [7]. The percentages for end-of-life treatments of materials are taken from IEC/TR 62635 [7].

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

ReliaGear lighting panelboards

The following table show the environmental impact indicators of the life cycle of ReliaGear lighting panelboards 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	Manufac-turing	Distribu-tion	Installa-tion	Use	End of Life
GWP-total	kg CO2 eq	4.59E+02	1.90E+02	7.60E+00	9.89E+00	2.44E+02	7.42E+00
GWP-fossil	kg CO2 eq	4.52E+02	1.94E+02	7.60E+00	1.09E+00	2.42E+02	7.31E+00
GWP-biogenic	kg CO2 eq	6.29E+00	-3.95E+00	3.41E-03	8.80E+00	1.33E+00	9.97E-02
GWP-luluc	kg CO2 eq	4.86E-01	2.53E-01	3.73E-03	5.43E-04	2.23E-01	6.02E-03
ODP	kg CFC-11 eq	8.12E-06	6.84E-06	1.22E-07	1.78E-08	1.05E-06	8.07E-08
AP	mol H+ eq	3.48E+00	2.61E+00	3.25E-02	4.88E-03	7.98E-01	3.84E-02
EP-freshwater	kg P eq	3.65E-01	2.08E-01	6.05E-04	9.71E-05	1.55E-01	1.48E-03
EP-marine	kg N eq	4.43E-01	2.73E-01	1.19E-02	3.26E-03	1.44E-01	1.07E-02
EP-terrestrial	mol N eq	4.63E+00	3.08E+00	1.27E-01	1.93E-02	1.29E+00	1.06E-01
POCP	kg NMVOC eq	1.64E+00	1.04E+00	4.59E-02	6.96E-03	5.05E-01	3.58E-02
ADP-m&m	kg Sb eq	3.15E-02	2.94E-02	2.02E-05	2.84E-06	1.98E-03	1.15E-05
ADP-fossil	MJ	6.96E+03	2.44E+03	1.09E+02	1.58E+01	4.30E+03	9.21E+01
WDP	m3 world eq. depriv.	9.12E+01	3.95E+01	5.53E-01	1.06E-01	5.04E+01	6.52E-01
PENRE	MJ	6.94E+03	2.42E+03	1.09E+02	1.58E+01	4.30E+03	9.21E+01
PENRM	MJ	2.12E+01	2.12E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRT	MJ	6.96E+03	2.44E+03	1.09E+02	1.58E+01	4.30E+03	9.21E+01
PERE	MJ	8.06E+02	2.45E+02	1.38E+00	2.08E-01	5.54E+02	5.26E+00
PERM	MJ	1.65E+02	1.65E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERT	MJ	9.71E+02	4.10E+02	1.38E+00	2.08E-01	5.54E+02	5.26E+00
SM	kg	1.94E+01	1.94E+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
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m3	3.04E+00	1.20E+00	1.74E-02	3.18E-03	1.79E+00	2.38E-02
HWD	kg	3.23E-02	2.18E-02	6.86E-04	9.79E-05	9.25E-03	4.18E-04
N-HWD	kg	9.50E+01	5.83E+01	9.47E+00	5.12E+00	1.48E+01	7.19E+00
RWD	kg	2.62E-02	4.78E-03	2.37E-05	3.59E-06	2.13E-02	7.51E-05
MfR	kg	4.92E+01	9.68E+00	0.00E+00	4.80E+00	0.00E+00	3.48E+01
MfER	kg	9.63E-01	0.00E+00	0.00E+00	9.31E-01	0.00E+00	3.27E-02
Efp	disease inc.	2.21E-05	1.65E-05	7.64E-07	1.12E-07	4.03E-06	7.28E-07
IrHH	kBq U-235 eq	1.14E+02	2.02E+01	9.97E-02	1.51E-02	9.30E+01	3.06E-01
ETX FW	CTUe	4.59E+03	4.06E+03	6.28E+01	9.63E+00	4.21E+02	3.98E+01
HTX CE	CTUh	8.58E-07	7.67E-07	3.23E-09	5.02E-10	8.01E-08	7.33E-09
HTX N-CE	CTUh	3.37E-05	3.00E-05	1.05E-07	1.75E-08	3.22E-06	4.14E-07
IrLS	Pt	3.73E+03	2.80E+03	1.10E+02	1.71E+01	7.35E+02	7.18E+01

Table 6: Impact indicators for ReliaGear lighting panelboards

Impact category	Unit	ReliaGear lighting panelboards
Biogenic Carbon content of the product	kg	4.64E-02
Biogenic Carbon content of the associated packaging	kg	4.74E+00

Table 7: 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	Water deprivation potential.

Resource use indicators

PENRE	Use of non-renewable primary energy excluding renewable primary energy resources used as raw material
PENRM	Use of non-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)
PERE	Use of renewable primary energy excluding non-renewable primary energy resources used as raw material
PERM	Use of renewable 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)

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

Additional environmental information

According to the waste treatment scenario calculation in Simapro [5], based on the recycling rate in the technical report IEC/TR 62635 Edition 1.0 [7] Table D.6, the following recyclability potentials were calculated. The recyclability potential is calculated based on the product weight (excluding packaging).

	ReliaGear lighting panelboards
Recyclability potential	92.6 %

Table 12: Recyclability potential

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 (Other equipments- Passive product-Continuous operation)

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

[4] ecoinvent v3.9.1 (2023). ecoinvent database version 3.9 - (https://ecoinvent.org/)

[5] SimaPro Software version 9.5.0.1 - PRé Sustainability

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

[7] 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

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

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