

MATELEC



ENVIRONMENTAL PRODUCT DECLARATION

Distribution Transformer 400 kVA FIT0400180 – 110081

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

In accordance with ISO 14025 and EN 50693:2019

Program Operator	EPDItaly
Publisher	EPDItaly

Declaration Number	EPD-IT-25-009
Registration Number	EPDITALY0933

Issue date	26 / 02 / 2025
Valid to	26 / 02 / 2030



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GENERAL INFORMATION

EPD OWNER	
Name of the company	Matelec SAL
Registered office	Matelec SAL 59, Matelec Sal, Matelec Building, Ghorfine Jbeil Lebanon
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PROGRAM OPERATOR	
EPDItaly	Via Gaetano De Castillia nº 10 - 20124 Milano, Italy
INFORMATION ON THE EPD	
Product name (s)	Transformer FIT0400180 - 110081
Site (s)	Matelec SAL 59, Matelec Sal, Matelec Building, Ghorfine Jbeil Lebanon
Short description and technical information of the product (s)	The functional unit for this study refers to the operation of each transformer under ONAN power conditions, over 30 years RSL, 365 days per year, 24 hours per day. The ONAN power values are: 400 kVA transformer
Field of application of the product (s)	Electronic and Electrical Products and Systems
Product (s) reference standards (if any)	Cradle to Grave
CPC Code (number)	46121 – Electrical transformers
https://unstats.un.org/unsd/classifications/Econ	
VERIFICATION INFORMATION	
PCR (title, version, date of publication or update)	PCR EPDItaly 007, PCR for electronic and electrical prod-ucts and systems – Rev. 3.1 subPCR: EPDItaly018 - ELECTRONIC AND ELECTRI-CAL PRODUCTS AND SYSTEMS - POWER TRANS-FORMERS, Rev 3.6, 01/07/2029.
EPDItaly Regulation (version, date of publication or update)	EPDItaly Regulations Rev 6.0 PCR EPDItaly007 v.3.1 man-datory from 20/01/2020
Project Report LCA	Environmental Product Declaration of distribution transformer FIT0400180



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 compa-rable.			
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 sup-porting evidence.			
	EPDItaly disclaims any responsibility for the information, data and results provided by the EPD Owner for life cycle assessment.			



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, Matelec ensures that priority is given to ES&H issues in the planning and execution of all work activities.



2 PRODUCTS DESCRIPTION

Distribution transformers convert high network voltages to medium or low network voltages, so electricity can be transmitted more safely to the final consumers. The FIT0400180 Oil immersed, three phase ONAN transformer 400 KVA 20/0.42 KV.

<u>Geographical scope</u>: The transformer studied will be installed in Italy.

The nominal weight of the transformer is 1775 kg.

Table 1: Nominal weight of the transformer

Transformer name	Description	Nominal weight, shown on the plate [kg]
FIT0400180	400 KVA 20/0.42 KV	1775



3 FUNCTIONAL UNIT

Functional unit is the operation under ONAN power conditions, over 35 years reference service life, 365 days per year, 24 hours per day.

Reference service life:

35 years

Time representativeness:

The data collection for materials in the products is representative of the year 2024.

The data collection for energy and consumables used during manufacturing is representative of 2024.

Geographical representativeness:

The upstream processes for the components and assembly are representative to Lebanon.

The energy consumption during the use stage is representative to Italy.

Allocation:

This EPD considers that the transformer uses the entire given amount of input raw materials for each production process defined. 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 2024. 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 transformer studied. Modularity and polluter payer principles have been followed.

Cut-off criteria:

The DIN EN 15804+A2 (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.

The transportation of personnel to the plant: transportation of personnel within the plant, research and development activities & long-term emissions were also excluded in this study.

Database(s) and LCA software:

The LCA underlying this EPD has been performed using a dedicated parametric LCA model provided by the external practitioner Sphera Solutions Inc., registered at 130 E Randolph St #2900, Chicago, IL 60601, United States. This parametric model has been developed in 2023 to represent the potential environmen-tal impacts of product produced by Matelec and to produce LCA results that are conform to the require-ments of the EPD product category rules of EPDItaly for transformers (Core PCR EPDItaly 007 Electronic and electrical prod-ucts and systems – Rev3.1, 2026-01-19, Sub-PCR EPDItaly 018 Electronic and electrical products and systems – Power transformers, v3.6, 2029-07-01). The parametric LCA model is made available to Matelec via the software solution licensed by Sphera and named LCA Calculator. This cloud-based software (software as a service) allows users to input parameter values of the LCA model and gen-erate the corresponding LCA results. This software does not allow users to make any amendments to the model itself. More information on the software solution LCA Calculator here.

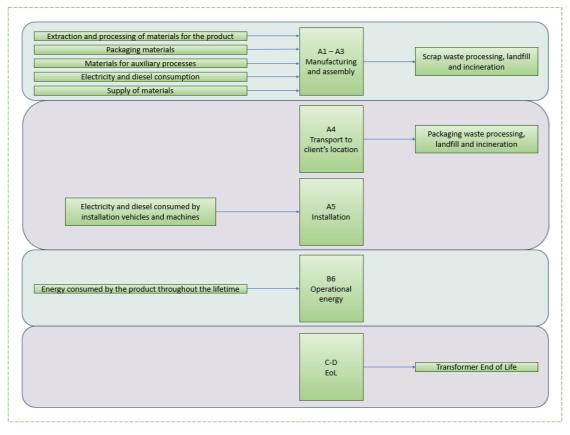
The LCA model itself has been developed on Sphera's premises using the software solution LCA For Ex-perts Version 10.9 and the Managed LCA Content Database version CUP2023.2. The model has been transferred to the LCA Calculator software environment by Sphera's delivery product delivery services on January 20th, 2025

The parametric LCA model is presented in more detail in section 3 "Parametric LCA model".



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

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

4.1 MODULES DECLARED

Table 2: Modules of the production life cycle included in the EPD according to PCR EDPItaly007 and consistent with EN 50693:2019 (X = declared module; MND = module not declared)

·	Manufacturing stage		Distribution Installation		Use &	End-Of-	Benefits &
Phases	Upstream	Core	stage	stage	maintenance stage	Life stage	
Phases declared	Х	Х	х	Х	Х	х	MND
Data quality indicator	%				80		

4.2 MANUFACTURING

In the manufacturing stage, all processes involved in the production of the transformer 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 product considers the truck transport from Matelec plant in Ghorfine, Lebanon to the Port of Beirut 40 km away, then 2955.7 km from the transatlantic distance to Italy & 227 km by truck to Rome.



Installation

The installation stage (A4-A5) of a transformer involves:

- transporting the transformer from the assembly site to its place of installation
- use of machinery (cranes and forklifts) in the installation process.
- packaging disposal and the corresponding waste treatment for each packaging material.

The parametric model allows users to specify the following parameters:

- distance travelled by ship and truck
- Diesel consumed by forklift
- Electricity for operating a 220-tons crane
- Electricity for operating a 5-tons crane
- Electricity for operating an oil treatment machine

The steel is recycled, and the wood is incinerated with energy recovery at a waste incineration

4.4 USE

Only 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 point of the transformer in Italy.

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 energy used is calculated following the equation according to PCR EPDItaly018, 2021:

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

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)

Paux = 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 this transformer used in the equation are described below:

Table 3: Parameters used in the equation for energy use.

Transformer name	Pload [kW]	kload	Pnoload [kW]	tyear [h]	RSL [years]	Paux * faux * tyear * RSL
FIT0400180	3.25	0.7	0.387	8760	35	0

The calculated Ed value is 606,914.70 kWh.



4.5 DISASSEMBLY AND EOL

The disassembly of the transformer uses a 75-ton crane. The electricity used by the crane is the only deconstruction 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

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
- 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 4: Waste treatment of dismantled products from transformer FIT0400180

Material	Amount [kg]	Waste treatment	Waste treatment percentage [%]
Steel	1108.12	Recycling	100
Aluminum	318.69	Recycling	100
Oil	313.00	Incineration	100
Cardboard	31.77	Incineration	100
Wood	18.13	Incineration	100
Painting	3.42	Incineration	100

5 CONTENT DECLARATION

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

- Magnetic steel
- Insulating oil
- Aluminum conductor
- Hot rolled steel sheet
- Other materials
 - o Materials or subcomponents made of smaller parts, with no electronic parts



The table 5 below, specify the weight distribution in the FIT0400180 transformer.

Table 5: Material content for transformer FIT0400180

Materials	Mass [kg]	Percentage from total weight	
Magnetic steel	840.30	47.34%	
Aluminum	318.69	17.95%	
Oil	313.00	17.63%	
Steel	259.52	14.62%	
Cardboard	31.77	1.79%	
Other	8.30	0.47%	
Painting	3.42	0.19%	
True weight	1775.00	100.00%	

[&]quot;Other" includes random sub-items that were omitted & do not impact the results as per the allocation rules of the associated PCRs.

No substance in the product greater than 0.10% by weight is present on the "List of Potentially Hazardous Substances" (SVHC in English) candidates for authorization under the REACH legislation.

5.1 SUBSTANCES OF VERY HIGH CONCERN (SVHC)

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

Table 22: Environmental impact: 1 FIT0400180 - 400 KVA 20/0.42 KV transformer over 35 years RSL with 365 days operation

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 FIT0400180

Table 23: Environmental impact: 1 FIT0400180 - 400 KVA 20/0.42 KV transformer over 35 years RSL with 365 days operation

rabic 25: Environmental impacti 2 i i i	- 100 E00 100 101 11 E07 1		or or yours not more	oce ways operation		
Parameter	Unit	Manufacturing stage	Distribution stage	Installation stage	Use stage	End-of-life incl. de- installation stage
ADPE	kg Sb eq.	2.49E-02	4.73E-06	2.83E-06	4.07E-02	2.48E-05
ADPF	MJ	1.13E+05	1.18E+03	4.30E+02	3.36E+06	3.70E+03
AP	mole of H+-eq.	3.17E+01	1.11E+00	1.91E-01	3.97E+02	1.84E+00
EP - freshwater	kg P eq.	8.80E-03	1.88E-04	1.38E-04	1.32E+00	1.08E-03
EP - marine	kg N eq.	8.48E+00	4.66E-01	9.22E-02	9.10E+01	7.38E-01
EP- terrestric	mole of N eq.	9.24E+01	5.12E+00	1.03E+00	1.10E+03	8.48E+00
GWP - biogenic	Kg CO2 eq.	-1.36E+02	1.45E-01	2.91E+01	3.15E+03	7.98E+01
GWP - fossil	Kg CO2 eq.	8.37E+03	9.60E+01	3.26E+01	2.29E+05	1.15E+03
GWP - Iuluc	Kg CO2 eq.	1.14E+01	6.83E-01	5.38E-01	3.37E+01	3.77E+00
GWP - total	Kg CO2 eq.	8.25E+03	9.68E+01	6.22E+01	2.32E+05	1.24E+03
ODP	Kg CFC-11 eq.	2.51E-08	1.02E-11	8.47E-12	5.61E-06	6.70E-10
POCP	kg NMVOC eq.	2.55E+01	1.27E+00	2.49E-01	2.40E+02	1.48E+00
WDP	m³ world eq.	1.28E+03	7.28E-01	3.76E+00	1.05E+05	8.92E+01

Caption

GWP = Global warming potential; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification po-tential 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: 1 FIT0400180 - 400 KVA 20/0.42 KV transformer over 35 years RSL with 365 days operation

Parameter	Unit	Manufacturing stage	Distribution stage	Installation stage	Use stage	End-of-life incl. de- installation stage
FW	[m3]	8.66E+01	5.52E-02	1.17E-01	2.75E+03	2.41E+00
PENRE	[MJ]	9.88E+04	1.18E+03	4.30E+02	3.36E+06	3.45E+03
PENRM	[MJ]	1.41E+04	0.00E+00	0.00E+00	0.00E+00	2.58E+02
PENRT	[MJ]	1.13E+05	1.18E+03	4.30E+02	3.36E+06	3.70E+03
PERE	[MJ]	2.83E+04	4.92E+01	3.65E+02	3.47E+06	9.10E+02
PERM	[MJ]	8.98E+02	0.00E+00	-3.26E+02	0.00E+00	-2.59E+02
PERT	[MJ]	2.92E+04	4.92E+01	3.87E+01	3.47E+06	6.51E+02
SM	[kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

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; RSF = Use of Non-Renewable secondary fuels; FW = Use of net fresh water



Table 25: Output flows and waste categories: 1 FIT0400180 - 400 KVA 20/0.42 KV transformer over 35 years RSL with 365 days operation

Parameter	Unit	Manufacturing stage	Distribution stage	Installation stage	Use stage	End-of-life incl. de- installation stage
EEE	[MJ]	0.00E+00	0.00E+00	4.10E+01	0.00E+00	8.89E+01
EET	[MJ]	0.00E+00	0.00E+00	7.39E+01	0.00E+00	1.61E+02
HWD	[kg]	5.22E-05	4.05E-08	2.10E-08	3.08E-03	9.31E-07
MER	[kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.64E+01
MFR	[kg]	9.87E+01	0.00E+00	0.00E+00	0.00E+00	1.40E+03
NHWD	[kg]	1.29E+03	1.49E-01	1.30E+01	3.88E+03	3.36E+02
RWD	[kg]	2.18E+00	1.72E-03	1.18E-03	1.32E+02	8.32E-02

	HWD = Hazardous waste disposed; NHWD = Non-hazardous waste disposed; RWD = Radioactive waste disposed; CRU = Components
Caption	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.



8 References

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Managed LCA

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REGOLAMENTO

EPDITALY V.6

Regolamento del Programma EPDItaly. Data di emissione: 30/10/2023

LCA REPORT:

MATELEC_LCA_FIT040 0180-110081 Final version 11/02/2025