EPD

Environmental Product Declaration

Enviline™ ESS 750 – Energy Storage System

Production site: Bielsko-Biała, Poland

DOCUMENT KIND	IN COMPLIANCE WITH			
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Manufacturer name and address	ABB Sp. z o.o. Switchgear and Energy Distribution Systems Factory Rudawka 96, 43-300 Bielsko-Biała, 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	Enviline™ ESS 750 – Energy Storage System		
Product description	The Enviline™ ESS 750 is a wayside energy management system that stores and recycles the surplus braking energy. Dependently on operation mode it shall contribute to energy savings, a more stable operating traction power system and a reduction of a peak power demand from the utility.		
Functional unit	To capture the excess wayside braking energy of rolling stock, at nominal voltage of DC 750V and use rate according to load profile class III of IEC 60146-1-1 standard during a service life of 20 year.		
Reference flow	A single Enviline™ ESS 750 device (1CCU + 1CU + 2SU), including related accessories and packaging.		
CPC code	46213 - Boards, consoles, cabinets and other bases, equipped with electrical switching etc. apparatus, for electric control or the distribution of electricity, for a voltage not 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: 		
Reference PCR and PSR	EN 50693:2019 – Product Category Rules for Life Cycle Assessments of Electronic and Electrical Products and Systems. EPDItaly007 – Electronic and Electrical Products and Systems, Rev. 3.0, 2023/01/13. EPDItaly015 – Electronic and Electrical Products and Systems – Switchboards, Rev. 1.5, 2022/02/23.		
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 2UFB104058.		
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 9.4.0.2 (2022)		
LCI database	Ecoinvent v3.8 (2021)		
Comparability	EPDs published within the same product category, though originating from different programs, may not be comparable. Full conformance with a PCR allows EPD comparability only when all stages of a life cycle have been considered. However, variations and deviations are possible.		
Liability	The owner of the declaration shall be liable for the underlying information and evidence. EPD-Norge shall not be liable with respect to manufacturer, life cycle assessment data, and evidence.		

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Sustainability at ABB

ABB is a leading global technology company that energizes the transformation of society and industry to achieve a more productive, sustainable future. By connecting software to its electrification, robotics, automation, and motion portfolio, ABB pushes the boundaries of technology to drive performance to new levels.

At ABB, we actively contribute to a more sustainable world, leading by example in our own operations and partnering with customers and suppliers to enable a low-carbon society, preserve resources, and promote social progress.

Learn more on our website global.abb/group/en/sustainability or scan the QR code.

General Information

The product declared in this Environmental Product Declaration is the Enviline™ ESS 750 – Energy Storage System, including related accessories and packaging.

When trains brake, their kinetic energy is converted into electricity and returned on the traction power line. Most of the time, on-board loads and distant trains can only take a portion of this energy, and the surplus is wasted into resistors. Trains also draw excessive peaks of power during their acceleration. This causes voltage drops which can lead to performance problems and results in large demand charges and peak power penalties from the utility company. The Enviline™ ESS captures this braking energy and returns it seconds later to sustain the acceleration and is an ideal solution for demand charge reduction and voltage support.

General technical specifications of the product are presented below.

	Enviline™ ESS 750
Nominal voltage [V]	750
Rated system voltage [V]	900
Rated system power up to [MW]	2.7
Rated system current up to [A]	3600
Rated energy up to [kWh]	25.3
Auxiliaries nominal voltage [V]	400
Auxiliaries rates power [kW]	4.5
Duty cycle class	I-X

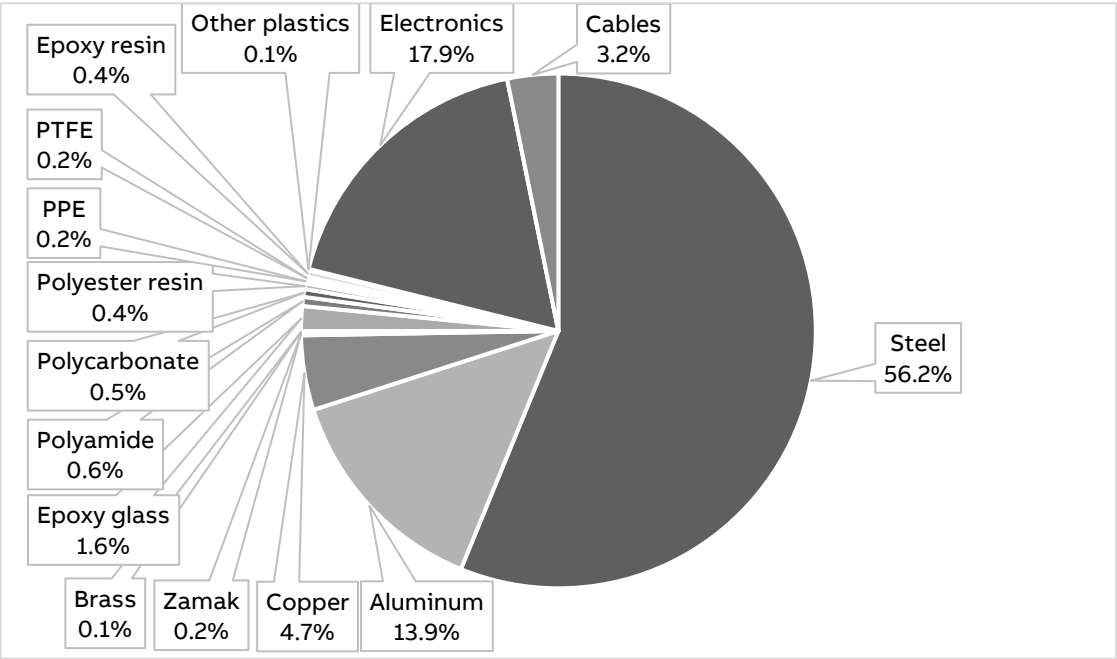
The Enviline™ ESS 750 - Energy Storage System is manufactured by the ABB Industrial Solutions Poland manufacturing site located in Bielsko-Biała.

The ABB Poland facility produces medium voltage products: switchgears, disconnectors, contactors, complete packages and services for substations. Smart systems and technologies for electrical distribution are supplied to utilities, industrial and tertiary sector customers.

Constituent Materials

The Enviline™ ESS 750 weighs 4473.69 kg, and the constituent materials are presented below.

Type	Material	Weight [kg]	Weight %
Plastics	Epoxy glass	69.54	1.55
	Polyamide	25.59	0.57
	Polycarbonate	21.72	0.49
	Epoxy resin	18.14	0.41
	Polyester resin	16.05	0.36
	PPE	11.00	0.25
	PTFE	8.05	0.18
	Other plastics	3.59	0.08
Metals	Steel	2513.47	56.18
	Aluminum	619.87	13.86
	Copper	209.65	4.69
	ZAMAK	7.41	0.17
	Brass	4.56	0.10
Others	Electronics	802.29	17.93
	Cables	142.78	3.18
Total		**4473.69**	**100**



The packaging materials and accessories weighs 267.54 kg, and the constituent materials are presented below.

Description	Material	Weight [kg]	Weight %
Protective film	PE	4.00	1.5
Pallet	Wood	263.54	98.5
Total		**267.54**	**100**

LCA Background Information

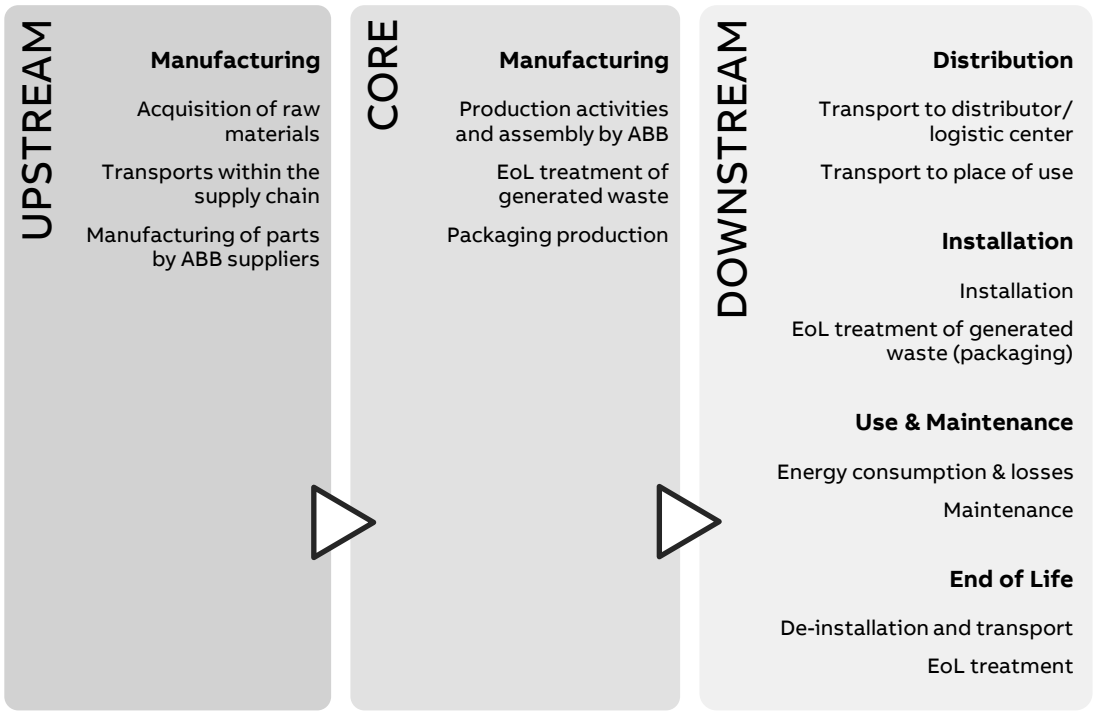
Functional Unit

The functional unit of this study is to capture the excess wayside braking energy of rolling stock, at nominal voltage of DC 750V and use rate according to load profile class III of IEC 60146-1-1 standard during a service life of 20 year. The reference flow is a single Enviline™ ESS 750 device (1CCU + 1CU + 2SU), including related accessories and packaging.

Note, 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 assessment of the Enviline™ ESS 750, 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 Standard/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 v3.8 which was released in 2021.

In terms of geographical boundaries, the materials and components used in the production of the Enviline™ ESS 750 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 v3.8 database, “allocation, cut-off by classification”, are used. The database Industry Data 2.0 is also used for chemicals which are not available by ecoinvent. The LCA software used for the calculations is SimaPro 9.4.0.2.

Environmental impact indicators

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

Allocation rules

The utility consumption and waste generation at the ABB manufacturing site is allocated to the production of one Enviline™ ESS 750 by using allocation rules. Since the factory produces several products (apparatus and switchgears), only a part of the environmental impact has been allocated to the Enviline™ ESS 750 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 Enviline™ ESS 750 were multiplied by time operating coefficient.

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 EN 50693, the cut-off criteria can be set to a maximum of 5 % of the overall environmental impacts.

Fiber-optic cables and their connectors are neglected, due to lack of adequate material in library and complexity of model. Although, their mass represents less than 0,01% of that of the whole panel.

The packaging is also included in the functional unit. Sticking labels have been excluded since their weight is negligibly small compared to the whole product. All product manuals are excluded, due to not being printed and are available in ABB Library and on the Internet.

Surface treatments like galvanizing and tin plating have been considered in the LCA model.

Inventory Analysis

Manufacturing stage

As presented in chapter Constituent Materials, steel and electronics are the most frequently used materials, followed by aluminum, wooden packaging pallet and copper.

Using the ecoinvent database, the steels are mainly modelled with *Steel, low-alloyed {GLO}| market for* and the electronic parts are mainly modelled with *Electronic component, passive, un-specified {GLO}| market for*. To account for the production activities of metal, *Metal working, average* and *Sheet rolling, steel* are the most frequently used processes. Surface treatments are also included, and the most common surface treatments are *ecoinvent Zinc coat, coils* and *ecoinvent Tin plating, pieces*.

Supply chain transports are added as far as data is available between ABB, the suppliers, and sub-suppliers. Only primary suppliers are considered. The rest of the transports are assumed to already be included in ecoinvent's "market for"-processes.

For the ABB manufacturing site, which is considered in the core manufacturing stage, utility consumption and waste generation are allocated to the production of one Enviline™ ESS 750 according to the defined allocation rules. The packaging materials and accessories associated with the product are also considered in the core manufacturing stage.

Distribution

The transport distance from ABB's plant to the site of installation is assumed to be 300 km transport by lorry, as suggested in PCR EPDItaly015, and the scenario is global representative.

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 actual location of disposal is unknown.

Use

The use stage considers the power losses over the reference service life of 20 years as defined in the functional unit.

The power loss of main power circuit and auxiliary circuits are defined based on measurement data from the type test of device.

Specific 24h daily traffic - rush hours, night down time, etc. needs to be taken into account, so best approximation of the daily load profile class III of IEC 60146-1-1 was taken.

Because this product is sold globally and is not limited to any specific country, the latest energy mix of the European Union is adopted as suggested by the standard EN 50693. The emission factor of the energy mix is presented below.

Energy mix	Source	Amount	Unit
European energy mix; *Electricity, medium voltage {Europe without Switzerland}| market group for | Cut-off, S*	Ecoinvent v3.8	0.1127	kg CO_2-eq./kWh

To provide failure-free work of device during service life, predetermined preventive maintenance actions needs to be taken and for some components replacement or repair is required. In this cases, additional spare parts were included, with transport process to destination point.

End of life

Decommissioning of the product only implies manual activities, and no energy is consumed. Therefore, this phase only considers the end-of-life of the product.

The end-of-life scenario for the product is based on IEC/TR 62635 (Annex D.3), which is representative for Europe. A conservative approach is adopted by using the rates given for materials that go through a separation process, except for electronics for which selective treatment is assumed, and this includes the losses in the separation processes. A transport distance of 100 km by lorry is assumed as actual location of disposal is unknown.

Environmental Indicators

Enviline™ ESS 750

Impact category	Unit	Total	UPSTREAM	CORE	DOWNSTREAM			
			Manufacturing		Distribution	Installation	Use and maintenance	End-of-life
GWP – total	kg CO_2 eq.	1.33E+05	6.79E+04	1.02E+04	2.35E+02	1.35E+02	5.24E+04	2.06E+03
GWP – fossil	kg CO_2 eq.	1.30E+05	6.73E+04	1.03E+04	2.34E+02	1.20E+01	5.06E+04	1.93E+03
GWP – biogenic	kg CO_2 eq.	2.16E+03	4.14E+02	-1.19E+02	2.13E-01	1.24E+02	1.62E+03	1.20E+02
GWP – luluc	kg CO_2 eq.	2.60E+02	1.38E+02	2.57E+00	9.29E-02	3.63E-03	1.19E+02	5.37E-01
ODP	kg CFC-11 eq.	3.53E-02	3.22E-02	3.89E-04	5.47E-05	1.48E-06	2.53E-03	4.01E-05
AP	mol H+ eq.	9.51E+02	6.06E+02	6.56E+01	1.19E+00	4.65E-02	2.76E+02	2.62E+00
EP – freshwater	kg P eq.	1.12E+02	4.97E+01	1.08E+01	1.52E-02	1.13E-03	5.08E+01	1.62E-01
EP – marine	kg N eq.	1.40E+02	8.08E+01	9.74E+00	4.09E-01	5.52E-02	4.77E+01	1.16E+00
EP – terrestrial	mol N eq.	1.47E+03	9.56E+02	8.50E+01	4.47E+00	1.90E-01	4.19E+02	7.67E+00
POCP	kg NMVOC eq.	5.16E+02	3.74E+02	2.43E+01	1.28E+00	5.43E-02	1.15E+02	2.03E+00
ADP – minerals and metals	kg Sb eq.	9.41E+00	8.90E+00	1.08E-02	8.22E-04	2.49E-05	4.97E-01	6.22E-03
ADP – fossil	MJ, net calorific value	2.01E+06	8.18E+05	1.20E+05	3.57E+03	1.09E+02	1.07E+06	5.52E+03
WDP	m^3 eq.	3.20E+04	1.88E+04	1.35E+03	1.08E+01	5.54E-01	1.17E+04	8.63E+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	UPSTREAM	CORE	DOWNSTREAM			
			Manufacturing		Distribution	Installation	Use and maintenance	End-of-life
PENRE	MJ, low cal. value	2.00E+06	8.06E+05	1.20E+05	3.57E+03	1.09E+02	1.07E+06	5.52E+03
PERE	MJ, low cal. value	2.85E+05	8.89E+04	1.26E+04	5.04E+01	1.94E+00	1.83E+05	4.98E+02
PENRM	MJ, low cal. value	1.20E+04	1.17E+04	1.70E+02	0.00E+00	0.00E+00	1.18E+02	0.00E+00
PERM	MJ, low cal. value	1.41E+02	0.00E+00	1.41E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRT	MJ, low cal. value	2.01E+06	8.18E+05	1.20E+05	3.57E+03	1.09E+02	1.07E+06	5.52E+03
PERT	MJ, low cal. value	2.86E+05	8.89E+04	1.27E+04	5.04E+01	1.94E+00	1.83E+05	4.98E+02
FW	m^3	1.79E+03	6.29E+02	2.67E+02	3.99E-01	2.17E-02	8.89E+02	3.37E+00
MS	kg	1.59E+03	1.56E+03	6.32E-01	0.00E+00	0.00E+00	2.07E+01	0.00E+00
RSF	MJ	0.00E+00	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	0.00E+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	UPSTREAM	CORE	DOWNSTREAM			
			Manufacturing		Distribution	Installation	Use and maintenance	End-of-life
HWD	kg	7.41E+00	6.83E+00	6.08E-02	9.33E-03	2.52E-04	4.99E-01	9.32E-03
NHWD	kg	1.62E+04	1.07E+04	7.48E+02	1.84E+02	1.07E+02	3.62E+03	8.95E+02
RWD	kg	1.00E+01	2.12E+00	1.13E-01	2.42E-02	6.45E-04	7.76E+00	2.43E-02
MER	kg	8.42E+02	0.00E+00	2.69E+02	0.00E+00	7.90E+01	0.00E+00	4.94E+02
MFR	kg	4.30E+03	4.21E+02	4.48E+02	0.00E+00	8.66E+01	6.34E+00	3.33E+03
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ETE	MJ	3.40E+03	0.00E+00	1.66E+03	0.00E+00	3.28E+02	0.00E+00	1.41E+03
EEE	MJ	1.81E+03	0.00E+00	8.46E+02	0.00E+00	1.82E+02	0.00E+00	7.83E+02

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

Enviline™ ESS 750 lineup is configurable and built with 3 units - which were modelled separately – 1 CCU, 1-2 CU and from 1 up to 12 SU. CCU is available in 2 variants, depending on number of connected CU units. All the analyzed configurations have the same main functionality, product standards and manufacturing technology, so extrapolation rules are established according to EN 50693.

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.

Configuration	Total	UPSTREAM	CORE	DOWNSTREAM			
		Manufacturing		Distribution	Installation	Use and maintenance	End-of-life
1CCU + 1CU + 1SU	0.74	0.62	0.75	0.78	0.73	0.91	0.61
1CCU + 1CU + 2SU	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1CCU + 1CU + 3SU	1.26	1.38	1.25	1.22	1.27	1.09	1.39
1CCU + 1CU + 4SU	1.51	1.75	1.51	1.44	1.54	1.19	1.77
1CCU + 1CU + 5SU	1.77	2.13	1.76	1.67	1.80	1.28	2.16
1CCU + 1CU + 6SU	2.02	2.51	2.01	1.89	2.07	1.38	2.54
1CCU + 2CU + 2SU	1.45	1.28	1.24	1.39	1.21	1.71	1.25
1CCU + 2CU + 3SU	1.70	1.66	1.49	1.61	1.48	1.80	1.64
1CCU + 2CU + 4SU	1.96	2.03	1.74	1.84	1.75	1.90	2.02
1CCU + 2CU + 5SU	2.21	2.41	2.00	2.06	2.02	1.99	2.41
1CCU + 2CU + 6SU	2.47	2.79	2.25	2.28	2.29	2.09	2.79
1CCU + 2CU + 7SU	2.73	3.17	2.50	2.50	2.56	2.18	3.18
1CCU + 2CU + 8SU	2.98	3.54	2.76	2.72	2.82	2.28	3.56
1CCU + 2CU + 9SU	3.24	3.92	3.01	2.95	3.09	2.37	3.95
1CCU + 2CU + 10SU	3.49	4.30	3.27	3.17	3.36	2.47	4.33
1CCU + 2CU + 11SU	3.75	4.67	3.52	3.39	3.63	2.56	4.72
1CCU + 2CU + 12SU	4.01	5.05	3.77	3.61	3.90	2.66	5.11

Sensitivity analysis

A sensitivity analysis is conducted to understand how the impact category “GWP – total” varies for Enviline™ ESS 750 sold in different geographical locations. Bielsko-Biała is currently the only one manufacturing location, thus manufacturing site and intercontinental transport in Distribution stage remains the same. Energy mix in the Use stage is selected according to geographical location. End-of-life stage could be modelled in accordance with local statistics, however impact on the final results is quite low, so it was aborted. The results are presented in following table.

Scenario	Total [kg CO_2 eq.]	UPSTREAM	CORE	DOWNSTREAM			
		Manufacturing		Distribution	Installation	Use and maintenance	End-of-life
Declared scenario Use stage: Europe	1.33E+05	6.79E+04	1.02E+04	2.35E+02	1.35E+02	5.24E+04	2.06E+03
RAF Use stage: Africa	1.72E+05	6.79E+04	1.02E+04	2.35E+02	1.35E+02	9.15E+04	2.06E+03
RAS Use stage: Asia	2.02E+05	6.79E+04	1.02E+04	2.35E+02	1.35E+02	1.22E+05	2.06E+03
RLA Use stage: Latin America	1.30E+05	6.79E+04	1.02E+04	2.35E+02	1.35E+02	4.90E+04	2.06E+03
RME Use stage: Middle East	1.81E+05	6.79E+04	1.02E+04	2.35E+02	1.35E+02	1.00E+05	2.06E+03
RNA Use stage: Northern America	1.42E+05	6.79E+04	1.02E+04	2.35E+02	1.35E+02	6.11E+04	2.06E+03
GLO Use stage: Global	1.71E+05	6.79E+04	1.02E+04	2.35E+02	1.35E+02	9.07E+04	2.06E+03

Additional Environmental Information

Recyclability potential

The recyclability potential of the Enviline™ ESS 750 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 74 %.

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 for | Cut-off, S*	Ecoinvent v3.8	0.2807	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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