EPD

Environmental Product Declaration

DIN-Rail Concentrator for Digital/M&D: MDC605

Production site: Dalmine, Italy

DOCUMENT KIND Environmental Product Declaration	IN COMPLIANCE WITH ISO 14025 and EN50693			
PROGRAM OPERATOR The Norwegian EPD Foundation	PUBLISHER The Norwegian EPD Foundation			
REGISTRATION NUMBER OF THE PROGRAM OPERATOR NEPD-4065-3092-EN	ISSUE DATE 2022-12-22			
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OWNING ORGANIZATION ABB Switzerland Ltd, Group Technology Management	DECLARATION NUMBER 2RDA045143	REV. A	LANG. EN	PAGE 1/18

EPD Owner	ABB Switzerland Ltd, Group Technology Management
Manufacturer name and address	ABB S.p.A. Via Friuli, 4, 24044 Dalmine (BG)
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Program operator	The Norwegian EPD Foundation Post Box 5250 Majorstuen, 0303 Oslo, Norway Ph.:+47 23 08 80 00 email: post@epd-norge.no
Declared product & Functional unit or declared unit	DIN-Rail Concentrator for Digital/M&D: MDC605. DU: The declared unit is a single product (MDC605) with a service life of 20 years.
Product description	DIN-Rail Concentrator for Digital/M&D: MDC605 is an electronic device which is used for the digitization of medium voltage switchboards and it is installed directly in the lower compartment of the electrical switchboard.
CPC code	46 “Electrical machinery and apparatus”
Independent verification	Independent verification of the declaration and data, according to ISO14025:2010 ☐ INTERNAL ☒ EXTERNAL Independent verifier approved by EPD Norway: Vito D’Incognito
Reference PCR and version number	PCR EPDItaly007 REV 2. *Electronic and electrical products and systems*. Review carried out by: Ing. Massimo De Pieri, Arch. Michele Paleari, Ing. Sara Toniolo.
Other reference documents	EN 50693:2019 - Product category rules for life cycle assessments of electronic and electrical products and systems. Regulations of the EPDItaly Programme rev. 5.2 (16th February 2022).
Product RSL description	20 years
Markets of applicability	World (raw materials) Malaysia (production) Europe (use and end-of-life)
LCA study	This EPD is based on the LCA study described in the LCA report “ABB Dalmine_LCA Report_MDC605”.
EPD type	Product specific
EPD scope	“Cradle to grave”
Year of reported primary data	2021

Technical support	2B Srl (Italy) Via della Chiesa Campocroce 4, Mogliano Veneto (TV)
LCA software	SimaPro 9.3.0.3 (2022)
LCI database	ecoinvent v3.8 (2021)
LCIA methodology	Reference Standards EN 50693:2019
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	EPDItaly declines any responsibility regarding the manufacturer's information, data and results of the life cycle assessment.
Approved by	Håkon Hauan, Manager director of EPD-Norway. Signature: 

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 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 humane behavior.

General Information

ABB S.p.A. Electrification Distribution Solutions facility in Dalmine (ELDS division) produces medium voltage circuit breakers, disconnectors, contactors, medium voltage switchboards for primary and secondary distribution, low voltage switchboards, complete packages and services for substations. Smart systems and technologies for electrical distribution are supplied to utilities, industrial, and tertiary sector customers. Dalmine exports 85% of the volumes produced.

ABB ELDS division, Italy adopts and implements for its own activities an integrated Quality/Environmental/Health Management System in compliance with the following standards:

- UNI EN ISO 9001/2015 - Quality Management Systems- Requirements
- UNI EN ISO 14001/2015 - Sistemi di Gestione Ambientale Requisiti e Guida per l'Uso
- UNI EN ISO 45001:2018 - Occupational Health and Safety Assessment Series

The manufacturing site of MDC605 is located in Malaysia and made by the ABB supplier "Celestica Electronics". The storage of MDC605 series takes place in ABB Dalmine site.

Digital devices embedded in medium voltage apparatus for monitor and diagnostic, such as MDC605, enable and support new operation processes and business models and drives smart and sustainable revolution in switchgears/apparatus.
MDC605 DIN-Rail Concentrator is an electronic device directly installed on a metal rail, DIN type, in the low voltage compartment of the electrical switchboard. It allows the connection of sensors and smart devices, the collection of the related data and their analysis. MDC605 it is composed by 3 electronic boards enclosed in a plastic container and among the main functions there are data recording, monitoring, diagnostics and upstream communication to electrical control systems.

Technical specifications of MDC605 are as follow:

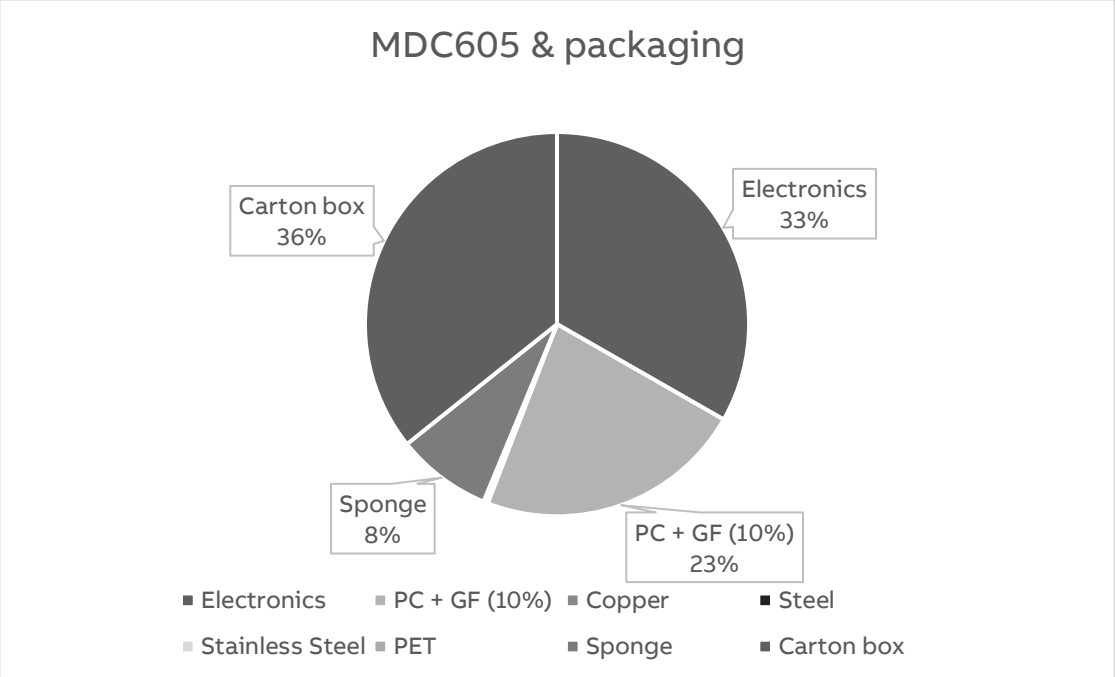
MDC605	Value
Rated voltage [VAC]	85-305
Frequency [Hz]	47-440
Rated voltage [VDC]	120-430

The accessories associated with this product are also included in the study.

Constituent materials

The **MDC605** weights about 0,35 kg. Due to the complex nature of the electronics, these are presented as a separate category, which includes printed circuit boards and their components. Electronics are typically composed of various plastics, copper, and precious metals. The packaging is composed of LDPE and cardboard, resulting in a total weight of 0,27 kg (referred to 1 declared unit).

MDC605			
Materials	Name	Weight [kg]	%
Plastics	Polycarbonate	0,1410	22,6%
	PET	0,0002	< 0,1%
Metals	Steel, low-alloyed	0,0006	0,1%
	Steel, stainless steel	0,0001	< 0,1%
	Copper	0,0015	0,2%
Others	Electronics (PCA)	0,2075	33,3%
Total MDC605		0,3509	56,3%
Packaging			
Plastics	LDPE sponge	0,0500	8,0%
Others	Carton box	0,2228	35,7%
Sub-total packaging		0,2728	43,7%
Total		0,6237	100,0%



LCA background information

This Environmental Product Declaration (EPD) has been performed in line with Product Category Rules PCR EPDItaly007, standard EN 50693, and ISO 14040/14044. For the realization of this LCA study, Sub-PCR 015 - *Electronic and electrical products and systems Switchboards* is also consider for the use phase formula.

Declared Unit

The declared unit is a single product (MDC605) and its packaging with a service life of 20 years, as required by PCR 007 Electronic and electrical products and systems. MDC605 is applied to connect sensors and smart devices with the function of data recording, monitoring and diagnostics.

Note that the reference service life (RSL) of 20 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 of the MDC605, an EEPS (Electronic and Electrical Products and Systems), is a “from cradle to grave” analysis and covers the following main life cycle stages according to EN 50693: manufacturing, including the relevant upstream process (e.g. acquisition of raw material, preparation of semi-finished goods, etc.) and the main manufacturing 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 PCR EPDItaly007 for the evaluation of electronic and electrical products and systems.

UPSTREAM	**CORE**	**DOWNSTREAM**			
Manufacturing		**Distribution**	**Installation**	**Use**	**End-of-Life (EoL)**

Acquisition of raw materials Transport to manufacturing site Components/parts manufacturing Assembly Packaging	ABB storage consumption	Transport to distributor/ logistic center Transport to place of use	Installation EoL treatment of generated waste (packaging)	Usage Maintenance EoL treatment of generated waste	De-Installation Collection and transport EoL treatment

The stages of the product life cycle and the information considered for the evaluation of MDC605 are presented below:

- The manufacturing upstream stage includes the extraction of raw materials, the transport and production of components, parts and sub-assemblies of the MDC605 by ABB suppliers, the production of packaging, the consumption of the MDC605 assembly and the transport from Celestica to ABB Dalmine.
- The core part of the manufacturing stage includes and the storage consumptions of ABB Dalmine.
- The distribution stage includes the impacts related to the distribution of the product to the installation site.
- The installation stage includes the end of life of the packaging.
- The use and maintenance stages include the impact related to energy consumption during the service life of the product.
- End of life includes the operations for the disposal of the product at the end of its service life.

Temporal and geographical boundaries

All primary data collected from ABB are from 2021, which is a representative production year. Secondary data refers to the ecoinvent database v3.8 published in 2021.

When the origin of the components is unknown, the selected ecoinvent processes in the LCA model have global representativeness. In this way, a conservative approach has been adopted.

The ABB component suppliers are sourced all over the world. ABB's supplier, Celestica Electronics, manufactures the product in Malaysia. The product is then shipped assembled to ABB Dalmine. For the use stage of MDC605, the geographical boundaries of Europe have been considered.

Boundaries in the life cycle

In terms of boundaries, the PCR EPDitaly007 requires to refer to chapter 4.2.3.1 in the standard EN 50693 for products that can be easily replaced or recovered. As indicated in the EN 50693:2019, 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 database have not been excluded.

Data quality

In this EPD, both primary and secondary data are used. Site specific foreground data have been provided by ABB. Main data sources are the bill of materials available on the enterprise resource planning. For all processes for which primary are not available, generic data originating from the ecoinvent v3.8 database, allocation cut-off by classification, are used. The ecoinvent database is available in the SimaPro 9.3 software used for the calculations.

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.

Note, the PCR EPDItaly007 uses four different indicators for climate change (GWP-GHG): GWP (total), which includes all greenhouse gases; GWP (fossil fuels); GWP (biogenic carbon), which includes the emissions and absorption of biogenic carbon dioxide and biogenic carbon stored in the product; GWP (land use).

Allocation rules

There are no co-products in this product system, so no allocation of inputs and outputs is necessary.

No allocation is made for materials subject to recycling. For the input of recycled resources, the recycling process is included. Outputs subject to recycling are considered as inputs for the next life cycle.

Concerning the end-of-life allocation, the “polluter pay” principle is adopted as required by the PCR EPDItaly007. This means that waste treatment processes are allocated to the product system that generates the waste until the end-of-waste state is reached. However, the potential benefits and avoided loads from recovery and recycling processes beyond the end-of-waste state are not considered because it is not required by EPDItaly007.

Limitations and simplifications

No cut-off criteria were applied to exclude materials from the calculation.

Inventory analysis

In this study, both primary and secondary data are used. The main sources for primary data are the Bill of Materials as well as technical drawings and documents. Site specific foreground data have been provided by ABB. The ecoinvent v3.8 cut-off by classification system processes are used to model the background system of the processes.

Due to the large amounts of components in the MDC605, raw material inputs are modelled with data from ecoinvent representing a global market coverage. These datasets are assumed to be representative.

Manufacturing stage

For the data of MDC605, information from the Bill of Materials (BoM) was used. Electronics is the most frequently components' group used, followed by polycarbonate glass filled. The printed wiring boards (PWB) are modelled on a component level. Thus, every single component that is mounted on the PWBs is categorized and grouped into the most corresponding component found in ecoinvent.

For the modelling of raw materials, the processes from the market in the ecoinvent v3.8 database were used, adding an assumed transport distance of 100 km for the direct supply of materials. Distances were calculated using Google Maps and Sea Rates.

The manufacturing site of MDC605 is located in Malaysia (Celestica Electronics).

The storage of MDC605 series takes place in ABB Dalmine site. The utility consumption of ABB's plant is allocated to the production of one MDC according to the provided allocation rules.

The energy mix used for the storage phase is representative for ABB Dalmine site and includes green energy only.

Packaging materials and manuals are also included in the analysis. For the data of the packaging, information from the Bill of Materials (BoM) was used. The distances between the suppliers of the packaging components and ABB Dalmine were calculated using Google Maps and Sea Rates.

Distribution

The transport from Celestica Electronics (Malaysia) to ABB Dalmine was taken into account. For the distribution of the MDC605 from ABB Dalmine to the final customer, the intracontinental transport scenario provided by EN 50693 standard was adopted, considering the European macro-area for the use phase. The transport distances from ABB plant to the place of use are assumed to be 3500 km, as required by EN 50693.

Installation

The installation phase only implies manual activities and no energy is consumed due to the fact that there is no direct consumption during installation of the product. The device is installed on din rail by the operator and connected by wiring. This phase also includes the disposal of the packaging of the MDC605. Average data from Eurostat databases were

considered, relating to the percentages of landfill, incineration and recycling treatment, per type of waste treated.

Use

The European general electric mix from ecoinvent v3.8 is used for the use phase. The formula for calculating the electrical energy consumed is given in Sub-PCR EPDItaly015 and is described as follows:

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

Where:

- P_{use} [W] is the power consumed by the product;
- RSL is the service life of the product, assumed to be 20 years;
- 8760 is the number of hours in a year;
- 1000 is the conversion factor that allows the energy consumed in kWh over the product's service life to be expressed.

MDC605	
P_{use} [W]	4,5*
E_{use} [kWh]	788,4

*The tests have been performed considering the device operating in "stand-alone" conditions.
There is no ordinary or extraordinary scheduled maintenance during the use phase.

End of life

For MDC605, neither energy nor materials are required for its removal and dismantling. As far as the DIN-Rail Concentrator is concerned, the end-of-life scenarios in document IEC/TR 62635 were adopted.

Environmental indicators

The following tables show the environmental impact indicators of the life cycle of a MDC605, as indicated by PCR EPDItaly007.

The indicators are divided into the contribution of the processes to the different modules (upstream, core and downstream) and stages (manufacturing, distribution, installation, use and end-of-life).

MDC605

Impact category	Unit	Total	UPSTREAM	CORE	DOWNSTREAM			
			Manufacturing		Distribution	Installation	Use	End of life
Climate change	kg CO_2 eq	3,46E+02	3,01E+01	3,89E-02	2,79E-01	2,95E-01	3,15E+02	2,30E-01
Climate change - Fossil	kg CO_2 eq	3,35E+02	2,99E+01	3,88E-02	2,79E-01	4,86E-02	3,04E+02	2,15E-01
Climate change - Biogenic	kg CO_2 eq	1,05E+01	9,11E-02	4,56E-05	2,08E-04	2,46E-01	1,02E+01	1,43E-02
Climate change - Land use and LU change	kg CO_2 eq	7,71E-01	5,35E-02	4,74E-06	1,27E-04	1,08E-05	7,17E-01	4,82E-05
Ozone depletion	kg CFC11 eq	1,74E-05	2,24E-06	5,65E-09	6,42E-08	6,68E-09	1,51E-05	1,28E-08
Acidification	mol H^+ eq	1,92E+00	2,83E-01	4,60E-05	3,32E-03	1,72E-04	1,64E+00	3,81E-04
Eutrophication, freshwater	kg P eq	3,39E-01	3,53E-02	1,68E-06	1,55E-05	2,14E-06	3,04E-01	1,30E-05
Eutrophication, marine	kg N eq	3,27E-01	4,17E-02	1,07E-05	9,21E-04	1,60E-04	2,84E-01	3,59E-04
Eutrophication, terrestrial	mol N eq	2,93E+00	4,50E-01	1,14E-04	1,02E-02	6,67E-04	2,47E+00	1,38E-03
Photochemical ozone formation	kg NMVOC eq	8,15E-01	1,37E-01	4,00E-05	2,79E-03	2,20E-04	6,75E-01	4,18E-04
Resource use, minerals and metals	kg Sb eq	1,04E-02	9,69E-03	1,96E-07	5,80E-07	7,48E-08	7,21E-04	3,74E-07
Resource use, fossils	MJ	6,90E+03	3,87E+02	6,45E-01	4,18E+00	4,21E-01	6,51E+03	1,12E+00
Water use (AWARE)	m^3	7,87E+01	8,15E+00	5,40E-02	1,30E-02	2,44E-03	7,05E+01	1,34E-02
Particulate matter	disease inc.	6,60E-06	1,70E-06	2,60E-10	2,74E-08	3,34E-09	4,86E-06	7,41E-09
Ionising radiation	kBq U-235 eq	1,82E+02	3,55E+00	5,68E-04	2,06E-02	2,30E-03	1,79E+02	5,97E-03
Ecotoxicity, freshwater	CTUe	6,13E+03	2,75E+03	1,31E-01	3,12E+00	7,38E-01	3,36E+03	2,19E+01
Human toxicity, cancer	CTUh	1,13E-07	2,70E-08	8,85E-12	1,13E-10	3,95E-11	8,55E-08	4,35E-10
Human toxicity, non-cancer	CTUh	4,08E-06	1,23E-06	1,56E-10	3,17E-09	7,10E-10	2,83E-06	2,57E-08
Land use	Pt	1,10E+03	1,44E+02	5,81E-02	3,89E+00	4,85E-01	9,47E+02	1,13E+00

Resource use parameters	Unit	Total	UPSTREAM	CORE	DOWNSTREAM			
			Manufacturing		Distribution	Installation	Use	End of life
Use of non-renewable primary energy, excluding non-renewable primary energy resources used as raw materials (PENRE)	MJ	6,89E+03	3,81E+02	6,45E-01	4,18E+00	4,21E-01	6,50E+03	1,12E+00
Use of non-renewable primary energy resources used as raw materials (PENRM)	MJ	5,87E+00	5,87E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Total use of non-renew primary energy res (PENRT)	MJ	6,90E+03	3,87E+02	6,45E-01	4,18E+00	4,21E-01	6,50E+03	1,12E+00
Use of renewable primary energy, excluding renewable primary energy resources used as raw materials (PERE)	MJ	1,20E+03	3,88E+01	3,40E-01	4,78E-02	9,10E-03	1,16E+03	3,70E-02
Use of renewable primary energy resources used as raw materials (PERM)	MJ	2,87E+00	2,87E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Total use of renewable primary energy res (PERT)	MJ	1,20E+03	4,17E+01	3,40E-01	4,78E-02	9,10E-03	1,16E+03	3,70E-02
Use of secondary material (*)	kg	1,82E-01	1,82E-01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Use of renewable secondary fuels	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Use of non-renewable secondary fuels	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Net use of fresh water	m^3	5,84E+00	3,02E-01	1,28E-03	4,44E-04	1,35E-04	5,54E+00	4,52E-04

(*) = The recycled input percentages used to calculate the kg of secondary material are referred to the processes in the ecoinvent v3.8 database.

Waste production indicators	Unit	Total	UPSTREAM	CORE	DOWNSTREAM			
			Manufacturing		Distribution	Installation	Use	End of life
Hazardous waste disposed	kg	3,67E-03	1,35E-03	1,80E-06	8,79E-06	1,00E-06	2,30E-03	2,45E-06
Non-hazardous waste disposed	kg	2,52E+01	2,82E+00	1,96E-03	3,10E-01	2,23E-01	2,15E+01	3,40E-01
Radioactive waste disposed	kg	4,91E-02	1,09E-03	4,59E-07	2,84E-05	2,79E-06	4,80E-02	5,90E-06
Components for re-use	kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Materials for recycling	kg	2,88E-01	1,58E-03	0,00E+00	0,00E+00	1,22E-01	0,00E+00	1,64E-01
Materials for energy recovery	kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Exported energy	MJ per energy carrier	1,18E+00	0,00E+00	0,00E+00	0,00E+00	5,83E-01	0,00E+00	6,01E-01

Additional environmental information

Reciclability potential

According to the waste treatment scenario calculation in SimaPro, based on the recycling rate in the technical report IEC/TR 62635 Edition 1.0, the following recyclability potentials were calculated.

Recycling & Recovery rates of MDC605					
Model description	**Total weight (kg)**	**Recyclable mass (kg)**	**Recoverable mass (kg)**	**Recycling rate (%)**	**Recovery rate (%)**
MDC605	0,35	0,16	0,25	47%	72%

Additional Norwegian requirements

Greenhouse gas emissions from the use of electricity in the manufacturing phase

The manufacturing site of MDC605 is located in Malaysia (Celestica Electronics). For the assembly of MDC605 in Celestica Electronics facility, the Malaysia electricity mix from ecoinvent 3.8 has been considered.

Production mix from green energy purchasing certificate medium voltage (production of transmission lines, in addition to direct emissions and losses in grid) applied electricity for the manufacturing phase regarding the storage of MDC605 in ABB Dalmine facility.

Data source	Amount	Unit
ABB Green mix	0,03	kg CO_2-eq/kWh

Emission factor of product transport

The emission factor for transport related to the distribution of the product from ABB Dalmine's headquarters in Via Friuli, 4, 24044 Dalmine (BG), Italy to Oslo, Norway is shown in the table below. Both transport by truck and by ferry to transport the product and its packaging has been considered. The processes related to the two type of transport are referred to ecoinvent 3.8 database.

Data source	Distance	Amount
Lorry transport >32 metric ton	1791 km	0,111 kg CO_2-eq
Ferry transport	156 km	

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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