Matelec SAL

ENVIRONMENTAL PRODUCT DECLARATION

Product name: FPT1842100, FPT1843100, FPT1844100, FPT1845100, FPT1846100

Production site: Matelec SAL 59, Matelec Sal, Matelec Building, Ghorfine, Jbeil Lebanon

In accordance with ISO 14025 and EN 50693:2019

Program Operator	EPDItaly
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www.epditaly.it

GENERAL INFORMATION

EPD OWNER

Name of the company	Matelec SAL
Registered office	Matelec SAL 59, Matelec Sal, Matelec Building, Ghorfine, Jbeil Lebanon
Contacts for information on the EPD	+961 9 620 920 ; Email: matelec@matelecgroup.com Ref. Eng. Rabih Dib (rabih.dib@matelecgroup.com) Eng. Pierre Haddad (pierre.haddad@matelecgroup.com)

PROGRAM OPERATOR

EPDItaly	Via Gaetano De Castillia n° 10 - 20124 Milano, Italy

INFORMATION ON THE EPD

Product name (s)	FPT1842100, FPT1843100, FPT1844100, FPT1845100, FPT1846100
Site (s)	Matelec SAL 59, Matelec Sal, Matelec Building, Ghorfine, Jbeil Lebanon
Functional unit	The functional unit for this study refers to the operation of each transformer under ONAN power conditions, over 35 years RSL, 365 days per year, 24 hours per day. The ONAN power values are: 40 MVA for transformer 40/50 MVA 150/33 kV, 74 MVA for transformer 74/92 MVA 150/33 kV, 18 MVA for transformer 18/23 MVA 132/30 kV, 25 MVA for transformer 25/30 MVA 132/30 kV, 32 MVA for transformer 32/40 MVA 132/30 kV
Field of application of the product (s)	Electronic and Electrical Products and Systems
EPD type	Specific product EPD Cradle to Grave
CPC Code (number) https://unstats.un.org/unsd/classifications/Econ	46121 – Electrical transformers

VERIFICATION INFORMATION

PCR (title, version, date of publication or update)	SIST EN 50693:2019 Product category rules for life cycle assessments of electronic and electrical products and systems (2020)
Framework reference for PCRs	Core PCR EPDItaly 007 Electronic and electrical products and systems – Rev3, 2023-01-13 Sub-PCR EPDItaly 018 Electronic and electrical products and systems – Power transformers, v3.5, 2021-12-13
EPDItaly Regulation (version, date of publication or update)	REGOLAMENTO DEL PROGRAMMA EPDItaly, v. 6.0, 30/10/2023
Project Report LCA	Environmental Product Declaration of power transformers FPT1842100, FPT1843100, FPT1844100, FPT1845100, FPT1846100
Independent Verification Statement	Independent verification of the declaration and data, carried out according to ISO 14025: 2010. ☐ Internal ☑ External Third party verification carried out by: ICMQ S.p.A., via Gaetano De Castillia n ° 10 - 20124 Milan, Italy. Accredited by Accredia.
Comparability Statement	Environmental statements published within the same product category, but from different programs, may not be comparable.
Liability Statement	The EPD Owner releases EPDItaly from any non-compliance with environmental legislation. The holder of the declaration will be responsible for the information and supporting evidence. EPDItaly disclaims any responsibility for the information, data and results provided by the EPD Owner for life cycle assessment.

OTHER INFORMATION

Technical support	Sphera Inc.

1 COMPANY INFORMATION

Matelec SAL was founded in 1974 to produce distribution transformers and has grown into a diversified electricity business player since then. Matelec enlarged its products offering gear switching, package substations, and control and protection systems within its first decade. In parallel, Matelec expanded into engineering and contracting activities with the realization of complex HV, MV, and LV projects.

Throughout the years, Matelec expanded its manufacturing capabilities in the Mideast, Africa, and Europe with the acquisition or participation in many factories, namely Electrical Equipment Industries Co. (ELICO) in Jordan, International Transformers Matelec (ITM) in Egypt, Transfo Matelec in France, and lately Entreprise algérienne des équipements de transformation et de distribution électrique SPA (EDIEL SPA) in Algeria. Matelec is further exploring other geographic deployments and business ventures across these regions to optimize its global business portfolio.

Matelec employs more than 1000 people in the Mideast, Africa, and Europe.

Matelec guarantees high-quality products and services and provides its customers with technical quality assistance in all project phases. Matelec is part of a multinational industrial group leader in the field of design, development, production, installation, sales and servicing of a range of electrical products and turnkey projects. In order to maintain its leadership, Matelec is committed to implementing a quality management system that meets the requirements of the international standard ISO 9001:2015. The system consists of a set of interacting processes continuously monitored, measured and analyzed. Actions are taken when results do not meet objectives providing a drive for continual improvement. It is the policy of Matelec to deliver error–free products on time. Quality, continual improvement and customer satisfaction are the personal responsibility of each employee. Moreover, Matelec's environmental, safety & health (ES&H) policy ensures that work is performed in a manner that protects the health and safety of employees and the public, preserves the quality of the environment, and prevents property damage. Having the ISO 14001:2015 and ISO 45001:2018, and ISO 9001:2005 Matelec ensures that priority is given to ES&H issues in the planning and execution of all work activities.

The respective certificate numbers for the ISOs mentioned above are:

- ISO 14001:2015 LB21/2343171
- ISO 45001:2018 LB21/2343172
- ISO 9001:2015 LB21/2343173

2 PRODUCTS DESCRIPTION

The power transformers in this study convert high network voltages to medium network voltages, so electricity can be transmitted more safely to the final consumers.

The FPT184XX00 transformers studied are oil immersed, three phase ONAN/ONAF, with OLTC at 50 Hz frequency, with a vector group YNd11. Below is a short description of the studied power transformers, with the following power and voltage reduction features:

- FPT1842100 - 40/50 MVA 150/33kV
- FPT1843100 - 74/92MVA 150/33kV
- FPT1844100 - 18/23MVA 132/30kV
- FPT1845100 - 25/30MVA 132/30kV
- FPT1846100 - 32/40 MVA 132/30kV

Geographical scope:
The materials for the transformers are obtained from Germany, Belgium, Japan, India, Italy, Turkey, Spain, The Netherlands, France, and Portugal.

The products are assembled in Lebanon.

The transformers will be installed in Italy, in the following locations: Assemini, Quartucciui, Fusina, Porto Tolle, and Carpi.

The EoL is assumed to take place in Italy.

The nominal weight of each transformer is described on the table below:

Table 1: Nominal weight of each transformer

Transformer name	Description	Nominal weight, shown on the plate [kg]
FPT1842100	40/50 MVA 150/33 kV	87100
FPT1843100	74/92 MVA 150/33 kV	130000
FPT1844100	18/23 MVA 132/30 kV	56400
FPT1845100	25/30 MVA 132/30 kV	63300
FPT1846100	32/40 MVA 132/30 kV	76300

3 FUNCTIONAL UNIT

The functional unit for this study refers to the operation of each transformer under ONAN power conditions, over 35 years RSL, 365 days per year, 24 hours per day. The respective ONAN power values are shown below:

Table 2: ONAN power values considered for the functional unit on each transformer.

Transformer name	Description	ONAN power value [MVA]
FPT1842100	40/50 MVA 150/33 kV	40
FPT1843100	74/92 MVA 150/33 kV	74
FPT1844100	18/23 MVA 132/30 kV	18
FPT1845100	25/30 MVA 132/30 kV	25
FPT1846100	32/40 MVA 132/30 kV	32

Reference service life:
35 years

Time representativeness:
The data collection for materials in the products is representative of the year 2023, the transformers were produced in 2023, data for production materials is from 2023.
The data collection for energy and consumables used during manufacturing is representative of 2022.
Production of products was initiated in 2023 and the energy data from 2022 are representative given the similarity in MVA production and the energy dependency remaining the same.

Geographical representativeness:
The upstream processes for the components and assembly are representative to European countries, India, and Japan.
The energy consumption during the use stage is representative to Italy.

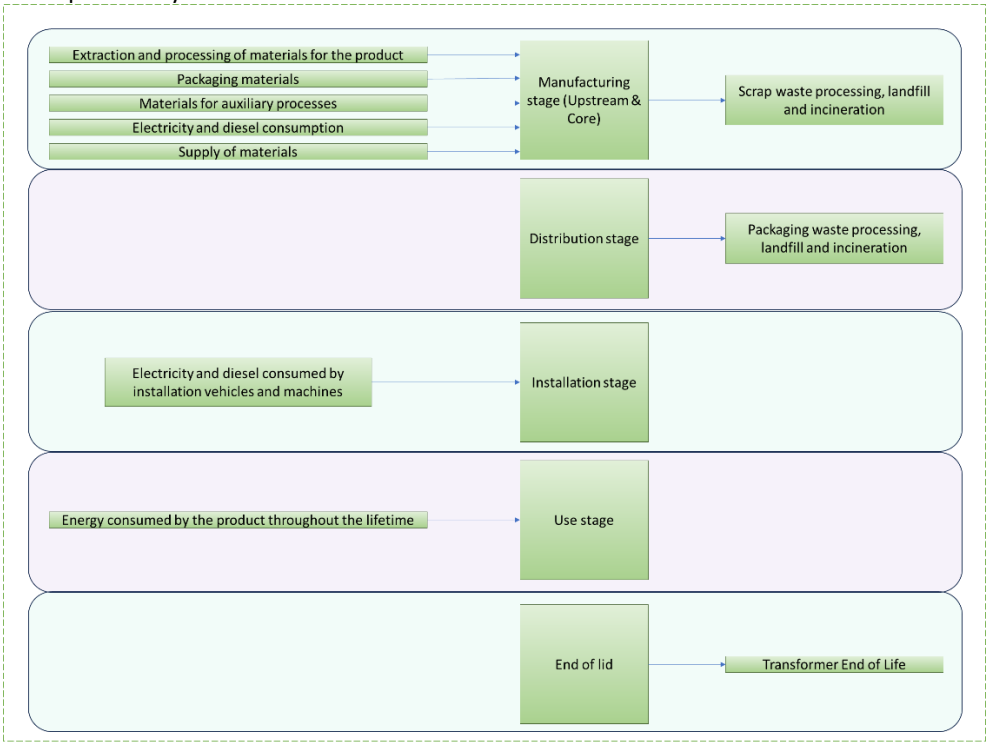
Allocation:
This EPD considers that the transformers use the entire given amount of input raw materials for each production process defined for each type of transformer. Hence, there is no need to allocate raw materials among different types of transformers. However, the use of energy, infrastructure, and other consumables is shared with other types of transformers during manufacturing in the year of reference 2022. Therefore, since other co-products are generated during the transformers production process, allocation rules are required for the foreground data: calculation of electricity, welding gases, and diesel consumption, on the five transformers studied.

Cut-off criteria:
The EN 50693:2019 requires that in case of data gaps or insufficient input data for a unit process, the cut-off criteria shall be 1% of renewable and non-renewable primary energy usage, and 1% of the total mass of this unit process. The total neglected flows from a product stage must be no more than 5% of product inputs by mass or 5% of primary energy contribution.
This assessment involved very comprehensive data collection, and all collected data were modelled; no known flows have been omitted.

Database(s) and LCA software:
The LCA model is created using the LCA for Experts Software system for life cycle engineering, developed by Sphera. The Managed LCA Content provides the life cycle inventory data for several of the raw and process materials obtained from the background system. The most recent database version is CUP2023.2.

4 SYSTEM BOUNDARIES

Cradle-to-grave, including Manufacturing, Distribution, Installation, Use & Maintenance, End-of-Life stages, and benefits and loads of the next product system.



Excluded:
Impacts related to production of machinery, facilities and infrastructure. End-of-life credits associated to recycling and energy recovery.

Figure 1: System boundary of main production processes, transportation, installation, use, and EoL stages.

4.1 MODULES DECLARED

Table 3: Modules of the production life cycle included in the EPD according to PCR EDPItaly007 – Rev3, 2023-01-13 and consistent with EN 50693:2019 (X = declared module; MND = module not declared)

Phases	Manufacturing stage		Distribution stage	Installation stage	Use & maintenance stage	End-Of-Life stage	Benefits & Loads
	Upstream	Core					
Phases declared	X	X	X	X	X	X	MND

4.2 MANUFACTURING

In the manufacturing stage, all processes involved in the production of the 5 transformers have been considered within the study. These include pre-product manufacture, different sources of energy (thermal energy, fuel, and electric power consumption), direct generation of waste from production, as well as relevant emissions data.

4.3 DISTRIBUTION

The transportation of the products considers the truck transport from Matelec plant in Ghorfine, Lebanon to the Port of Beirut, then the transatlantic distance to the nearest ports (as shown in the table below), in three of the transformers an additional truck travelled distance was considered to the final installation point.

Table 4: Product distribution (Distribution Stage)

Transformer name	Total ship distance	Total truck distance	Distribution path		
			Truck (1st)	Ship	Truck (2nd)
FPT1842100	2700	58	Ghorfine, Lebanon → Beirut	Beirut, Lebanon → Cagliari, Italy	Cagliari, Italy → Assemini, Italy
FPT1843100	2700	49	Ghorfine, Lebanon → Beirut	Beirut, Lebanon → Cagliari, Italy	Cagliari, Italy → Quartucciui, Italy
FPT1844100	3020	41	Ghorfine, Lebanon → Beirut, Lebanon	Beirut, Lebanon → Fusina, Italy	N/A
FPT1845100	3020	41	Ghorfine, Lebanon → Beirut, Lebanon	Beirut, Lebanon → Porto Tolle, Italy	N/A
FPT1846100	3020	241	Ghorfine, Lebanon → Beirut, Lebanon	Beirut, Lebanon → Cagliari, Italy	Cagliari, Italy → Carpi, Italy

4.4 INSTALLATION

The installation of each of the analyzed power transformers requires the following machinery:

- 5-ton crane operating for 15 hours,
- A telescopic 220-ton crane operating for 10 hours.
- A forklift operation for 3 hours.
- An oil treatment machine of 105 kW for 4 hours

In this stage, the end-of-life of the packaging material (wood and steel sheet) is considered. The steel is recycled, and the wood is incinerated with energy recovery at a waste incineration plant as shown on the table below.

Table 5: Waste treatment for packaging materials of transformer FPT1842100

Material	Amount [kg]	Waste treatment	Waste treatment percentage [%]
Steel	101.10	Recycling	100
Wood	358.93	Incineration	100

Table 6: Waste treatment for packaging materials of transformer FPT1843100

Material	Amount [kg]	Waste treatment	Waste treatment percentage [%]
Steel	101.10	Recycling	100
Wood	422.19	Incineration	100

Table 7: Waste treatment for packaging materials of transformer FPT1844100

Material	Amount [kg]	Waste treatment	Waste treatment percentage [%]
Steel	101.10	Recycling	100
Wood	149.21	Incineration	100

Table 8: Waste treatment for packaging materials of transformer FPT1845100

Material	Amount [kg]	Waste treatment	Waste treatment percentage [%]
Steel	101.10	Recycling	100
Wood	238.79	Incineration	100

Table 9: Waste treatment for packaging materials of transformer FPT1846100

Material	Amount [kg]	Waste treatment	Waste treatment percentage [%]
Steel	101.10	Recycling	100
Wood	329.79	Incineration	100

4.5 USE

Only the operational energy is considered in the use stage. Maintenance is not required or can be neglected. Throughout their service life of 35 years, the transformers will operate 24 hours a day. No maintenance is considered for the power transformers during their lifetime.

The installation points of the transformers are in the northeast of Italy and the Sardinia Island.

To represent the electricity consumption in this stage, the electricity grid mix from Italy was used.

The study considered the power rates of the transformer when working at partial load with Oil Natural Air Natural (ONAN). Complying with the PCR for transformers, when operating at partial load of 70%, the calculations are adopted with ONAN. The values for ONAN and ONAF are communicated in the products description.

The energy used is calculated following the equation according to Sub-PCR EPDItaly 018 Electronic and electrical products and systems – Power transformers, v3.5, 2021-12-13:

Sub PCR EPDItaly018 – v3.5, 2021-12-13Sub PCR EPDItaly018 – v3.5, 2021-12-13Sub PCR EPDItaly018 – v3.5, 2021-12-13

$$\boldsymbol{E_d}\ [\mathbf{kWh}] = [\boldsymbol{P_{load}} * \boldsymbol{k_{load}}^2 + \boldsymbol{P_{noload}}] * \boldsymbol{t_{year}} * \boldsymbol{RSL} + \boldsymbol{P_{aux}} * \boldsymbol{f_{aux}} * \boldsymbol{t_{year}} * \boldsymbol{RSL}$$

Where:

E_d = The energy used by the power transformers for 35 years [kWh]
P_{load} = Load losses of the transformers [kW]
P_{noload} = No-load losses of the transformers [kW]
k_{load} = Average load factor (0.70 for all transformers)
t_{year} = Total number of hours in a year (8760 hours)
RSL = Reference service life (35 years)
P_{aux} = Power loss due to auxiliary activities at no load (zero in all transformers, calculation adopted for ONAN)
f_{aux} = Fraction of time in which ancillary equipment is operating (zero in all transformers, calculation adopted for ONAN)

The parameters of each transformer used in the equation are described in the table below:

Table 10: Parameters used in the equation for energy use.

Transformer name	$Pload$ [kW]	$kload$	$Pnoload$ [kW]	$tyear$ [h]	RSL [years]	$Paux * faux * tyear * RSL$

FPT1842100	111.8540	0.7	25.604	8760	35	0
FPT1843100	195.0000	0.7	38.000	8760	35	0
FPT1844100	54.5550	0.7	14.260	8760	35	0
FPT1845100	75.8380	0.7	15.638	8760	35	0
FPT1846100	90.4460	0.7	20.418	8760	35	0

The calculated Ed values for each transformer are given below:

Table 11: Energy used by the power transformers over 35 years (E_d)

Transformer name	Ed [kWh]
FPT1842100	24,654,460
FPT1843100	40,946,430
FPT1844100	12,568,131
FPT1845100	16,188,056
FPT1846100	19,848,223

4.6 DISASSEMBLY AND EOL

The disassembly of the transformer uses a 75-ton crane. The electricity used by the crane is the only disassembly process considered in the End-of-Life stage, as the oil is removed from the transformers by gravity with no extra equipment needed.

The transportation of the product from its use location to the disassembly point is assumed by a distance of 500 km by truck.

An additional 500km distance is assumed for the transportation of every disassembled material to their respective waste treatment location.

These modules include waste processing for reuse, recovery and/or recycling, and disposal. Transport, provision of all materials, products and related energy and water use is accounted for the waste treatment processes.
The following waste materials are sorted, recycled, and credited as secondary materials as benefits of the next product system:

- Copper
- Hot rolled steel
- Aluminum
- Stainless steel

The following materials are used for energy recovery processes and credited as secondary materials in thermal energy and electricity processes, the masses of each material going to the waste treatment are described on tables 12 to 16 :

- Plastics
- Oil
- Wood
- Paper
- Carboard

Table 12: Waste treatment of dismantled products from transformer FPT1842100

Material	Amount [kg]	Waste treatment	Waste treatment percentage [%]
Hot rolled steel	47499	Recycling	100
Oil	22000	Incineration	100
Copper	13708	Recycling	100
Wood	1802	Incineration	100
Cardboard	1462	Incineration	100
Aluminum	768	Recycling	100
Plastic	209	Incineration	100
Stainless steel	154	Recycling	100
Painting	431	Incineration	100

Table 13: Waste treatment of dismantled products from transformer FPT1843100

Material	Amount [kg]	Waste treatment	Waste treatment percentage [%]
Hot rolled steel	80534	Recycling	100
Oil	30000	Incineration	100
Copper	17566	Recycling	100
Wood	2384	Incineration	100
Cardboard	2673	Incineration	100
Aluminum	678	Recycling	100
Plastic	185	Incineration	100
Stainless steel	136	Recycling	100
Painting	637	Incineration	100

Table 14: Waste treatment of dismantled products from transformer FPT1844100

Material	Amount [kg]	Waste treatment	Waste treatment percentage [%]
Hot rolled steel	31729	Recycling	100
Oil	15100	Incineration	100
Copper	7683	Recycling	100
Wood	1854	Incineration	100
Cardboard	3458	Incineration	100
Aluminum	663	Recycling	100
Plastic	181	Incineration	100
Stainless steel	133	Recycling	100

Painting	225	Incineration	100

Table 15: Waste treatment of dismantled products from transformer FPT1845100

Material	Amount [kg]	Waste treatment	Waste treatment percentage [%]
Hot rolled steel	35033	Recycling	100
Oil	16600	Incineration	100
Copper	9766	Recycling	100
Wood	1381	Incineration	100
Cardboard	1674	Incineration	100
Aluminum	730	Recycling	100
Plastic	199	Incineration	100
Stainless steel	146	Recycling	100
Painting	225	Incineration	100

Table 16: Waste treatment of dismantled products from transformer FPT1846100

Material	Amount [kg]	Waste treatment	Waste treatment percentage [%]
Hot rolled steel	45602	Recycling	100
Oil	18900	Incineration	100
Copper	10240	Recycling	100
Wood	1986	Incineration	100
Cardboard	1603	Incineration	100
Aluminum	702	Recycling	100
Plastic	191	Incineration	100
Stainless steel	140	Recycling	100
Painting	431	Incineration	100

5 CONTENT DECLARATION

The transformers produced by Matelec contain the following materials and modules:

- Magnetic steel
    - Carbon reduced magnetic steel and Conventional magnetic steel: Two types of magnetic steels are used. The first type is a lower carbon intensity steel called “bluemint powercore”. This carbon-reduced steel is included in the 5 transformers; 4.14 tons are included in each of them.
- Insulating oil
- Copper conductor
- Hot rolled steel sheet
- Other metal
    - Materials or subcomponents made of smaller parts, with no electronic parts. Including parts made of stainless steel, AC DX steel tubes, and aluminum
- Accessories
    - Materials or subcomponents with electronic parts

The tables below (tables 17 to 21), specify the weight distribution in each of the 5 transformers.

Table 17: Material content for transformer FPT1842100

Materials	Material classes ID	Mass [kg]	Mass [%]
Magnetic steel	M-119	30874.06	34.81%
Insulating oil	M-410	22000.00	24.80%
Copper conductor	M-121	13270.00	14.96%
Steel sheet	M-100	11921.96	13.44%
Radiators	M-119	4048.00	4.56%
Wood	M-340	1801.97	2.03%
Insulation	M-341	1461.75	1.65%
Accessories[1]	Multiple[3]	1396.32	1.57%
Other metal[2]	Multiple[3]	655.11	0.74%
Painting	M-449	430.75	0.49%
Packaging – wood	M-340	358.93	0.40%
Copper connections	M-121	298.83	0.34%
Packaging – steel sheets	M-100	101.10	0.11%
Rest	Multiple[3]	92.71	0.09%
Total		**88695.93**	**100%**

1 Accessories includes materials or subcomponents with electronic parts.
2 Other metal includes parts made of stainless steel, AC DX steel tubes, and aluminum.
3 Multiple means the module contain various material compositions.

Table 18: Material content for transformer FPT1843100

Materials	Material classes ID	Mass [kg]	Mass [%]
Magnetic steel	M-119	49858.00	36.79%
Insulating oil	M-410	30000.00	22.14%
Steel sheet	M-100	22265.00	16.43%
Cooper conductor	M-121	17050.00	12.58%
Radiators	M-119	7536.00	5.56%
Insulation	M-341	2672.56	1.97%
Wood	M-340	2384.21	1.76%
Accessories[1]	Multiple[3]	1232.24	0.91%
Other metal[2]	Multiple[3]	875.12	0.65%
Painting	M-449	637.00	0.47%
Packaging – wood	M-340	422.19	0.31%
Copper connections	M-121	392.89	0.29%
Packaging – steel sheets	M-100	101.10	0.07%
Rest	Multiple[3]	98.84	0.05%
Total		**135509.59**	**100%**

1 Accessories includes materials or subcomponents with electronic parts.
2 Other metal includes parts made of stainless steel, AC DX steel tubes, and aluminum.
3 Multiple means the module contain various material compositions.

Table 19: Material content for transformer FPT1844100

Materials	Material classes ID	Mass [kg]	Mass [%]
Magnetic steel	M-119	18580.00	30.23%
Insulating oil	M-410	15100.00	24.57%
Steel sheet	M-100	10688.00	17.39%
Cooper conductor	M-121	7374.00	12.00%
Insulation	M-341	3458.08	5.63%
Radiators	M-119	1974.00	3.21%
Wood	M-340	1854.05	3.02%
Accessories[1]	Multiple[3]	1206.04	1.96%
Other metal[2]	Multiple[3]	487.41	0.79%
Painting	M-449	224.5	0.37%
Copper connections	M-121	188.53	0.31%
Packaging – wood	M-340	149.21	0.24%
Packaging – steel sheets	M-100	101.1	0.16%
Rest	Multiple[3]	67.52	0.11%
Total		**61452.44**	**100%**

1 Accessories includes materials or subcomponents with electronic parts.
2 Other metal includes parts made of stainless steel, AC DX steel tubes, and aluminum.
3 Multiple means the module contain various material compositions.

Table 20: Material content for transformer FPT1845100

Materials	Material classes ID	Mass [kg]	Mass [%]
Magnetic steel	M-119	20684.00	31.34%
Insulating oil	M-410	16600.00	25.15%
Steel sheet	M-100	10756.00	16.30%
Cooper conductor	M-121	9400.00	14.24%
Radiators	M-119	3030.00	4.59%
Insulation	M-341	1674.47	2.54%
Wood	M-340	1380.89	2.09%
Accessories[1]	Multiple[3]	1037.20	1.57%
Other metal[2]	Multiple[3]	563.16	0.85%
Packaging – wood	M-340	238.79	0.36%
Copper connections	M-121	232.92	0.35%
Painting	M-449	224.5	0.34%
Packaging – steel sheets	M-100	101.1	0.15%
Rest	Multiple[3]	69.43	0.11%
Total		**65992.46**	**100%**

1 Accessories includes materials or subcomponents with electronic parts.
2 Other metal includes parts made of stainless steel, AC DX steel tubes, and aluminum.
3 Multiple means the module contain various material compositions.

Table 21: Material content for transformer FPT1846100

Materials	Material classes ID	Mass [kg]	Mass [%]
Magnetic steel	M-119	27827.00	34.61%
Insulating oil	M-410	18900.00	23.50%
Steel sheet	M-100	13400.00	16.66%
Cooper conductor	M-121	9844.99	12.24%
Radiators	M-119	3744.00	4.66%
Wood	M-340	1986.34	2.47%
Insulation	M-341	1603.30	1.99%
Accessories[1]	Multiple[3]	1276.37	1.59%
Other metal[2]	Multiple[3]	631.28	0.79%
Painting	M-449	430.75	0.54%
Packaging – wood	M-340	329.79	0.41%
Copper connections	M-121	267.05	0.33%
Packaging – steel sheets	M-100	101.1	0.13%
Rest	Multiple[3]	69.48	0.09%
Total		**80411.46**	**100%**

1 Accessories includes materials or subcomponents with electronic parts.
2 Other metal includes parts made of stainless steel, AC DX steel tubes, and aluminum.
3 Multiple means the module contain various material compositions.

5.1 SUBSTANCES OF VERY HIGH CONCERN (SVHC)

The painting process involves the usage of powder paintings and coatings that contain the following hazardous substances:

Table 22: Hazardous substances contained in powder paintings and coatings

Hazardous substances	CAS number	Hazardous substances	CAS number
Polyurethane	9009-54-5	Hardener/Cross linker	12451-62-9
Ethyl acrylate	140-88-5	Barium sulfate	7727-43-7
Epoxy resin	25085-99-8	Additives	7631-86-9/119-53-9
Zinc phosphate	7779-90-0	Pigments	1333-86-4
Saturated Carboxylated Polyester resin	1860-26-0	Bisphenol A epichlorhydrin	25036-25-3
Xylene	1330-20-7	2-butoxyethanol	111-76-2
Ethylbenzene	100-41-4	Bisphenol-A-Epichlorhydrinharze	25036-25-3
Xylol	1330-20-7	Hexamethylene-1.6-diisocyanate homopolymer	28182-81-2
2-methoxy-1-methylethyl acetate	108-65-6	hexamethylene-di-isocyanate	822-06-0
2-methylpropan-1-ol	78-83-1	Bisphenol A epichlorhydrin	25036-25-3
1-methoxy-2-propanol	107-98-2	4-hydroxy-2,2,6,6-tetramethyl-1-piperidineethanol	59535-09-0
Toluene	108-88-3		

***None of the substances listed above are considered as substances of very high concern (SVHC) on REACH Candidate List published by the European Chemicals Agency.

6 ENVIRONMENTAL PERFORMANCE

6.1 TRANSFORMER FPT1842100

Table 23: Environmental impact: Results according to EN15804 + A2 (based on EF 3.1) of 1 FPT1842100 - 40/50 MVA 150/33KV (Assemini) transformer over 35 years RSL with 365 days operation

Parameter	Unit	Manufacturing: Upstream	Manufacturing: Core	Distribution stage	Installation stage	Use stage	End-of-life incl. de-installation stage
GWP total	kg CO_2-eq.	2,89E+05	1,01E+05	2,82E+03	2,49E+03	9,06E+06	1,37E+05
GWP fossil	kg CO_2-eq.	2,97E+05	9,93E+04	2,82E+03	1,89E+03	8,94E+06	1,34E+05
GWP biogenic	kg CO_2-eq.	-3,90E+03	4,07E+02	0,00E+00	5,76E+02	1,20E+05	2,92E+03
GWP luluc	kg CO_2-eq.	4,88E+02	8,64E+02	3,94E+00	1,76E+01	1,19E+03	4,54E+01
ODP	kg CFC-11-eq.	8,66E-07	1,17E-06	2,18E-10	2,28E-10	2,04E-04	9,76E-08
AP	mole of H^+-eq.	1,66E+03	9,60E+02	4,76E+01	1,91E+01	1,22E+04	1,80E+02
EP - freshwater	kg P eq.	6,05E-01	3,58E-01	2,08E-03	6,94E-03	5,00E+01	4,38E-02
EP - marine	kg N eq.	2,23E+02	4,80E+02	2,01E+01	9,63E+00	3,80E+03	8,32E+01
EP - terrestrial	mole of N eq.	2,39E+03	5,28E+03	2,20E+02	1,06E+02	4,17E+04	9,23E+02
POCP	kg NMVOC eq.	7,31E+02	1,31E+03	5,48E+01	2,62E+01	9,91E+03	1,92E+02
ADPE	kg Sb eq.	4,68E+01	3,49E-02	4,95E-05	1,24E-04	1,69E+00	1,26E-03
ADPF	MJ	4,31E+06	1,37E+06	3,46E+04	2,60E+04	1,37E+08	4,07E+05
WDP	m^3 world eq.	4,49E+04	1,75E+03	9,06E+00	8,62E+01	3,84E+06	6,55E+03

Caption	GWP = Global warming potential; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential of land and water; EP = Eutrophication potential; POCP = Formation potential of tropospheric ozone photo-chemical oxidants; ADPE = Abiotic depletion potential for non-fossil resources; ADPF = Abiotic depletion potential for fossil resources; WDP=Water user deprivation potential, deprivation-weighted water consumption

Table 24: Use of resources of transformer: Results according to EN15804 + A2 (based on EF 3.1) of 1 FPT1842100 - 40/50 MVA 150/33KV (Assemini) transformer over 35 years RSL with 365 days operation

Parameter	Unit	Manufacturing: Upstream	Manufacturing: Core	Distribution stage	Installation stage	Use stage	End-of-life incl. de-installation stage
PERE	[MJ]	6,15E+05	3,08E+05	5,45E+02	7,17E+03	1,28E+08	1,21E+05
PERM	[MJ]	6,44E+04	5,30E+03	0,00E+00	-5,30E+03	0,00E+00	-6,44E+04
PERT	[MJ]	6,80E+05	3,13E+05	5,45E+02	1,87E+03	1,28E+08	5,68E+04
PENRE	[MJ]	4,31E+06	1,37E+06	3,47E+04	2,60E+04	1,37E+08	4,16E+05
PENRM	[MJ]	9,24E+05	0,00E+00	0,00E+00	0,00E+00	0,00E+00	-9,24E+05

PENRT	[MJ]	4,32E+06	1,37E+06	3,47E+04	2,60E+04	1,37E+08	4,08E+05
SM	[kg]	8,67E+03	0,00E+00	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]	2,46E+03	1,34E+02	6,25E-01	3,53E+00	1,01E+05	1,78E+02

Caption	PERE = Use of renewable primary energy as energy carrier; PERM = Use of renewable primary energy as raw materials; PERT = Total use of renewable primary energy resources; PENRE = Use of Non-Renewable primary energy as energy carrier; PENRM = Use of Non-Renewable primary energy as raw materials; PENRT = Total use of Non-Renewable primary energy resources; SM = Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of Non-Renewable secondary fuels; FW = Use of net fresh water

Table 25: Output flows and waste categories: Results according to EN15804 + A2 (based on EF 3.1) of 1 FPT1842100 - 40/50 MVA 150/33KV (Assemini) transformer over 35 years RSL with 365 days operation

Parameter	Unit	Manufacturing: Upstream	Manufacturing: Core	Distribution stage	Installation stage	Use stage	End-of-life incl. de-installation stage
HWD	[kg]	4,29E-03	9,06E-05	1,11E-07	9,95E-08	1,87E-02	1,51E-05
NHWD	[kg]	2,51E+04	4,87E+02	3,52E+00	1,16E+02	1,54E+05	3,07E+04
RWD	[kg]	4,83E+01	4,43E+00	4,51E-02	4,20E-02	5,83E+03	7,91E+00
CRU	[kg]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
MFR	[kg]	0,00E+00	2,97E+03	0,00E+00	0,00E+00	0,00E+00	6,12E+04
MER	[kg]	0,00E+00	6,06E+02	0,00E+00	3,59E+02	0,00E+00	2,27E+04
EEE	[MJ]	0,00E+00	1,24E+03	0,00E+00	8,12E+02	0,00E+00	1,03E+05
EET	[MJ]	0,00E+00	2,23E+03	0,00E+00	1,46E+03	0,00E+00	1,84E+05

Caption	HWD = Hazardous waste disposed; NHWD = Non-hazardous waste disposed; RWD = Radioactive waste disposed; CRU = Components for re-use; MFR = Materials for recycling; MER = Materials for energy recovery; EEE = Exported electrical energy; EET = Exported thermal energy

6.2 TRANSFORMER FPT1843100

Table 26: Environmental impact: Results according to EN15804 + A2 (based on EF 3.1) of 1 FPT1843100 - 74/92MVA 150/33KV (Quartucciui) transformer over 35 years RSL with 365 days of operation time

Parameter	Unit	Manufacturing: Upstream	Manufacturing: Core	Distribution stage	Installation stage	Use stage	End-of-life incl. de-installation stage
GWP total	kg CO_2-eq.	4,65E+05	1,82E+05	4,21E+03	2,59E+03	1,51E+07	1,69E+04
GWP fossil	kg CO_2-eq.	4,78E+05	1,80E+05	4,22E+03	1,89E+03	1,49E+07	1,07E+05
GWP biogenic	kg CO_2-eq.	-4,53E+03	9,39E+02	0,00E+00	6,77E+02	2,00E+05	7,92E+03
GWP luluc	kg CO_2-eq.	7,08E+02	1,60E+03	5,09E+00	1,76E+01	1,98E+03	6,41E+01
ODP	kg CFC-11-eq.	1,32E-06	2,16E-06	3,20E-10	2,38E-10	3,39E-04	1,23E-07
AP	mole of H^+-eq.	2,36E+03	1,77E+03	7,26E+01	1,91E+01	2,02E+04	2,26E+02
EP - freshwater	kg P eq.	9,29E-01	6,60E-01	2,82E-03	6,95E-03	8,30E+01	5,78E-02
EP - marine	kg N eq.	3,57E+02	8,86E+02	3,06E+01	9,63E+00	6,31E+03	1,06E+02
EP - terrestrial	mole of N eq.	3,82E+03	9,76E+03	3,36E+02	1,06E+02	6,93E+04	1,16E+03
POCP	kg NMVOC eq.	1,15E+03	2,43E+03	8,35E+01	2,63E+01	1,65E+04	2,44E+02
ADPE	kg Sb eq.	5,92E+01	6,10E-02	6,91E-05	1,24E-04	2,81E+00	1,63E-03
ADPF	MJ	6,68E+06	2,45E+06	5,15E+04	2,60E+04	2,27E+08	5,16E+05
WDP	m^3 world eq.	5,84E+04	2,98E+03	1,26E+01	9,75E+01	6,38E+06	2,33E+03

Caption	GWP = Global warming potential; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential of land and water; EP = Eutrophication potential; POCP = Formation potential of tropospheric ozone photo-chemical oxidants; ADPE = Abiotic depletion potential for non-fossil resources; ADPF = Abiotic depletion potential for fossil resources; WDP=Water user deprivation potential, deprivation-weighted water consumption

Table 27: Use of resources: Results according to EN15804 + A2 (based on EF 3.1) of 1 FPT1843100 - 74/92MVA 150/33KV (Quartucciui) transformer over 35 years RSL with 365 days of operation time

Parameter	Unit	Manufacturing: Upstream	Manufacturing: Core	Distribution stage	Installation stage	Use stage	End-of-life incl. de-installation stage
PERE	[MJ]	9,70E+05	5,62E+05	7,33E+02	7,17E+03	2,12E+08	1,37E+05
PERM	[MJ]	6,44E+04	5,30E+03	0,00E+00	-5,30E+03	0,00E+00	-6,42E+04
PERT	[MJ]	1,03E+06	5,67E+05	7,33E+02	1,87E+03	2,12E+08	7,29E+04
PENRE	[MJ]	6,70E+06	2,45E+06	5,16E+04	2,61E+04	2,28E+08	1,78E+06
PENRM	[MJ]	1,26E+06	0,00E+00	0,00E+00	0,00E+00	0,00E+00	-1,26E+06
PENRT	[MJ]	6,71E+06	2,45E+06	5,16E+04	2,61E+04	2,28E+08	5,17E+05

SM	[kg]	1,46E+04	0,00E+00	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]	3,79E+03	2,28E+02	8,46E-01	3,79E+00	1,68E+05	8,74E+01

Caption	PERE = Use of renewable primary energy as energy carrier; PERM = Use of renewable primary energy as raw materials; PERT = Total use of renewable primary energy resources; PENRE = Use of Non-Renewable primary energy as energy carrier; PENRM = Use of Non-Renewable primary energy as raw materials; PENRT = Total use of Non-Renewable primary energy resources; SM = Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of Non-Renewable secondary fuels; FW = Use of net fresh water

Table 28: Output flows and waste categories: Results according to EN15804 + A2 (based on EF 3.1) of 1 FPT1843100 - 74/92MVA 150/33KV (Quartucciui) transformer over 35 years RSL with 365 days of operation time

Parameter	Unit	Manufacturing: Upstream	Manufacturing: Core	Distribution stage	Installation stage	Use stage	End-of-life incl. de-installation stage
HWD	[kg]	5,67E-03	1,63E-04	1,65E-07	1,00E-07	3,11E-02	1,98E-05
NHWD	[kg]	3,22E+04	8,66E+02	5,18E+00	1,18E+02	2,56E+05	3,50E+04
RWD	[kg]	7,42E+01	7,47E+00	6,63E-02	4,34E-02	9,68E+03	1,04E+01
CRU	[kg]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
MFR	[kg]	0,00E+00	1,18E+04	0,00E+00	0,00E+00	0,00E+00	9,85E+04
MER	[kg]	0,00E+00	9,27E+02	0,00E+00	4,22E+02	0,00E+00	3,56E+03
EEE	[MJ]	0,00E+00	1,94E+03	0,00E+00	9,55E+02	0,00E+00	9,95E+03
EET	[MJ]	0,00E+00	3,51E+03	0,00E+00	1,72E+03	0,00E+00	1,80E+04

Caption	HWD = Hazardous waste disposed; NHWD = Non-hazardous waste disposed; RWD = Radioactive waste disposed; CRU = Components for re-use; MFR = Materials for recycling; MER = Materials for energy recovery; EEE = Exported electrical energy; EET = Exported thermal energy

6.3 TRANSFORMER FPT1844100

Table 29: Environmental impact: Results according to EN15804 + A2 (based on EF 3.1) of 1 FPT1844100 - 18/23MVA 132/30KV (Fusina) transformer over 35 years RSL with 365 days of operation time

Parameter	Unit	Manufacturing: Upstream	Manufacturing: Core	Distribution stage	Installation stage	Use stage	End-of-life incl. de-installation stage
GWP total	kg CO_2-eq.	2,02E+05	4,48E+04	1,86E+03	2,14E+03	4,62E+06	7,02E+04
GWP fossil	kg CO_2-eq.	2,16E+05	4,42E+04	1,86E+03	1,89E+03	4,56E+06	6,72E+04
GWP biogenic	kg CO_2-eq.	-3,40E+03	1,76E+02	0,00E+00	2,41E+02	6,14E+04	2,98E+03
GWP luluc	kg CO_2-eq.	3,39E+02	3,89E+02	3,17E-02	1,76E+01	6,07E+02	3,04E+01
ODP	kg CFC-11-eq.	5,94E-07	5,26E-07	1,26E-10	1,94E-10	1,04E-04	2,64E-08
AP	mole of H^+-eq.	1,13E+03	4,34E+02	3,63E+01	1,91E+01	6,21E+03	7,59E+01
EP - freshwater	kg P eq.	5,25E-01	1,59E-01	4,22E-04	6,93E-03	2,55E+01	1,89E-02
EP - marine	kg N eq.	1,71E+02	2,16E+02	1,54E+01	9,61E+00	1,94E+03	3,56E+01
EP - terrestrial	mole of N eq.	1,82E+03	2,38E+03	1,68E+02	1,06E+02	2,13E+04	4,04E+02
POCP	kg NMVOC eq.	5,48E+02	5,90E+02	4,20E+01	2,62E+01	5,05E+03	7,25E+01
ADPE	kg Sb eq.	2,87E+01	2,92E-02	1,68E-05	1,24E-04	8,63E-01	4,98E-04
ADPF	MJ	3,10E+06	6,00E+05	2,24E+04	2,59E+04	6,98E+07	1,79E+05
WDP	m^3 world eq.	2,90E+04	9,21E+02	3,08E+00	4,87E+01	1,96E+06	5,95E+03

Caption	GWP = Global warming potential; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential of land and water; EP = Eutrophication potential; POCP = Formation potential of tropospheric ozone photo-chemical oxidants; ADPE = Abiotic depletion potential for non-fossil resources; ADPF = Abiotic depletion potential for fossil resources; WDP=Water user deprivation potential, deprivation-weighted water consumption

Table 30: Use of resources: Results according to EN15804 + A2 (based on EF 3.1) of 1 FPT1844100 - 18/23MVA 132/30KV (Fusina) transformer over 35 years RSL with 365 days of operation time

Parameter	Unit	Manufacturing: Upstream	Manufacturing: Core	Distribution stage	Installation stage	Use stage	End-of-life incl. de-installation stage
PERE	[MJ]	5,13E+05	1,42E+05	9,86E+01	4,05E+03	6,51E+07	8,40E+04
PERM	[MJ]	8,71E+04	2,20E+03	0,00E+00	-2,20E+03	0,00E+00	-6,46E+04
PERT	[MJ]	6,00E+05	1,44E+05	9,86E+01	1,85E+03	6,51E+07	1,94E+04
PENRE	[MJ]	3,10E+06	6,02E+05	2,24E+04	2,60E+04	6,98E+07	1,88E+05
PENRM	[MJ]	6,34E+05	0,00E+00	0,00E+00	0,00E+00	0,00E+00	-6,34E+05
PENRT	[MJ]	3,11E+06	6,02E+05	2,24E+04	2,60E+04	6,98E+07	1,80E+05
SM	[kg]	6,31E+03	0,00E+00	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]	1,66E+03	6,08E+01	1,30E-01	2,65E+00	5,17E+04	1,48E+02

Caption	PERE = Use of renewable primary energy as energy carrier; PERM = Use of renewable primary energy as raw materials; PERT = Total use of renewable primary energy resources; PENRE = Use of Non-Renewable primary energy as energy carrier; PENRM = Use of Non-Renewable primary energy as raw materials; PENRT = Total use of Non-Renewable primary energy resources; SM = Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of Non-Renewable secondary fuels; FW = Use of net fresh water

Figure 31: Output flows and waste categories: Results according to EN15804 + A2 (based on EF 3.1) of 1 FPT1844100 - 18/23MVA 132/30KV (Fusina) transformer over 35 years RSL with 365 days of operation time

Parameter	Unit	Manufacturing: Upstream	Manufacturing: Core	Distribution stage	Installation stage	Use stage	End-of-life incl. de-installation stage
HWD	[kg]	4,84E-03	3,95E-05	7,18E-08	9,76E-08	9,55E-03	-6,92E-07
NHWD	[kg]	1,56E+04	2,55E+02	2,05E+00	1,10E+02	7,85E+04	5,26E+03
RWD	[kg]	3,72E+01	1,83E+00	2,66E-02	3,71E-02	2,97E+03	3,69E+00
CRU	[kg]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
MFR	[kg]	0,00E+00	6,25E+03	0,00E+00	0,00E+00	0,00E+00	4,76E+04
MER	[kg]	0,00E+00	5,02E+02	0,00E+00	1,49E+02	0,00E+00	2,28E+04
EEE	[MJ]	0,00E+00	9,97E+02	0,00E+00	3,38E+02	0,00E+00	1,03E+05
EET	[MJ]	0,00E+00	1,80E+03	0,00E+00	6,09E+02	0,00E+00	1,85E+05

Caption	HWD = Hazardous waste disposed; NHWD = Non-hazardous waste disposed; RWD = Radioactive waste disposed; CRU = Components for re-use; MFR = Materials for recycling; MER = Materials for energy recovery; EEE = Exported electrical energy; EET = Exported thermal energy

6.4 TRANSFORMER FPT1845100

Table 32: Environmental impact: Results according to EN15804 + A2 (based on EF 3.1) of 1 FPT1845100 - 25/30MVA 132/30KV (Porto Tolle) transformer over 35 years RSL with 365 days of operation time

Parameter	Unit	Manufacturing: Upstream	Manufacturing: Core	Distribution stage	Installation stage	Use stage	End-of-life incl. de-installation stage
GWP total	kg CO_2-eq.	2,31E+05	6,18E+04	2,00E+03	2,29E+03	5,95E+06	6,72E+04
GWP fossil	kg CO_2-eq.	2,40E+05	6,10E+04	2,00E+03	1,89E+03	5,87E+06	6,72E+04
GWP biogenic	kg CO_2-eq.	-6,76E+02	2,82E+02	0,00E+00	3,84E+02	7,91E+04	1,19E+01
GWP luluc	kg CO_2-eq.	3,73E+02	5,40E+02	3,41E-02	1,76E+01	7,82E+02	3,20E+01
ODP	kg CFC-11-eq.	6,52E-07	7,29E-07	1,36E-10	2,09E-10	1,34E-04	2,61E-08
AP	mole of H^+-eq.	1,30E+03	6,00E+02	3,90E+01	1,91E+01	8,00E+03	7,50E+01
EP - freshwater	kg P eq.	4,96E-01	2,21E-01	4,53E-04	6,94E-03	3,28E+01	1,94E-02
EP - marine	kg N eq.	1,88E+02	3,00E+02	1,65E+01	9,62E+00	2,49E+03	3,53E+01
EP - terrestrial	mole of N eq.	2,01E+03	3,30E+03	1,81E+02	1,06E+02	2,74E+04	3,99E+02
POCP	kg NMVOC eq.	6,08E+02	8,19E+02	4,51E+01	2,62E+01	6,51E+03	7,17E+01
ADPE	kg Sb eq.	3,47E+01	3,10E-02	1,80E-05	1,24E-04	1,11E+00	5,06E-04
ADPF	MJ	3,40E+06	8,29E+05	2,40E+04	2,59E+04	8,99E+07	1,80E+05
WDP	m^3 world eq.	3,39E+04	1,17E+03	3,30E+00	6,47E+01	2,52E+06	5,61E+03

Caption	GWP = Global warming potential; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential of land and water; EP = Eutrophication potential; POCP = Formation potential of tropospheric ozone photo-chemical oxidants; ADPE = Abiotic depletion potential for non-fossil resources; ADPF = Abiotic depletion potential for fossil resources; WDP=Water user deprivation potential, deprivation-weighted water consumption

Table 33: Output flows and waste categories: Results according to EN15804 + A2 (based on EF 3.1) of 1 FPT1845100 - 25/30MVA 132/30KV (Porto Tolle) transformer over 35 years RSL with 365 days of operation time

Parameter	Unit	Manufacturing: Upstream	Manufacturing: Core	Distribution stage	Installation stage	Use stage	End-of-life incl. de-installation stage
PERE	[MJ]	4,85E+05	1,91E+05	1,06E+02	5,38E+03	8,38E+07	8,39E+04
PERM	[MJ]	6,44E+04	5,30E+03	0,00E+00	-3,52E+03	0,00E+00	-6,45E+04
PERT	[MJ]	5,49E+05	1,96E+05	1,06E+02	1,85E+03	8,38E+07	1,94E+04
PENRE	[MJ]	3,41E+06	8,31E+05	2,41E+04	2,60E+04	9,00E+07	1,88E+05
PENRM	[MJ]	6,97E+05	0,00E+00	0,00E+00	0,00E+00	0,00E+00	-6,97E+05
PENRT	[MJ]	3,42E+06	8,31E+05	2,41E+04	2,60E+04	9,00E+07	1,80E+05
SM	[kg]	6,34E+03	0,00E+00	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]	1,81E+03	8,14E+01	1,40E-01	3,02E+00	6,65E+04	1,40E+02

Caption	PERE = Use of renewable primary energy as energy carrier; PERM = Use of renewable primary energy as raw materials; PERT = Total use of renewable primary energy resources; PENRE = Use of Non-Renewable primary energy as energy carrier; PENRM = Use of Non-Renewable primary energy as raw materials; PENRT = Total use of Non-Renewable primary energy resources; SM = Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of Non-Renewable secondary fuels; FW = Use of net fresh water

Table 34: Output flows and waste categories: Results according to EN15804 + A2 (based on EF 3.1) of 1 FPT1845100 - 25/30MVA 132/30KV (Porto Tolle) transformer over 35 years RSL with 365 days of operation time

Parameter	Unit	Manufacturing: Upstream	Manufacturing: Core	Distribution stage	Installation stage	Use stage	End-of-life incl. de-installation stage
HWD	[kg]	3,97E-03	5,48E-05	7,71E-08	9,84E-08	1,23E-02	-7,03E-07
NHWD	[kg]	1,88E+04	3,20E+02	2,20E+00	1,13E+02	1,01E+05	5,19E+03
RWD	[kg]	3,85E+01	2,47E+00	2,85E-02	3,92E-02	3,83E+03	3,64E+00
CRU	[kg]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
MFR	[kg]	0,00E+00	7,71E+03	0,00E+00	0,00E+00	0,00E+00	4,75E+04
MER	[kg]	0,00E+00	5,65E+02	0,00E+00	2,39E+02	0,00E+00	2,27E+04
EEE	[MJ]	0,00E+00	1,14E+03	0,00E+00	5,40E+02	0,00E+00	1,03E+05
EET	[MJ]	0,00E+00	2,05E+03	0,00E+00	9,74E+02	0,00E+00	1,85E+05

Caption	HWD = Hazardous waste disposed; NHWD = Non-hazardous waste disposed; RWD = Radioactive waste disposed; CRU = Components for re-use; MFR = Materials for recycling; MER = Materials for energy recovery; EEE = Exported electrical energy; EET = Exported thermal energy

6.5 TRANSFORMER FPT1846100

Table 35: Environmental impact: Results according to EN15804 + A2 (based on EF 3.1) of 1 FPT1846100 - 32/40 MVA 132/30KV (Carpi) transformer over 35 years RSL with 365 days of operation time

Parameter	Unit	Manufacturing: Upstream	Manufacturing: Core	Distribution stage	Installation stage	Use stage	End-of-life incl. de-installation stage
GWP total	kg CO_2-eq.	2,77E+05	7,89E+04	4,00E+03	2,44E+03	7,30E+06	7,10E+04
GWP fossil	kg CO_2-eq.	2,86E+05	7,79E+04	4,03E+03	1,89E+03	7,20E+06	6,78E+04
GWP biogenic	kg CO_2-eq.	-4,08E+03	3,72E+02	0,00E+00	5,29E+02	9,70E+04	3,18E+03
GWP luluc	kg CO_2-eq.	4,25E+02	6,91E+02	1,47E+01	1,76E+01	9,59E+02	3,75E+01
ODP	kg CFC-11-eq.	7,93E-07	9,32E-07	3,72E-10	2,23E-10	1,65E-04	2,65E-08
AP	mole of H^+-eq.	1,43E+03	7,67E+02	5,02E+01	1,91E+01	9,81E+03	7,70E+01
EP - freshwater	kg P eq.	5,71E-01	2,82E-01	6,35E-03	6,94E-03	4,03E+01	2,16E-02
EP - marine	kg N eq.	2,17E+02	3,83E+02	2,11E+01	9,63E+00	3,06E+03	3,60E+01
EP - terrestrial	mole of N eq.	2,33E+03	4,22E+03	2,32E+02	1,06E+02	3,36E+04	4,09E+02
POCP	kg NMVOC eq.	7,02E+02	1,05E+03	5,72E+01	2,62E+01	7,98E+03	7,34E+01
ADPE	kg Sb eq.	3,57E+01	3,28E-02	1,27E-04	1,24E-04	1,36E+00	5,48E-04
ADPF	MJ	4,05E+06	1,06E+06	5,09E+04	2,60E+04	1,10E+08	1,89E+05
WDP	m^3 world eq.	3,56E+04	1,42E+03	2,32E+01	8,10E+01	3,09E+06	5,96E+03

Caption	GWP = Global warming potential; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential of land and water; EP = Eutrophication potential; POCP = Formation potential of tropospheric ozone photo-chemical oxidants; ADPE = Abiotic depletion potential for non-fossil resources; ADPF = Abiotic depletion potential for fossil resources; WDP=Water user deprivation potential, deprivation-weighted water consumption

Table 36: Use of resources: Results according to EN15804 + A2 (based on EF 3.1) of 1 FPT1846100 - 32/40 MVA 132/30KV (Carpi) transformer over 35 years RSL with 365 days of operation time

Parameter	Unit	Manufacturing: Upstream	Manufacturing: Core	Distribution stage	Installation stage	Use stage	End-of-life incl. de-installation stage
PERE	[MJ]	5,74E+05	2,43E+05	1,70E+03	5,39E+03	1,03E+08	8,45E+04
PERM	[MJ]	6,44E+04	5,30E+03	0,00E+00	-3,52E+03	0,00E+00	-6,44E+04
PERT	[MJ]	6,38E+05	2,48E+05	1,70E+03	1,86E+03	1,03E+08	2,01E+04
PENRE	[MJ]	4,06E+06	1,06E+06	5,10E+04	2,60E+04	1,10E+08	1,98E+05
PENRM	[MJ]	7,94E+05	0,00E+00	0,00E+00	0,00E+00	0,00E+00	-7,94E+05
PENRT	[MJ]	4,07E+06	1,06E+06	5,10E+04	2,60E+04	1,10E+08	1,90E+05
SM	[kg]	8,30E+03	0,00E+00	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]	2,22E+03	1,02E+02	1,89E+00	3,40E+00	8,16E+04	1,49E+02

Caption	PERE = Use of renewable primary energy as energy carrier; PERM = Use of renewable primary energy as raw materials; PERT = Total use of renewable primary energy resources; PENRE = Use of Non-Renewable primary energy as energy carrier; PENRM = Use of Non-Renewable primary energy as raw materials; PENRT = Total use of Non-Renewable primary energy resources; SM = Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of Non-Renewable secondary fuels; FW = Use of net fresh water

Table 37: Output flows and waste categories: Results according to EN15804 + A2 (based on EF 3.1) of 1 FPT1846100 - 32/40 MVA 132/30KV (Carpi) transformer over 35 years RSL with 365 days of operation time

Parameter	Unit	Manufacturing: Upstream	Manufacturing: Core	Distribution stage	Installation stage	Use stage	End-of-life incl. de-installation stage
HWD	[kg]	4,31E-03	1,61E-07	9,92E-08	1,95E-02	3,98E-07	-6,56E-07
NHWD	[kg]	2,56E+04	5,99E+00	1,15E+02	1,60E+05	1,66E+01	5,24E+03
RWD	[kg]	5,07E+01	7,53E-02	4,13E-02	6,07E+03	2,02E-01	3,70E+00
CRU	[kg]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
MFR	[kg]	4,34E+03	0,00E+00	0,00E+00	0,00E+00	0,00E+00	4,74E+04
MER	[kg]	6,06E+02	0,00E+00	3,30E+02	0,00E+00	0,00E+00	2,27E+04
EEE	[MJ]	1,36E+03	0,00E+00	7,46E+02	0,00E+00	0,00E+00	1,03E+05
EET	[MJ]	2,45E+03	0,00E+00	1,35E+03	0,00E+00	0,00E+00	1,84E+05

Caption	HWD = Hazardous waste disposed; NHWD = Non-hazardous waste disposed; RWD = Radioactive waste disposed; CRU = Components for re-use; MFR = Materials for recycling; MER = Materials for energy recovery; EEE = Exported electrical energy; EET = Exported thermal energy

7 LIFE CYCLE INVENTORY ANALYSIS - CHARACTERIZATION FACTORS AND METHODS USED

For all indicators the characterization factors from EC-JRC (http://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml) mentioned were applied. All LCIA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks.

The environmental parameters apply data based on the LCI describing the use of renewable and non-renewable material resources, renewable and non-renewable primary energy, and water.

The results from the impact assessment are only relative statements which give no information about the endpoint of the impact categories, exceeding threshold values, safety margins or risk.

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