

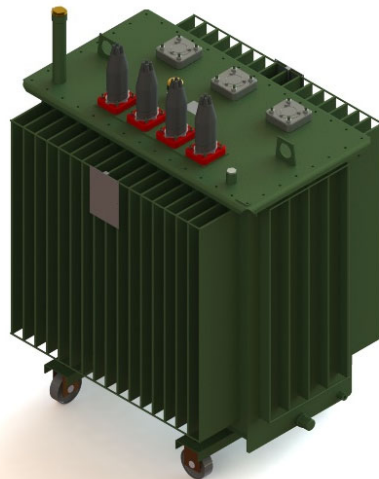


**Officine elettromeccaniche Vangone & C. S.r.l.**  
Sede e Stabilimento in Via Cervito, 49 – 84084 Fisciano (SA) - ITALY  
www.oevangone.it

## Environmental Product Declaration

In compliance with ISO 14025:2010 and EN 50693:2019

400 kVA mineral oil transformer, with primary voltage of 20 kV  
and secondary voltage of 0.42 kV, product name 400/20/SB/ET2  
ref. e-distribuzione GST001/1056 – 110081



Program operator	EPDItaly
Publisher	EPDItaly
Declaration number	400/20/SB/ET2
Registration number	EPDITALY0985
Issue date	2025-05-06
Valid until	2026-11-06



## GENERAL INFORMATION

EPD OWNER	
Company name and legal address	Officine elettromeccaniche Vangone & C. s.r.l. Via Cervito, 49 – 84084 FISCIANO (SA) – ITALY <a href="http://www.oevangone.it">www.oevangone.it</a>
Contact	Santino Pedone <a href="mailto:vangone.pedone@gmail.com">vangone.pedone@gmail.com</a>

PROGRAM OPERATOR	
EPDIItaly	via Gaetano De Castillia 10, 20124 Milano, Italy <a href="https://www.epditaly.it/">https://www.epditaly.it/</a> <a href="mailto:info@epditaly.it">info@epditaly.it</a>

EPD INFORMATION	
Product name	400/20/SB/ET2 (specific product EPD)
Site	Via Cervito, 49 – 84084 FISCIANO (SA) - ITALY
Short description of the product	400 kVA mineral oil transformer, with a primary voltage of 20 kV and a secondary voltage of 0.42 kV compliant with e-distribuzione Spa GST001/1056 – 110081
Product scope	Electric distribution network.
Product standards	<ul style="list-style-type: none"> <li>• IEC 60076</li> <li>• EU Regulation 548/2014 (tier 2)</li> <li>• E-distribuzione Spa GST001 Rev. 5</li> </ul>
CPC Code	46121

VERIFICATION INFORMATION	
PCR	<ul style="list-style-type: none"> <li>• EN 50693:2019</li> <li>• PCR: EPDIItaly007 Rev. 3.1</li> <li>• Sub-PCR: EPDIItaly018 Rev. 3.6</li> </ul>
EPD Regulation	Regolamento EPDIItaly 6.0
Project report LCA	LCA 400/20/SB/ET2 Rev. 2
Independent Verification/Validation statement	<p>This declaration has been developed in accordance with the EPDIItaly Regulations; further information and the Regulations themselves are available on the website: <a href="http://www.epditaly.it">www.epditaly.it</a></p> <p>EN 50693 is the framework reference for PCRs.</p> <p>The PCR revision was carried out by ICMQ S.p.a. <a href="mailto:info@epditaly.it">info@epditaly.it</a>.</p> <p>Independent verification of the declaration and data was carried out according to ISO 14025:2010.</p> <p><input type="checkbox"/> Internal <input checked="" type="checkbox"/> External</p> <p>Third party verification/validation performed by: SGS ICS Italia s.r.l. via Caldera, 21, 20153 – Milano <a href="https://www.sgs.com/it-it/">https://www.sgs.com/it-it/</a> Accreditato da Accredia con certificato n. 0005VV</p>

Comparability statement	Environmental declarations published within the same product category, but from different programs, may not be comparable. In particular, EPDs of similar products may not be comparable if they do not comply with the reference PCRs.
Responsibility statement	The EPD owner relieves EPDIItaly from any non-compliance with environmental legislation. The holder of the declaration will be responsible for the information and supporting evidence. EPDIItaly declines all responsibility for the manufacturer's information, data and results of the life cycle assessment.

## COMPANY PROFILE

Officine elettromeccaniche Vangone & C. S.r.l., abbreviated OEV, is an Italian company founded in 1979 and specialized in design and manufacturing of MV/LV liquid immersed transformers for electricity distribution. Since 1992 it implements a quality management system certified by IMQ in compliance to ISO 9001:2015 standard. Its transformers are developed and produced according to eco-design requirements and considering the environmental impact of its activities.



## PRODUCT DESCRIPTION

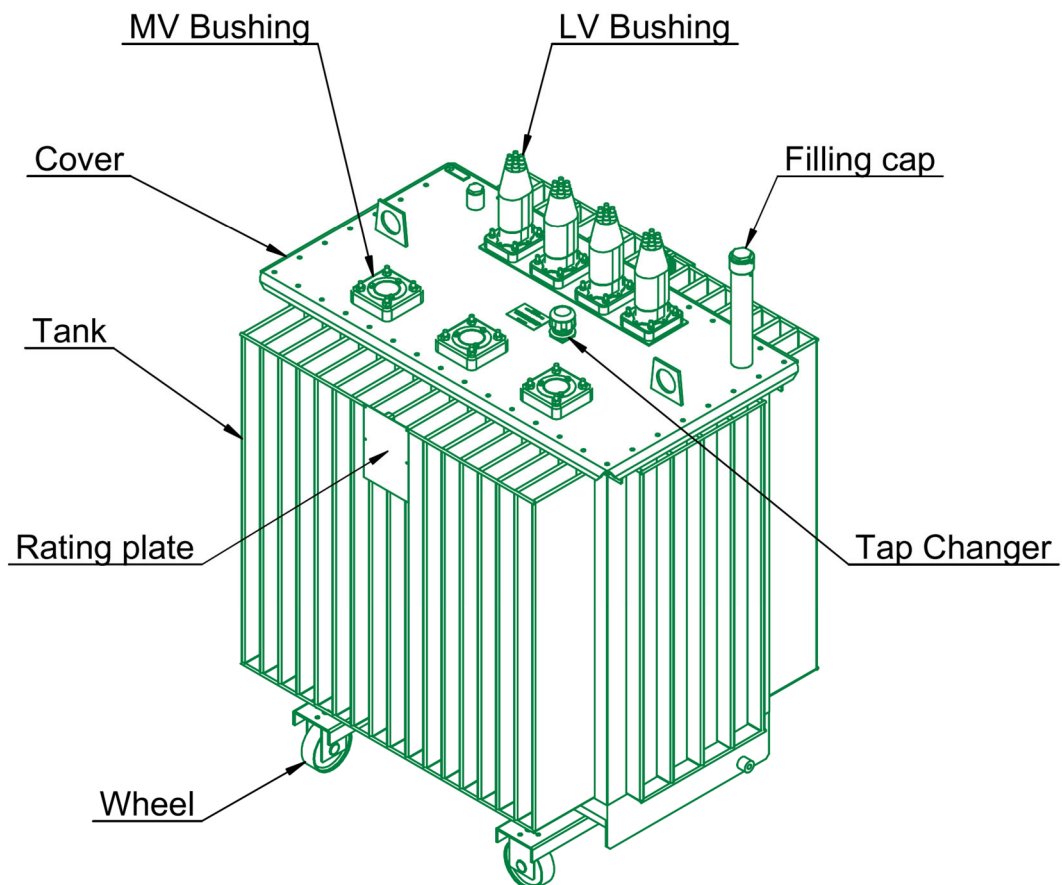
### General introduction

Distribution transformers are the last step in the transmission chain that bring electrical energy to final consumers. At the same time, they play an important role in smart grid systems to exchange the locally generated energy.

Distribution transformers are designed in compliance with IEC 60076 standard, European regulation EU 548/2014 (eco design requirements) and specifications of e-distribuzione Spa.

Type and special tests are performed under external supervision of third body, in order to validate the product in compliance with requirements.

The conformity to European standard is highlighted by CE marking stamped on the rating plate.



The main components involved in manufacturing process include: Magnetic core, windings, tightening clamps, tank, cover, tap changer, bushings, mineral oil and wheels.

### **Magnetic core (internal component)**

Magnetic core is made of hi permeability grain oriented (Fe-Si) magnetic steel sheets, cut with 45° angle in different widths and lengths and interleaved to form the desired section. Cutting and assembly processes are carried out by external suppliers located in Italy, according to OEV's design.

### **Windings (internal component)**

Secondary LV windings are made of aluminum sheet, wound in several layers, and primary HV windings are made of enameled aluminum wire, spirally wound in several layers. Paper sheets and tapes are interposed between layers to ensure electrical insulation and mechanical resistance. A final heat treatment is carried out in oven, to reduce humidity and to consolidate paper adhesive. The windings manufacturing and treatment took place in OEV's plant.

### **Tightening clamps (internal component)**

Magnetic core and windings are tight together and fixed to cover by nr. 4 clamps made of steel. Tightening clamps are manufactured by the supplier of magnetic core located in Italy, according to OEV's design.

### **Tank and cover**

The transformer external metal case consists of tank and cover, both made of steel sheets of various thicknesses (from 3 to 6 mm), cut, bended, drilled and assembled by electric arc welding. The external protective coating is applied after the sandblasting process. The painting cycle adopted complies with the specifications of the ISO 12944 standard, suitable for a high level of pollution (Heavy - C4), and it is guaranteed for a medium-long duration (Medium-High). Manufacturing and painting are carried out by external suppliers located in Italy, according to OEV's design.

### **Tap changer**

The tap changer is manufactured by external suppliers located in Italy, and it is made of thermoformed plastic components and of steel and copper parts finished by turning and milling process.

### **Bushings**

Bushings are manufactured by external suppliers located in Italy, according to main standards.

Primary MV bushings can be of the following types:

- Ceramic ins. with brass bushing M12 compliant with EN 50180 type 24-250 / P3;
- Epoxy resin inside cone compliant with ENEL GST001 Rev. 05 specification - Figure A.

Secondary LV bushings can be of the following types:

- Ceramic insulator with brass bushing M12 compliant with EN 50386, 250 A type 1.
- Ceramic insulator with brass bushing M20 compliant with EN 50386, 630 A type 3.
- Epoxy resin insulator with copper bus bar and external rubber cap compliant with the ENEL GST001 Rev. 5 specification - Figures B and C, suitable for internal use of the transformer.

See product datasheet for details.

### **Wheel**

The wheel is manufactured by external suppliers located in Italy, and it is made of metal finished by turning and milling process.

### **Transformer assembly**

Most of assembly operations are carried out by manual tools. Few operations require electrical device for lifting and moving components.

### **Mineral oil and transformer filling**

The mineral oil, produced by supplier located in Italy, is PCB free, compliant with European directives and registered in REACH database (as stated in safety datasheet provided by supplier).

After the sealing of the extractable part in the case, the transformer goes through a treatment done into a high vacuum chamber. The filling of the transformer took place inside the vacuum chamber with automatic dispensers, to avoid any contact with people and leaks in the environment.

Once filling is complete, a cap hermetically seals the tube on the cover.

The hermetic sealing keeps the liquid properties for the entire life cycle of the transformer.

The insulating liquid substitution have to be performed in manufacturing plant.

Monitoring and substitution of insulating liquid is not required by ordinary maintenance operations.

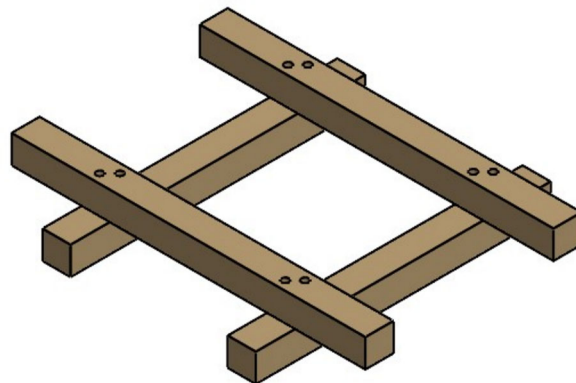
Extraordinary maintenance is performed only in case of transformer failure.

### **Final tests**

Final acceptance tests on transformer are carried out before delivery, in compliance with IEC 60076 standard.

### **Packaging**

The package is a pallet made of wooden beam (100x100mm) designed and manufactured by OEV for the specific transformer.



## PRODUCT DATASHEET

Constitutive materials and substances are defined according to the classification of the IEC 62474 standard.

<b>Datasheet – 400/20/SB/ET2</b>			
e-distribuzione GST001 Rev. 5 code type	GST001/1056 - 110081		
Power (kVA)	400		
Primary voltage (kV)	20		
Secondary voltage (kV)	0.42		
Primary bushing type	Epoxy resin – Inside cone GST001 Rev. 5		
Secondary bushing type	Epoxy resin – Busbar GST001 Rev. 5		
No load losses (kW)	0.387		
Load losses (kW)	3.250		
Total weight without package (Kg)	1825		
Package weight (Kg)	20		
Total weight including package (Kg)	1845		
Insulating liquid	Mineral oil		
Country of installation	Italy		
<b>Constitutive materials and substances</b>	<b>ID</b>	<b>Kg</b>	<b>%</b>
Stainless steel	M-100	1.0	0.1
Other ferrous alloys, non-stainless steels	M-119	1055.0	57.2
Aluminum and its alloys	M-120	338.6	18.4
Copper and its alloys	M-121	8.5	0.5
Ceramics	M-160	ND	ND
Other unfilled thermoplastics	M-249	0.7	< 0.1
Epoxy resin	M-302	5.6	0.3
NBR	M-320	1.2	0.1
Wood (for package)	M-340	20.0	1.1
Paper	M-341	90.5	4.9
Oil and gases (*)	M-410	324.0	17.6

(\*) The transformer under study do not contain dangerous substances of a high degree of concern (Substances of Very High Concern-SVHC) contemplated in the ECHA Candidate List (<https://echa.europa.eu/it/candidate-list-table>).

## LCA – Scope and rules

### Intended audience and goal

Through the LCA study and the subsequent EPD, the OEV intends to evaluate the environmental impacts of the specific product and communicate them to its business partners and customers.

### Declared unit

According to the Sub-PCR the declared unit is:

- One single piece of 400 kVA mineral oil transformer, with primary voltage of 20 kV and secondary voltage of 0.42 kV, product name 400/20/SB/ET2, operating for 35 years in Italy.

The reference unit is the mass in Kg.

Package is not included in the mass of declared unit.

### System Boundary and stages

For the declared unit, the System Boundary considered are from cradle to grave.

Life cycle stages (modules) have been classified according to EN 50693:2019 (Manufacturing, Distribution, Installation, Use and maintenance, End of life) and the EPDIItaly program regulation (Upstream, Core, Downstream).

Manufacturing		Distribution	Installation	Use and M.	End of life
Upstream	Core	Downstream			
<ul style="list-style-type: none"> <li>• Extraction of primary materials</li> <li>• production of raw materials and semifinished components</li> <li>• transport of raw materials and semifinished components</li> </ul>	<ul style="list-style-type: none"> <li>• production of windings and package</li> <li>• assembly operations</li> <li>• treatments and filling</li> <li>• waste handling and disposal</li> <li>• direct emissions</li> </ul>	<ul style="list-style-type: none"> <li>• transport to destination site</li> </ul>	<ul style="list-style-type: none"> <li>• unpacking and installation;</li> <li>• package disposal;</li> </ul>	<ul style="list-style-type: none"> <li>• Operation for 35 years</li> <li>• Maintenance</li> </ul>	<ul style="list-style-type: none"> <li>• Withdrawal;</li> <li>• Disassembly</li> <li>• Waste disposal or recovery</li> </ul>

### Exclusions from System Boundary

According to PCR and EN 50693:2019, impacts related to the production, transportation and installation of capital goods (buildings, infrastructure, machinery, internal transport packaging) and general operations (staff travel, marketing and communication actions) that cannot be directly allocated to products are excluded from the LCA study.

### Manufacturing upstream

The input flows of upstream stage have been sub-divided by main components of transformer.

All input and output flows are referred to mass in Kg.

Specific processes have been defined for each input flow, considering raw material extraction, manufacturing and transportation.

The transportation contribute is based on the average distance in Km upon suppliers of the same component in Italy.

Rating plates and filling cup are cut-off because they are less than 1% of total weight.

### **Manufacturing core**

The most important input of core stage is the electricity required by the equipment involved in the manufacturing operations. The amount of electricity, expressed in kWh, is defined recurring to measured data and internal expert judgments. The calculation has been performed selecting Italian mix for electricity.

The filling of the transformer took place inside the vacuum chamber with automatic dispensers, to avoid any leaks in the environment.

No direct emissions to air, water and land are determined by manufacturing process.

No water use is required by manufacturing process.

According to Sub-PCR following inputs and outputs are cut-off:

- Waste coming from raw material packaging;
- Waste coming from residues of manufacturing process (less than 1% of total mass).
- Direct emissions to air, water, land (not determined by manufacturing operations).

### **Distribution**

The specific product is distributed in Italy covering a max distance of 700 Km from the manufacturing site. This distance is considered in the calculation. Package (wooden pallet) is considered in this process, and the transport contribute is allocated by mass expressed in Kg.

According to PCR the type of transport selected is Euro 6 by lorry 16-32 t.

### **Installation**

The specific unit is installed in Italy.

Installation operations includes: unpacking, lifting, moving, positioning and cables mounting.

For the lifting and positioning of the product 1 hour of diesel devices have been considered.

A minimum quantity of electricity (1kWh) is added to cover the case when electric tools are used for cable mounting.

The disposal of the wooden package is considered 50% for energy recovery and 50% for municipal incineration, according to EN 50693:2019 table G.4.

**Use and maintenance**

Total energy consumed during 35 years has been calculated according to the formula defined in the Sub-PCR:

$$E_d[kWh] = [P_{load} * k^2_{load} + P_{noload}] * t_{year} * RSL + P_{aux} * f_{aux} * t_{year} * RSL$$

Where:

- $P_{load}$  are the load losses in kW, according to European regulation and customer requirements;
- $k$  is the load factor, fixed to 70% by the Sub-PCR;
- $P_{noload}$  are the no load losses in kW, according to European regulation and customer requirements;
- $t_{year}$  are the hours of service per year, fixed to 8760 by Sub-PCR;
- $RSL$  is the Reference Service Life, fixed to 35 years by Sub-PCR;
- $P_{aux}$  is the auxiliary devices consumption in kW, not required by distribution transformers;
- $f_{aux}$  is the auxiliary devices frequency % over 1 year, not required by distribution transformers;

Declared unit	$E_d[kWh]$	Unit	Note
One single piece of 400 kVA mineral oil transformer, with primary voltage of 20 kV and secondary voltage of 0.42 kV, product name 400/20/SB/ET2, operating for 35 years in Italy.	6.069E+05	kWh	$P_{load}$ = 3.250 kW $k$ = 0.7 $P_{noload}$ = 0.387 kW $t_{year}$ = 8760 $RSL$ = 35 years $P_{aux}$ = 0 kW $f_{aux}$ = 0

The declared unit have no auxiliary devices.

To calculate the LCI, the Italian specific electricity mix has been selected.

The hermetic sealing keeps the liquid properties for the entire life cycle of the transformer.

The insulating liquid substitution have to be performed in manufacturing plant.

Monitoring and substitution of insulating liquid is not required by ordinary maintenance operations.

Extraordinary maintenance is performed only in case of transformer failure.

Based on post-sales data, the failure rate is 1% of total transformers delivered. In all cases the failure was due to accidental damage of bushing. Transformer has been withdrawn to manufacturing plant and oil and bushing were replaced.

## End of life

According to Sub-PCR, end of life stage includes:

- Operation to remove the transformer from installation site in Italy;
- Transportation of transformer to collection site in Italy;
- Disassembly operations;
- Waste treatment process.

For the transformer removing operation is considered 1 h of diesel device for moving, lifting and positioning.

The transport distance and rules are the same applied for distribution stage (700 Km Euro 6 transport).

For disassembly operations is considered 40 kWh of energy consumption.

Waste treatment scenario, for constitutive material and substances, is according to EN 50693:2019 table G.4.

All materials and substances less than 1% of total weight are cut-off.

## Geographic and temporal reference

The LCA study is focused on the activities performed by OEV in Italy during 2023.

## Study limitations

The failure rate considered during use and maintenance is limited to the product warranty period, because information extended to 35 years of service is not available.

In absence of specific data for waste paper (M-341), the considered end of life scenario is: 100% disposal by municipal incineration.

## Cut-off

According to Sub-PCR, the following flaws and operations are cut off:

- Production, use and disposal of the packaging of components and semi-finished intermediates.
- Materials making up the transformer itself whose total mass does not exceed 1% of total weight of the device:
  - Plastic, rubber and epoxy resin waste flows outcoming end of life stage;
  - Rating plates and filling cap incoming in upstream stage;
  - Wire enameling;

Cut-off do not have significant impact on LCA results.

## Allocation criteria

In case of co-product, according to EN 50693:2019, when allocation cannot be avoided by subdivision, the allocation is based on attributional principle and referred to physical properties (mass in Kg).

In this study there are no co-product in any stage. No allocation rules were applied.

According to PCR, the Polluter Pays Principle is adopted to recovery operations.

Allocation of wastes is according to scenarios reported in table G.4 of EN 50693:2019, since no more specific data are available.

## Data quality

Generic data have been selected from the most updated version of the ecoinvent database.

Specific data have been selected from drawings, bill of materials and test reports of the specific product.

Data quality was assessed based on the following aspects:

- Precision: Variability of the data is assumed to be very low.
- Completeness: 99% of the material and energy flows were included in the study (see cut-off for excluded flows)
- Representativeness:
  - Temporal: Primary and secondary data are recent (< 5 years primary, < 10 years secondary);
  - Geographical: Primary data are specific to the site under examination and secondary data are comparable to similar cases;
  - Technological: Primary and secondary data fully represent the characteristics of the product under study.
- Consistency: both primary and secondary data collection was conducted consistently with the allocation methods, assumptions and data sources.

The quality of the data in this study can be considered good;

Some data available for the specific product are not complete or representative, because its production started less than 12 months ago. To have a representative database, the missing data have been selected from *similar* product delivered and installed in Italy in 2023.

According to Annex 5 of Regolamento EPDIItaly 6.0:

*The database used is considered representative on the basis of the representativeness analysis carried out with respect to the data of a similar product of the EPD Owner.*

## Impact assessment method (LCIA)

The impact indicators required by PCR, have been calculated in compliance to [EN 15804:2012+A2:2019](#), using a specific add-on to ecoinvent database developed by GreenDelta GmbH. The add-on for ecoinvent was reviewed and certified by Daxner & Merl GmbH in compliance to EN 15804 standard.

## Software and Tools

- openLCA ver. 2.4.1;
- ecoinvent database ver. 3.10;
- EN 15804 add-on to ecoinvent ver. 3.10;
- MS Office.

## LCA - Results

The following indicators, have been calculated according to EN 15804:2012+A2:2019.

Environmental impact indicators:

- Global warming potential (total) | GWP-total
- Global warming potential (fossil) | GWP-fossil
- Global warming potential (biogenic) | GWP-biogenic
- Global warming potential (land use) | GWP-luluc
- Ozone depletion potential | ODP
- Acidification potential | AP
- Eutrophication potential (freshwater) | EP-freshwater
- Eutrophication potential (marine) | EP-marine
- Eutrophication potential (terrestrial) | EP-terrestrial
- Photochemical ozone creation potential | POCP
- Abiotic depletion potential (elements) | ADP-minerals&metals
- Abiotic depletion potential (fossils) | ADP-fossil
- Water deprivation potential | WDP

Resource use indicators:

- Primary energy: Non-renewable (energy use) | PENRE
- Primary energy: Renewable (energy use) | PERE
- Primary energy: Non-renewable (material use) | PENRM
- Primary energy: Renewable (material use) | PERM
- Primary energy: Non-renewable (total) | PENRT
- Primary energy: Renewable (total) | PERT
- Net use of fresh water | FW
- Secondary materials | SM
- Renewable secondary fuels | RSF
- Non-renewable secondary fuels | NRSF

Waste and output flows indicators:

- Hazardous waste disposed | HWD
- Non-hazardous waste disposed | NHWD
- Radioactive waste disposed | RWD
- Materials for energy recovery | MER
- Materials for recycling | MFR
- Components for reuse | CRU
- Exported energy (thermal) | EET
- Exported energy (electrical) | EEE

Environmental impact indicators - 400/20/SB/ET2								
Indicator	Unit	Manufacturing		Distribution	Installation	Use and M.	End of life	Total
		Upstream	Core					
GWP-total	kg CO2 eq	6.822E+03	8.550E+01	2.407E+02	1.987E+02	2.519E+05	8.487E+02	2.601E+05
GWPF-fossil	kg CO2 eq	6.836E+03	7.838E+01	2.405E+02	1.640E+02	2.313E+05	7.041E+02	2.394E+05
GWP-biogenic	kg CO2 eq	-2.247E+01	7.105E+00	1.666E-01	3.466E+01	2.053E+04	1.445E+02	2.070E+04
GWP-luluc	kg CO2 eq	8.999E+00	1.017E-02	7.983E-02	1.495E-02	3.100E+01	1.022E-01	4.021E+01
ODP	kg CFC-11 eq	8.892E-05	1.705E-06	4.781E-06	2.480E-06	5.020E-03	7.784E-06	5.126E-03
AP	mol H+ eq	4.049E+01	2.719E-01	5.009E-01	5.839E-01	7.958E+02	1.181E+00	8.388E+02
EP-freshwater	kg P eq	3.035E+00	1.261E-02	1.629E-02	5.160E-03	3.677E+01	4.236E-02	3.988E+01
EP-marine	Kg N eq	6.708E+00	4.562E-02	1.203E-01	2.396E-01	1.343E+02	3.859E-01	1.418E+02
EP-terrestrial	Mol N eq	6.874E+01	4.901E-01	1.298E+00	2.627E+00	1.442E+03	4.178E+00	1.520E+03
POCP	kg NMVOC eq	2.545E+01	2.181E-01	8.324E-01	9.127E-01	6.471E+02	1.838E+00	6.764E+02
ADP-min&met (*)	kg Sb eq	1.685E-01	1.500E-04	8.000E-04	6.418E-05	4.472E-01	9.300E-04	6.176E-01
ADP-fossil (*)	MJ	9.401E+04	1.274E+03	3.383E+03	2.123E+03	3.751E+06	5.892E+03	3.857E+06
WDP (*)	m3 eq	2.264E+03	4.635E+01	1.654E+01	5.951E+00	1.343E+05	4.184E+01	1.366E+05
<b>Note</b>								
(*) The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experienced with the indicator.								

Resource use - 400/20/SB/ET2								
Indicator	Unit	Manufacturing		Distribution	Installation	Use and M.	End of life	Total
		Upstream	Core					
PENRE	MJ	8.967E+04	1.209E+03	3.068E+03	1.915E+03	3.554E+06	5.345E+03	3.656E+06
PERE	MJ	8.446E+03	4.285E+02	5.106E+01	1.465E+01	1.239E+06	1.479E+02	1.248E+06
PENRM	MJ	4.340E+03	6.582E+01	3.144E+02	2.085E+02	1.965E+05	5.474E+02	2.020E+05
PERM	MJ	4.640E+03	9.898E+00	7.021E+00	1.515E+00	2.874E+04	1.102E+01	3.341E+04
PENRT	MJ	9.401E+04	1.274E+03	3.383E+03	2.123E+03	3.751E+06	5.892E+03	3.858E+06
PERT	MJ	1.309E+04	4.384E+02	5.808E+01	1.617E+01	1.268E+06	1.590E+02	1.282E+06
FW	m3	5.302E+01	1.486E+00	4.546E-01	1.503E-01	4.304E+03	7.134E-01	4.360E+03
SM	Kg	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
RSF	MJ	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
NRSF	MJ	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
<b>Note</b>								

<b>Waste and output flows - 400/20/SB/ET2</b>								
Indicator	Unit	Manufacturing		Distribution	Installation	Use and M.	End of life	Total
		Upstream	Core	Downstream				
HWD	Kg	1.413E+03	8.394E-01	3.357E+00	1.923E+00	2.493E+03	8.409E+00	3.921E+03
NHWD	Kg	1.695E+04	8.224E+00	3.718E+01	2.425E+01	2.451E+04	7.085E+02	4.224E+04
RWD	Kg	1.370E-01	2.520E-03	1.090E-03	2.600E-04	7.308E+00	1.880E-03	7.450E+00
MER	Kg	6.352E-02	1.757E-02	4.900E-04	1.500E-04	5.078E+01	3.930E-03	5.086E+01
MFR	Kg	0.000E+00	0.000E+00	0.000E+00	1.362E+00	0.000E+00	1.332E+03	1.333E+03
CRU (*)	Kg	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.497E+01	0.000E+00	1.497E+01
EET	MJ	0.000E+00	0.000E+00	0.000E+00	5.212E-02	0.000E+00	0.000E+00	5.212E-02
EEE	MJ	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
<b>Note</b>								
(*) Value is not null in use and maintenance stage due to components recovery in case of transformer fault.								

## FINAL CONSIDERATIONS

The LCA results show that the most impactful life cycle stages are **Upstream** and **Use and maintenance**. Both of them depend by external and internal factors.

The geographic localization in Italy of suppliers, manufacturer and customers play a fundamental role in the reduction of impacts due to transport distance and the electricity mix available.

The compliance with European eco-design standards (EU 548/2014 tier 2) guarantees hi-efficiency (low losses) of the transformer over its operating life of 35 years.

Impacts due to maintenance operation are mitigated by hermetic sealing design and the manufacturing quality (low failure rate).

In the near future new trends open up further possibilities for reducing upstream impacts and increase the benefits from circular economy. More sustainable and high-performance magnetic steels are currently in phase of research and development and it is possible to detect a growing availability of conductors containing recycled material.

## REFERENCES

- ISO 14040:2006 – Environmental management – Life cycle assessment – Principles and framework;
- ISO 14044:2006 – Environmental management – Life cycle assessment – Requirements and guidelines;
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- EN 50693:2019: Product category rules for life cycle assessments of electronic and electrical products and systems;
- EN 15804:2012+A2:2019;
- Regolamento EPDIItaly 6.0:
- PCR: EPDIItaly007 Rev. 3.1 – Electronic and electrical products and systems;
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- EPDIItaly – <https://www.epditaly.it/> ;
- openLCA 2.4.1, developed by GreenDelta GmbH – <https://www.openlca.org/> ;
- ecoinvent 3.10 for openLCA – <https://nexus.openlca.org/database/ecoinvent> ;
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- Type A and B documents (drawing and bill of materials) of the specific product;
- Safety datasheet TRW/GL rev. 9.0 - Mineral oil supplied by RA.M.OIL Spa;
- PFC 001 Ed. 3 Rev. 0 – Detailed quality plan for MV/LV transformer manufacturing.