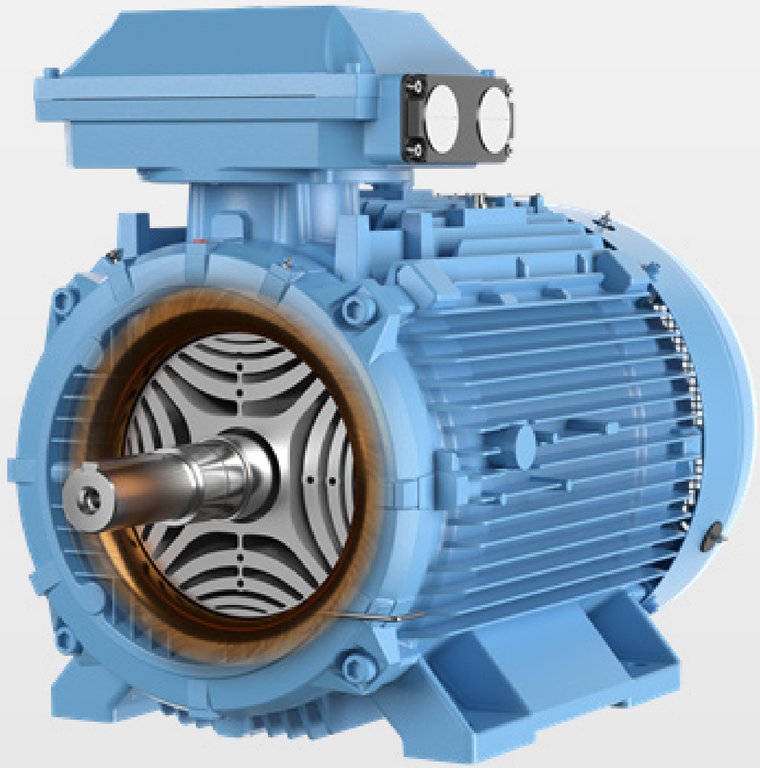


Environmental Product Declaration for Synchronous reluctance (incl. increased safety) motors (7,5 kW-45 kW)

In accordance with ISO 14025:2006

Programme	The International EPD® System, www.environ-dec.com
Programme operator	EPD International AB
EPD registration number	S-P-08110
Publication date	2023-02-10
Revision date	2023-08-19
Valid until	2028-08-18
Product Category Rules (PCR)	Electrical motors and generators and parts thereof (for industrial applications), 2022:06, version 1.0, UN CPC 46112 and 46131

Product id: M3BL 160 – 250, M3GL 160 – 280, M3HL 160 – 280

START

Company information

ABB is a leading global technology company that energizes the transformation of society and industry to achieve a more productive, sustainable future. By connecting software to its electrification, robotics, automation and motion portfolio, ABB pushes the boundaries of technology to drive performance to new levels. With a history of excellence stretching back more than 130 years, ABB's success is driven by about 105,000 talented employees in over 100 countries.

We offer a wide range of reliable and high efficiency motors and generators to help every industry and application reach new levels of efficiency and energy savings. Combining the best available materials with superior technology, a global footprint and application expertise, our electric motor and generator have a well-earned reputation of improving reliability and productivity in the most demanding applications.

Owner of the EPD	Marko Laatu, marko.laatu@fi.abb.com, +358503341712
The production facility is certified according to the following management systems	ISO 9001, ISO 14001 and ISO 45001.
Name and location of production site	ABB Vaasa, Finland

Sustainability

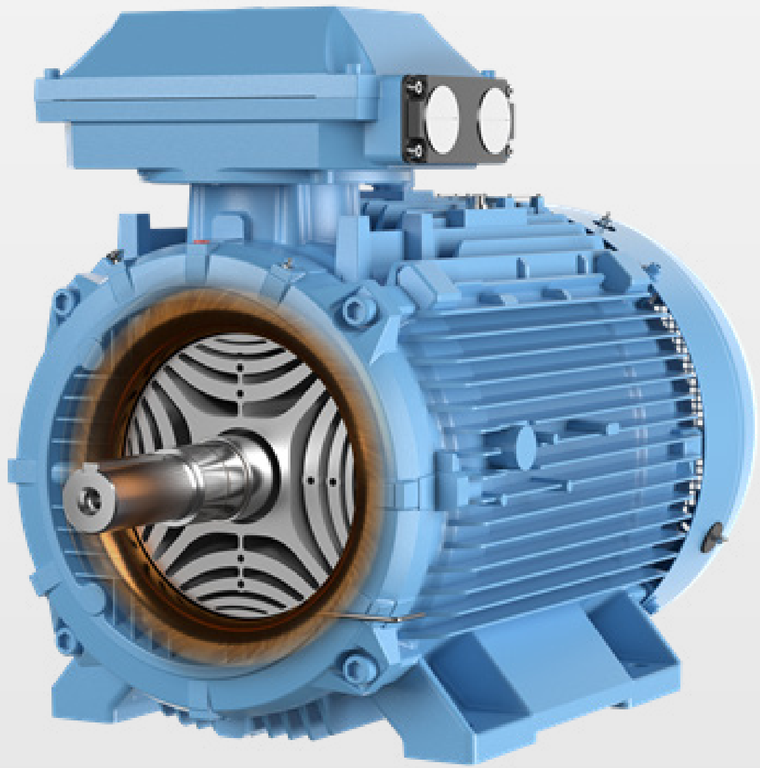
Striving to achieve all targets by 2030

With our 2030 sustainability strategy, we are actively enabling a low-carbon society as well as working with our customers and suppliers to implement sustainable practices across our value chain and the lifecycle of our products and solutions. We are equally committed to driving social progress, along with our suppliers and in our communities.

A key part of our 2030 sustainability strategy is to support our customers and suppliers to reduce their emissions and achieve carbon neutrality in our own operations. Our greenhouse gas emissions reduction targets have been validated by the Science Based Targets initiative as being in line with the 1.5°C scenario of the Paris Agreement.

To ensure that we are focused on achieving our goals, our sustainability targets are integrated into our decision-making processes and we have accountabilities and incentive plans in place to drive action.

Link to our website



Product information

Synchronous reluctance motor

The synchronous reluctance motor is a three-phase electric motor with a magnetically anisotropic rotor structure. The rotor in a synchronous reluctance motor has no magnets or windings and suffers virtually no power losses. Synchronous reluctance technology combines the performance of permanent magnet motors with induction motors, without the use of rare earth metals.

Key features

- Robust design for any industrial application
- Reliability with a sustainable and long-lasting performance by minimizing motor failures and downtime.
- Always used with a variable speed drive (VSD)
- Deliver full torque from zero speed and give excellent partial-load efficiency
- Improved bearing system reliability

Product identification:	M3BL 160 – 250, M3GL 160 – 280, M3HL 160 – 280
UN CPC code	UN CPC 46112 and 46131
Geographical scope	Europe is considered for the downstream phase
Shaft height	160-250
Nominal output power	7,5 kW-45 kW
Efficiency	IE5

LCA information

Grouping of products, data quality, allocation rules and cut-off criteria

Grouping of products

This EPD includes products of the Synchronous reluctance motors family between the nominal output power of 7,5 kW to 45 kW. In this document the highest result is presented (i.e., the "worst-case scenario"). This is done in accordance with the GPI of EPD International. This indicates that for some of the products, the environmental impact will actually be lower than what is shown here, but never worse.

This EPD is equally relevant and applicable for the Synchronous reluctance increased safety motors, within the same range of nominal output power.

Data quality, allocation rules and cut-off criteria

In this LCA, both primary and secondary data are used. Site specific foreground data have been provided by ABB using data from the Vaasa factory from year 2021. Main data sources are the bill of materials available on the enterprise resource planning. 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 ecoinvent database is available in the SimaPro 9.5.0.0 software.

An allocation key is used for consumptions related to the manufacturing process at the production site, as well for company waste. Since the factory produces several products, only a part of the environmental impact has been allocated to the production line. In this study the allocation is divided into allocation of co-products and allocation of waste.

- Co-product allocation: the main products in this LCA are the electrical motors, the co-products are the other products being manufactured and assembled on the same production line. In this study a physical allocation based on mass has been adopted.

- Allocation of waste treatment processes: Allocation of waste shall follow the polluter pays principle and its interpretation in EN 15804: processes of waste processing shall be assigned to the product system that generates the waste until the end-of-waste state is reached.

A cut-off rule of 1% has been applied. In other words, the included inventory data shall together give rise to at least 99% of the results of any of the environmental impact categories. Also, 99% of the mass of the product content and 99% of the energy use of the product life cycle has been accounted for.

LCA information

Functional unit, Use stage and System boundaries

Functional unit

In accordance with the PCR: UN CPC 46112 AND 46131, the functional unit in this study is to provide 1 kW of mechanical power during the reference service life of 25 years. The functional unit is the reference unit used to quantify the performance of the service delivered by a product to the user. The main purpose of the functional unit is to provide a reference to which inputs and outputs are related in the LCA.

This EPD shows the environmental impact based on 1 kW (the functional unit) which enables comparisons between products with different output. The environmental impact needs to be multiplied by the output of the motor to get the total impact the motor contributes with.

Use stage

The motor is assumed to be operating 6 500 hours/year on 100% load in accordance with the PCR. Maintenance of the motor is assumed to be one bearings change during the life time of the motor, which is 20 years.

The considered efficiency for the use stage is 93.1 %, based on the efficiency at 100% load for motors for operation with variable speed drive according to IEC TS 60034-30-2.

System boundaries

This is a “from cradle to grave” analysis and covers the life cycle of the motor under study. It does not include other components in a motor system. The stages of the product life cycle that are considered according to the PCR are the following:

Upstream processes (from cradle-to-gate)

- The extraction of all raw material that is used in the different components
- Impact of the different materials that are used in the components: steel, cast iron, synthetic rubber, aluminum, sawn wood, board carton, copper, resistor, cable, polypropylene
- Processes included for some of the materials, such as:
  - Cast iron removed by milling
  - Metal working for steel product manufacturing
  - Sheet rolling of electrical steel
  - Wire drawing of copper
- Processes for other materials are included in the generic data in SimaPro

Core processes (from gate-to-gate)

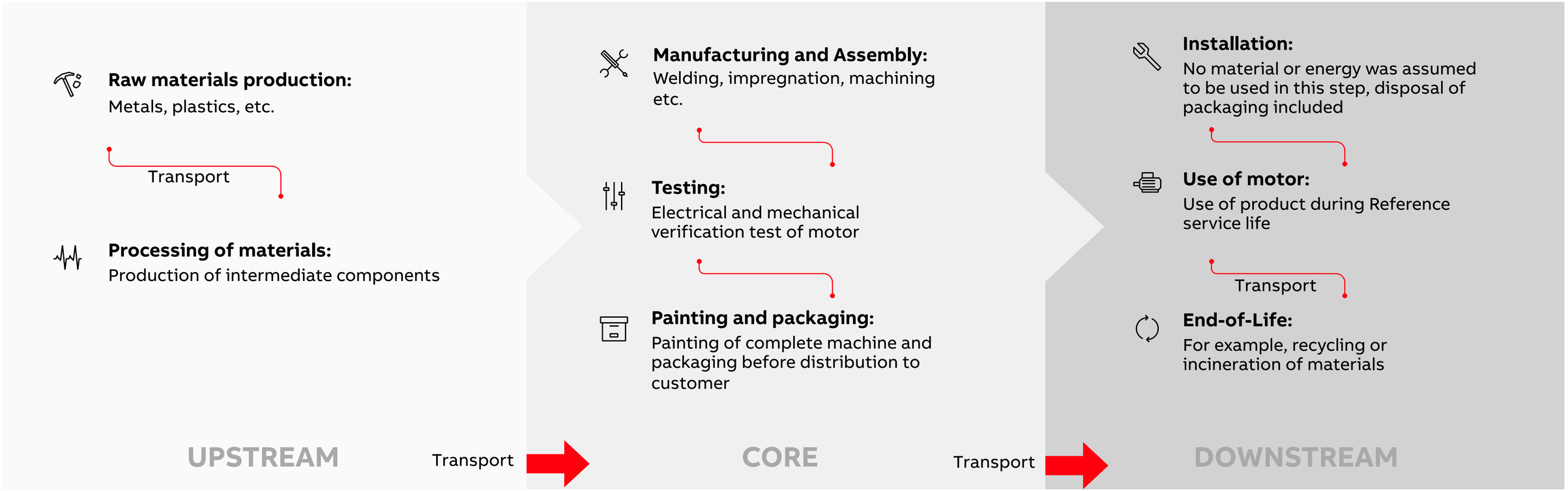
- Transportation of material and components from supplier to the production in Vaasa
- Energy and resources used in the production
- Finnish renewable electricity 50% hydro, 50% wind
- The electricity includes all manufacturing and assembly steps as well as testing, painting, and packaging
- District heating from mainly municipal waste and biomaterials
- Internal transport (diesel)
- Water consumption
- Epoxy resin that the stators are covered with
- The waste generation from the production including the transportation of it to the scrapyard

Downstream (from gate-to-grave)

- Transport of the motor from the production in Vaasa to the end customer
- Installation
- No material or energy is assumed to be required during the installation
- The disposal of the packaging that the motor arrived with
- Maintenance: change of bearings every 15th year including transport to the customer with the new bearings and transport of the old bearings to the scrapyard
- The energy consumption of the motor over the reference service life
- Transport of the motor at end-of-life to scrapyard
- End-of-life scenario which is assumed to be 95% recycled and 5% landfill

Capital goods such as buildings, machinery, tools and infrastructure, as well as packaging for internal transport, which cannot be allocated directly to the production of the reference product is excluded from the system boundary.

LCA information

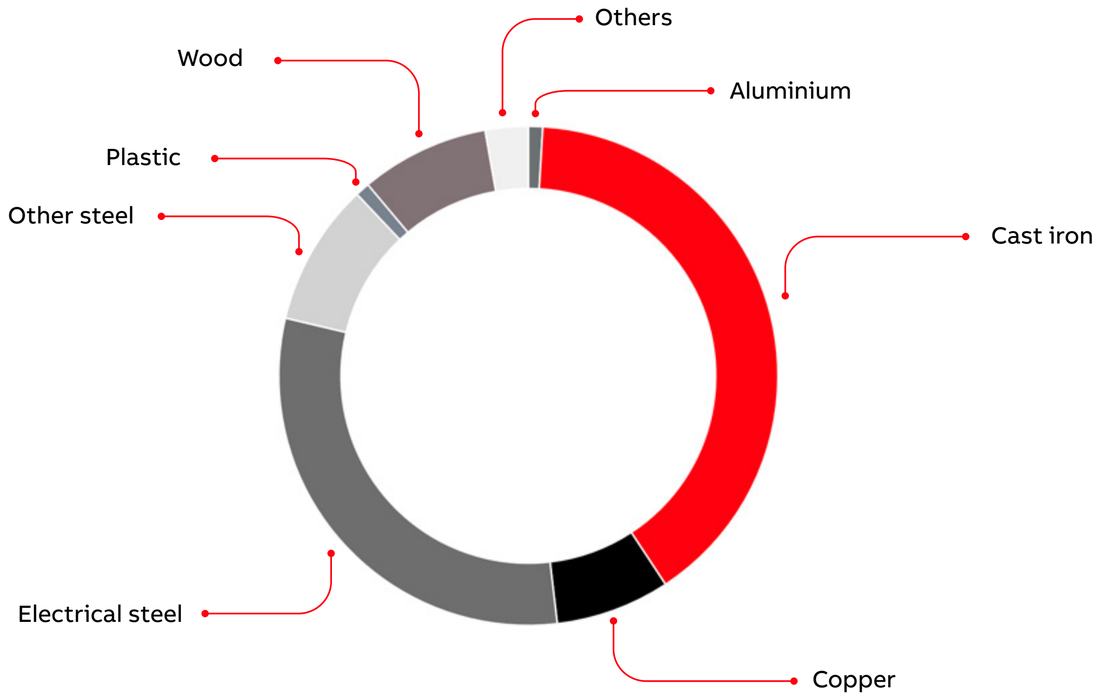


Content declaration

Product with packaging

Based on average content of included products in this EPD

Materials	Percentage (%)
Aluminium	< 1 %
Cast iron	40-45 %
Copper	6-11 %
Electrical steel	31-36 %
Other steel	8-13 %
Plastic	< 1 %
Wood	7-12 %
Others	< 3 %



Environmental performance

Potential environmental impact

Parameter		Unit	Upstream (per kW)	Core (per kW)	Downstream distribution (per kW)	Downstream use (per kW)	Downstream end-of-life (per kW)	TOTAL (per kW)*
Global warming potential (GWP)	**Fossil**	kg CO2 eq	9,10E+01	4,69E+00	7,40E+00	6,28E+04	6,98E-01	**6,29E+04**
	Biogenic	kg CO2 eq	7,21E+00	1,36E-02	2,79E-03	4,00E+02	9,05E-04	**4,08E+02**
	Land use and land transformation	kg CO2 eq.	9,88E-02	6,78E-02	3,62E-03	1,55E+02	7,37E-04	**1,55E+02**
	TOTAL	kg CO2 eq.	**9,83E+01**	**4,77E+00**	**7,41E+00**	**6,34E+04**	**7,00E-01**	**6,35E+04**
Acidification potential (AP)		kg mol H+ eq.	6,78E-01	8,06E-02	1,66E-02	3,10E+02	2,68E-03	**3,11E+02**
Eutrophication potential (EP)	**Aquatic freshwater**	kg P eq.	2,48E-01	4,45E-04	5,31E-04	5,64E+01	5,82E-05	**5,67E+01**
	Aquatic marine	kg N eq.	1,71E-01	2,00E-02	4,30E-03	5,51E+01	8,20E-04	**5,53E+01**
	Aquatic terrestrial	mol N eq.	2,00E+00	2,22E-01	4,39E-02	4,86E+02	8,75E-03	**4,88E+02**
Photochemical oxidant creation potential (POCP)		kg NMVOC eq.	5,73E-01	6,33E-02	2,62E-02	1,57E+02	3,05E-03	**1,57E+02**
Ozone layer depletion (ODP)		kg CFC 11 eq.	2,35E-06	9,03E-08	1,60E-07	1,11E-03	9,03E-09	**1,11E-03**
Abiotic depletion potential (ADP)	**Metals and minerals**	kg Sb eq.	5,53E-03	2,87E-05	2,30E-05	1,21E-01	1,97E-06	**1,27E-01**
	Fossil resources	MJ, net calorific value	1,01E+03	5,92E+01	1,05E+02	1,41E+06	7,51E+00	**1,41E+06**
Water deprivation potential (WDP)		m3 world eq.	-5,89E+00**	1,98E+00	4,62E-01	1,47E+04	5,85E-02	**1,47E+04**

* Total for a specific motor = Nominal output power of motor x TOTAL (per kW), **Example: 45 x 6.35E+04 = 2.86E+06.** ** Negative value from latest SimaPro version, expecting update in next version

Environmental performance

Use of resources

Parameter		Unit	Upstream (per kW)	Core (per kW)	Downstream distribution (per kW)	Downstream use (per kW)	Downstream end-of-life (per kW)	TOTAL (per kW)
Primary energy resources – Renewable	**Use as energy carrier**	MJ, net calorific value	2,75E+02	5,77E+01	1,69E+00	2,64E+05	6,79E-01	**2,64E+05**
	Used as raw materials	MJ, net calorific value	5,50E+01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**5,50E+01**
	TOTAL	MJ, net calorific value	**3,30E+02**	**5,77E+01**	**1,69E+00**	**2,64E+05**	**6,79E-01**	**2,64E+05**
Primary energy resources – Non-renewable	**Use as energy carrier**	MJ, net calorific value	1,07E+03	6,29E+01	1,12E+02	1,48E+06	7,92E+00	**1,48E+06**
	Used as raw materials	MJ, net calorific value	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**
	TOTAL	MJ, net calorific value	1,07E+03	6,29E+01	1,12E+02	1,48E+06	7,92E+00	**1,48E+06**

Environmental performance

Waste production and output flows

Waste production

Parameter	Unit	Upstream (per kW)	Core (per kW)	Downstream distribution (per kW)	Downstream use (per kW)	Downstream end-of-life (per kW)	TOTAL (per kW)
Hazardous waste disposed	kg	0,00E+00	7,80E-02	0,00E+00	0,00E+00	0,00E+00	**7,80E-02**
Non-hazardous waste disposed	kg	0,00E+00	1,01E+00	3,25E-01	0,00E+00	0,00E+00	**1,33E+00**
Radioactive waste disposed	kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**

Output flows

Parameter	Unit	Upstream (per kW)	Core (per kW)	Downstream distribution (per kW)	Downstream use (per kW)	Downstream end-of-life (per kW)	TOTAL (per kW)
Components for reuse	kg	0,00E+00	0,00E+00	2,92E+00	0,00E+00	0,00E+00	**2,92E+00**
Material for recycling	kg	0,00E+00	5,29E+00	0,00E+00	2,07E-01	0,00E+00	**5,50E+00**
Materials for energy recovery	kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**
Exported energy, electricity	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**
Exported energy, thermal	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**

Programme information and references

The International EPD® System
EPD International AB
Box 210 60
SE-100 31 Stockholm
Sweden

www.environdec.com
info@environdec.com

Accountabilities for PCR, LCA and independent, third-party verification

Product Category Rules (PCR)

- PCR: Electrical motors and generators and parts thereof (for industrial applications), 2022:06, version 1.0, UN CPC 46112 and 46131
- PCR review was conducted by: The technical committee of the International EPD® System. A full list of members available on www.environdec.com. The review panel may be contacted via info@environdec.com. Chair of the PCR review: Lars-Gunnar Lindfors

Life Cycle Assessment (LCA)

- LCA accountability: Piotr Kotlicki, Santanu Singha, Srinidhi Sampath and Emma Westberg

Third-party verification

- Independent third-party verification of the declaration and data, according to ISO 14025:2006, via:

☑ EPD verification by individual verifier

- Third-party verifier: Pär Lindman, Miljögiraff
- Approved by: The International EPD® System

Procedure for follow-up of data during EPD validity involves third-party verifier:

☑ No

References

- General Programme Instructions of the International EPD® System. Version 4.0.
- PCR 2022:06. Version 1.0 - Electrical motors and generators and parts thereof (for industrial applications), UN CPC 46112 and 46131
- ISO 14040:2006 Environmental management – Life cycle assessment - Principles and Framework
- ISO 14044:2006 Environmental management – Life cycle assessment – Requirements and Guidelines
- IEC TS 60034-30-2:2016 – Rotating electrical machines – Efficiency classes of variable speed AC motors
- e. v. d. (2023), ecoinvent version 3.9, Centre for Life Cycle Inventories, 2022
- SimaPro, SimaPro desktop software, Available: https://support.simapro.com/
- Life Cycle Assessment report, Low voltage electrical motors, carried out by Corporate research in ABB, Sweden, 2022-11-22

Revision update

- Scope changed from specific output of 75kW to cover the range of motors from 7,5kW to 45kW and also to include the IE5 SynRM Increased Safety motors. Updated version of ecoinvent v3.9.1 database.

ABB IEC Low Voltage Motors

We empower people with technology to drive the transformation of industries needed to enable a low-carbon society and address the world’s energy challenges.

Link to our website

9AAU000000000028 EN 09-2023