KONČAR DISTRIBUTION AND SPECIAL TRANSFORMERS

ENVIRONMENTAL PRODUCT DECLARATION

400 kVA Distribution transformers

DT2656-1 (110062) and DT2656 (110082)

produced in Končar D&ST, Josipa Mokrovića 8, 10090 Zagreb, Croatia

in accordance with ISO 14025 and EN 50693

Program Operator	EPDItaly
Publisher	EPDItaly

Declaration Number	IT22/99000408
Registration Number	EPDITALY0320

Issue Date	26/04/2022
Valid to	25/04/2027

EPD owner
Končar D&ST

Production site
Josipa Mokrovića 8, 10090 Zagreb, Croatia

Product
400 kVA Distribution transformers: DT2656-1(110062) and DT2656 (110082) - with CPC code 46121

Declared unit
One 400 kVA Oil immersed Distribution Transformer with a primary voltage of 20 kV and a secondary voltage of 0,42 kV, operating for 35 years in Europe.

Verification
This declaration has been developed referring to EPD Italy, following the General Program Instruction; further information and the document itself are available at: www.epditaly.it.

Independent verification of the declaration and data, according to EN ISO 14025:2010.
☐ INTERNAL ☒ EXTERNAL

Third party verifier: SGS Italy S.p.A., Via Colombara, 115, 30176 Venezia VE, Italy (with Accreditation Certificate n° 006H).

This life cycle assessment was conducted in accordance with ISO 14025 and the reference PCR by: SGS Search Ingenieursbureau BV, Petroleumhavenweg 8, 1041 AC Amsterdam, Netherlands

Accountability/ responsibilty
Končar D&ST releases EPD Italy from any non-compliance with environmental legislation self-declared by the manufacturer. The holder of the declaration will be responsible for the information and supporting evidence; EPD Italy declines all responsibility for the manufacturer's information, data and results of the evaluation of the life cycle of the product.

Scope of declaration
This EPD is based on an LCA study of Končar's 400 kVA DT2656-1 and DT2656 distribution transformers [1] for which 2021 is the refence year. The objective of this study was to publish third party verified data about the environmental performance of this product via an EPD. It concerns a Cradle-to-Grave study with 2021 as base year and that is compiled according to the following standards: EN 50693 [2], ISO14040 [3], ISO 14044 [4] and ISO 14025 [5]. In addition to the EPDItaly007 - Core PCR for electronic and electrical products and systems, Rev 2 (21/10/2020) [6], PCR EPD Italy018– Power transformers v3.5 [7] and Regulations of the EPDItaly Programme, Rev. 5.0 [10] were used.

It should be noted that EPDs relating to the same category of products but belonging to different programs may not be comparable.

Scope and type

Manufacturing stage		Distribution stage	Installation stage	Use & Maintenance stage	End-of-life stage De-installation
Upstream module	Core module	Downstream module			
X		X	X	X	X

X = module assessed

Visual product

Description of product

International Electrotechnical Vocabulary defines a transformer as a static piece of apparatus with two or more windings which, by electromagnetic induction, transforms a system of alternating voltage and current into another system of voltage and current, usually of different values and at the same frequency for the purpose of transmitting electrical power [8]. Distribution transformers are used in distribution networks in order to transmit energy from the medium voltage (MV) network to the low voltage (LV) network of the consumers [9]. The rated power of the transformer is 400 kVA and the primary voltage is 20 kV, while the secondary voltage is 0,42 kV.
According to the type of cooling the transformer is defined as KNAN.

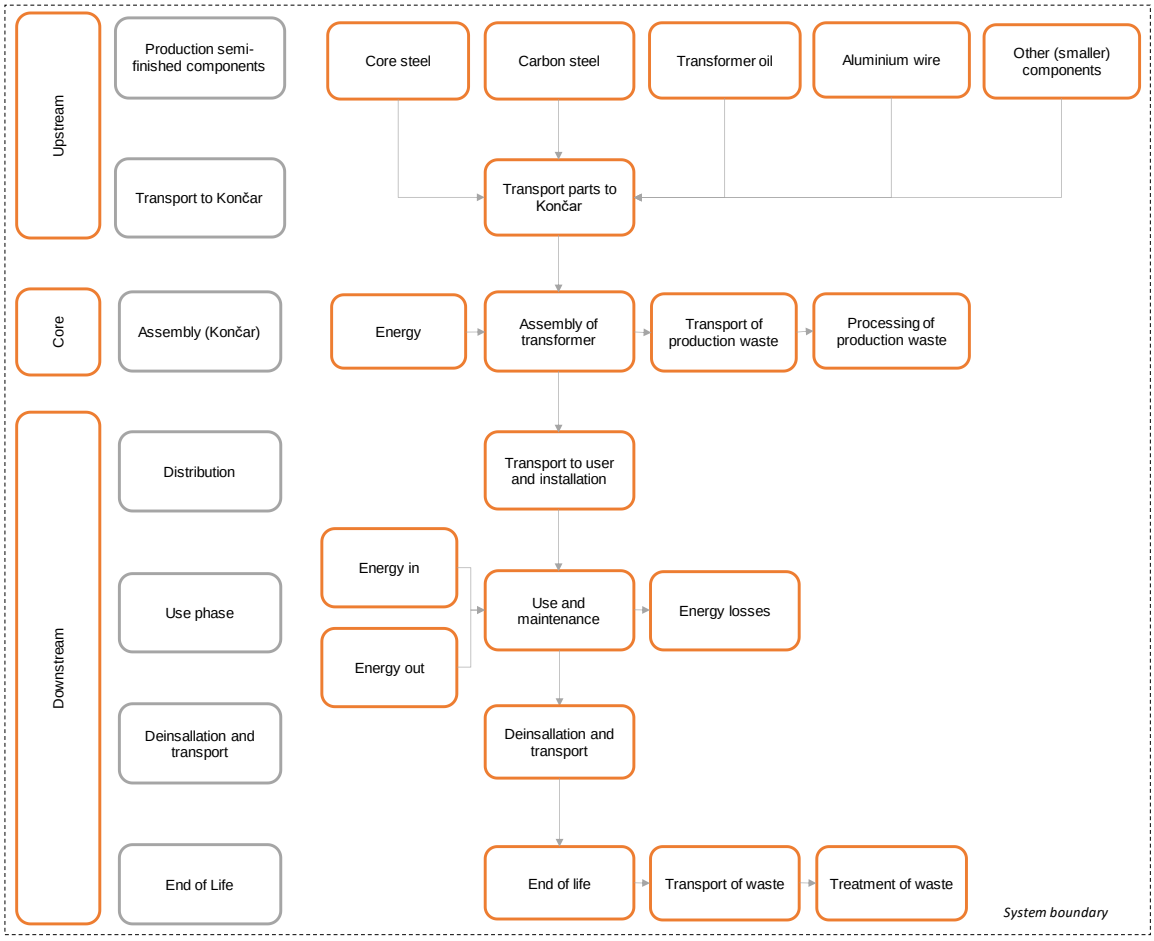
The total weight of both transformers (excl. packaging) is 1731 kg.

More information

https://koncar-dst.hr/en/

Product Life Cycle

The figure below displays a schematic overview of the product's life cycle.



Detailed product description

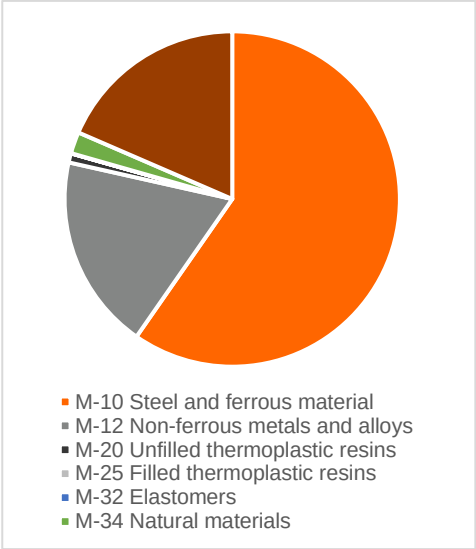
The declared unit comprises Cradle-to-Grave data for specific products from one plant and one manufacturer. Distribution transformer is produced at Končar D&ST production/assembly facility in Zagreb, Croatia.

The reference flows considered are all materials, packaging and energy flows to produce, use and dispose one oil immersed distribution transformer.

Both declared transformers have the same composition. The type of insulation oil is, however, different. The DT2656-1 transformer in this declaration uses a synthetic ester oil whereas the DT2656 uses a natural ester oil. The table and figure below show the composition according to the IEC 62474 material classes.

Material	Mass (kg)	Percentage (%)
1 inorganic materials	**1358**	**79%**
M-10 Steel and ferrous material	1032	60%
M-100 stainless steel	*6*	*0%*
M-119 Other ferrous alloys	*1026*	*59%*
M-12 Non-ferrous metals and alloys	326	19%
M-120 Aluminium and its alloys	*323*	*19%*
M-121 Copper and its alloys	*3*	*0%*
2 organic materials	**372**	**21%**
M-20 Unfilled thermoplastic resins	15	0,9%
M-25 Filled thermoplastic resins	0,03	0,0%
M-32 Elastomers	0,3	0,0%
M-34 Natural materials	36	2,1%
M-340 Wood	*8*	*0,4%*
M-341 Paper	*28*	*1,6%*
M-39 Other organics*	320	19%

**Transformer oil is added in this category*



Specifications of the declared products are presented in the table below.

Type	Rated power	Rated Primary voltage	Rated Secondary voltage	Type of cooling	Connection Symbol	Total weight of product	Total weight of packaging	Oil type
DT2656-1 (110062)	400 kVA	20 kV	0,42 kV	KNAN	Dyn11	1731 kg	24 kg	Synthetic ester
DT2656 (110082)	400 kVA	20 kV	0,42 kV	KNAN	Dyn11	1731 kg	24 kg	Natural ester

Representativeness

One product from one supplier, with reference year 2021. The declaration is valid for the European market.

Environmental impact, resource use and output flows

Environmental impacts are calculated with SimaPro 9.1 LCA software using the Ecoinvent 3.6 database (cut-off system model). For characterization the guidelines from the EN 15804:2012+A2:2019 are followed in conformity with the guidelines from the PCR for transformers from EPD Italy.

DT2656-1 (110062)

Environmental impact per declared unit of the DT2656-1 (110062)

Indicator	Unit	Total	Upstream	Core	Distribution	Installation	Use	End-of-life
Climate change	kg CO_2 eq	2,76E+05	1,03E+04	109,25403	2,39E+02	4,71E+01	2,65E+05	4,47E+02
Climate change - Fossil	kg CO_2 eq	2,66E+05	8,78E+03	70,663675	2,39E+02	2,20E+01	2,56E+05	3,03E+02
Climate change - Biogenic	kg CO_2 eq	8,74E+03	5,66E+02	38,569729	1,74E-01	2,51E+01	7,96E+03	1,44E+02
Climate change - Land use and LU ch	kg CO_2 eq	1,52E+03	9,27E+02	0,0206241	6,98E-02	1,20E-03	5,96E+02	1,64E-01
Ozone depletion	kg CFC11 eq	2,23E-02	6,99E-04	5,075E-06	5,62E-05	1,83E-06	2,15E-02	3,11E-05
Acidification	mol H^+ eq	1,49E+03	5,88E+01	0,7564535	1,01E+00	8,35E-02	1,43E+03	1,14E+00
Eutrophication	kg PO_4^{3-} eq	9,68E+01	1,36E+01	0,0240967	5,60E-03	1,34E-04	8,31E+01	1,70E-02
Photochemical ozone formation	kg NMVOC eq	6,16E+02	3,83E+01	0,2860519	1,08E+00	1,09E-01	5,75E+02	1,05E+00
Resource use, minerals and metals[1]	kg Sb eq	9,03E-01	1,11E-01	0,0007277	4,08E-03	5,88E-05	7,82E-01	5,08E-03
Resource use, fossils[1]	MJ	5,40E+06	1,03E+05	1206,127	3,72E+03	1,19E+02	5,29E+06	2,74E+03
Water use[1]	m^3 depriv.	6,08E+04	3,81E+03	26,781702	1,21E+01	6,57E-01	5,69E+04	2,18E+01

Disclaimer 1 – 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 per declared unit of the DT2656-1 (110062)

Indicator	Unit	Total	Upstream	Core	Distribution	Installation	Use	End-of-life
Renewable primary energy as energy carrier (PERE)	MJ	8,90E+05	9,27E+03	3,43E+02	4,68E+01	9,84E-01	8,81E+05	1,35E+02
Renewable primary energy resources as material utilization (PERM)	MJ	1,22E+04	1,16E+04	6,72E+02	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Total use of renewable primary energy resources (PERT)	MJ	9,03E+05	2,08E+04	1,02E+03	4,68E+01	9,84E-01	8,81E+05	1,35E+02
Non-renewable primary energy as energy carrier (PENRE)	MJ	5,67E+06	1,10E+05	1,27E+03	3,95E+03	1,27E+02	5,55E+06	2,91E+03
Non-renewable primary energy as material utilization (PENRM)	MJ	6,58E+02	6,58E+02	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Total use of non-renewable primary energy resources (PENRT)	MJ	5,67E+06	1,11E+05	1,27E+03	3,95E+03	1,27E+02	5,55E+06	2,91E+03
Use of secondary material (SM)	kg	3,18E+02	3,18E+02	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Use of renewable secondary fuels (RSF)	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Use of non-renewable secondary fuels NRSF	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Water consumption (FW)	m3	4,46E+03	1,14E+02	2,15E+00	4,24E-01	2,41E-02	4,34E+03	8,49E-01

Output flows and waste categories of declared unit of the DT2656-1 (110062)

Indicator	Unit	Total	Upstream	Core	Distribution	Installation	Use	End-of-life
Hazardous waste (HWD)	kg	3,62E+00	1,83E+00	6,12E-04	9,02E-03	3,21E-04	1,77E+00	5,72E-03
Non-hazardous waste (NHWD)	kg	1,94E+04	1,88E+03	7,97E+00	3,24E+02	3,25E+00	1,71E+04	1,23E+02
Radioactive waste (RWD)	kg	3,79E+01	2,81E-01	6,67E-03	2,54E-02	8,03E-04	3,76E+01	1,53E-02
Components for re-use (CRU)	kg	2,40E+01	0,00E+00	0,00E+00	0,00E+00	2,40E+01	0,00E+00	0,00E+00
Materials for recycling (MFR)	kg	1,23E+03	8,98E+01	8,98E+01	0,00E+00	0,00E+00	0,00E+00	1,05E+03
Materials for energy recovery (MER)	kg	4,53E+01	3,74E+00	3,74E+00	0,00E+00	1,20E+01	0,00E+00	2,59E+01
Exported electrical energy (EEE)	MJ	9,51E+02	0,00E+00	0,00E+00	0,00E+00	2,50E+01	0,00E+00	9,26E+02
Exported thermal energy (EET)	MJ	2,21E+03	0,00E+00	0,00E+00	0,00E+00	5,81E+01	0,00E+00	2,15E+03

DT2656 (110082)

Environmental impact per declared unit of the DT2656 (110082)

Indicator	Unit	Total	Upstream	Core	Distribution	Installation	Use	End-of-life
Climate change	kg CO_2 eq	2,78E+05	1,21E+04	6,67E+00	2,39E+02	4,71E+01	2,65E+05	4,47E+02
Climate change - Fossil	kg CO_2 eq	2,66E+05	9,09E+03	6,67E+00	2,39E+02	2,20E+01	2,56E+05	2,36E+02
Climate change - Biogenic	kg CO_2 eq	9,46E+03	1,26E+03	1,86E-03	1,74E-01	2,51E+01	7,96E+03	2,11E+02
Climate change - Land use and LU ch	kg CO_2 eq	2,33E+03	1,73E+03	5,26E-04	6,98E-02	1,20E-03	5,96E+02	1,64E-01
Ozone depletion	kg CFC11 eq	2,23E-02	6,29E-04	1,44E-06	5,62E-05	1,83E-06	2,15E-02	3,11E-05
Acidification	mol H^+ eq	1,49E+03	6,11E+01	6,98E-02	1,01E+00	8,35E-02	1,43E+03	1,14E+00
Eutrophication	kg PO_4^{3-} eq	1,08E+02	2,46E+01	7,48E-05	5,60E-03	1,34E-04	8,31E+01	1,70E-02
Photochemical ozone formation	kg NMVOC eq	6,17E+02	4,01E+01	9,29E-02	1,08E+00	1,09E-01	5,75E+02	1,05E+00
Resource use, minerals and metals[1]	kg Sb eq	9,18E-01	1,27E-01	1,02E-05	4,08E-03	5,88E-05	7,82E-01	5,08E-03
Resource use, fossils[1]	MJ	5,40E+06	9,98E+04	9,18E+01	3,72E+03	1,19E+02	5,29E+06	2,74E+03
Water use[1]	m^3 depriv.	6,19E+04	4,89E+03	1,23E-01	1,21E+01	6,57E-01	5,69E+04	2,17E+01

Disclaimer 1 – 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 per declared unit of the DT2656 (110082)

Indicator	Unit	Total	Upstream	Core	Distribution	Installation	Use	End-of-life
Renewable primary energy as energy carrier (PERE)	MJ	8,99E+05	1,77E+04	3,43E+02	4,68E+01	9,84E-01	8,81E+05	1,35E+02
Renewable primary energy resources as material utilization (PERM)	MJ	1,22E+04	1,16E+04	6,72E+02	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Total use of renewable primary energy resources (PERT)	MJ	9,11E+05	2,92E+04	1,02E+03	4,68E+01	9,84E-01	8,81E+05	1,35E+02
Non-renewable primary energy as energy carrier (PENRE)	MJ	5,66E+06	1,06E+05	1,27E+03	3,95E+03	1,27E+02	5,55E+06	2,91E+03
Non-renewable primary energy as material utilization (PENRM)	MJ	6,52E+02	6,52E+02	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Total use of non-renewable primary energy resources (PENRT)	MJ	5,67E+06	1,06E+05	1,27E+03	3,95E+03	1,27E+02	5,55E+06	2,91E+03
Use of secondary material (SM)	kg	3,18E+02	3,18E+02	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Use of renewable secondary fuels (RSF)	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Use of non-renewable secondary fuels NRSF	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Water consumption (FW)	m3	4,49E+03	1,41E+02	2,15E+00	4,24E-01	2,41E-02	4,34E+03	8,47E-01

Output flows and waste categories of declared unit of the DT2656 (110082)

Indicator	Unit	Total	Upstream	Core	Distribution	Installation	Use	End-of-life
Hazardous waste (HWD)	kg	4,12E+00	2,33E+00	6,12E-04	9,02E-03	3,21E-04	1,77E+00	5,72E-03
Non-hazardous waste (NHWD)	kg	1,95E+04	1,98E+03	7,97E+00	3,24E+02	3,25E+00	1,71E+04	1,23E+02
Radioactive waste (RWD)	kg	3,79E+01	2,40E-01	6,67E-03	2,54E-02	8,03E-04	3,76E+01	1,53E-02
Components for re-use (CRU)	kg	2,40E+01	0,00E+00	0,00E+00	0,00E+00	2,40E+01	0,00E+00	0,00E+00
Materials for recycling (MFR)	kg	1,37E+03	0,00E+00	8,98E+01	0,00E+00	0,00E+00	0,00E+00	1,28E+03
Materials for energy recovery (MER)	kg	4,16E+01	0,00E+00	3,74E+00	0,00E+00	1,20E+01	0,00E+00	2,59E+01
Exported electrical energy (EEE)	MJ	9,66E+02	0,00E+00	0,00E+00	0,00E+00	2,50E+01	0,00E+00	9,41E+02
Exported thermal energy (EET)	MJ	2,24E+03	0,00E+00	0,00E+00	0,00E+00	5,81E+01	0,00E+00	2,19E+03

Calculation rules

All relevant and known processes and materials have been included**.** The following processes have been **excluded** from the system boundary:

- Auxiliary materials in the assembly phase as quantities are negligible.
- Maintenance and operation of support equipment (except those included in Ecoinvent background processes).
- Capital goods and infrastructure for assembly (except those included in Ecoinvent background processes).

There is no reason to believe that relevant in- or outputs are excluded from this study. Based on the available information, the total of processes that are excluded contribute less than 1% of the total mass and environmental impact.

Data collection and quality

Data is retrieved from a Bill of Materials (BoM) supplied by Končar D&ST Zagreb production/assembly plant. There are no inconsistencies found in the data and there is no reason to believe data is incomplete or not reliable. The reference year for data collected is 2021.

Data about the production of five main components are provided by the suppliers of the components. The five main components add up to 95% of the mass of the transformer. Communication with suppliers went via Končar D&ST. Seeing that the data collection from suppliers was initiated in 2021, the reference year of this data is 2020. No changes are made in the composition nor production process of these components. Hence the 2020 is considered representative.

The materials for which generic data is used are under the 10% threshold.

The remaining materials are modelled with generic data, basic information on the compositions of these materials is provided by Končar D&ST.

Allocation

Allocation is avoided where possible. In the manufacturing stage allocation is avoided by calculating the energy consumption per unit of time and the operating time per type of transformer. This approach is preferred above allocation of yearly energy consumption based on power rating or weight of the transformer.

The allocation of recycling and recovery processes is done according to the polluter pays principle. This means that for materials leaving the systems all processes that are required to reach the end-of-waste status are allocated to the system under study. These processes include transport, shredding and sorting.

Scenarios and additional technical information

Manufacturing stage

This module considers the extraction and processing of all raw materials and energy which occur upstream to the transformer manufacturing process, as well as waste processing up to the end-of waste state.

Transport distance of the raw materials to the manufacturing facility via road, boat and/or train.

Manufacturing of the semifinished parts and the assembly of the transformer includes all processes linked to production such as storing, mixing, packing and internal transportation. Use of electricity and fuels production are considered as well as direct emissions from production process.

The manufacturing of production equipment and infrastructure is not included in the system boundary unless it is included in Ecoinvent background processes.

Packaging-related flows in the production process and all up-stream packaging are included in the manufacturing module.

The manufacturing process takes place at one production site. For upstream (raw material processes) and downstream processes (waste processing) generic data is used when no specific data is obtained.

Distribution stage
In conformity with the EPD Italy PCR for Power transformers, in this stage 1500 km transport per truck is modelled as an average distance for transformers in Europe.

Installation stage
The processes required to place the transformers can differ based on the location. For this stage a worst-case assumption is done in which the transformers are placed with a large crane.

Use & Maintenance stage
In this phase only electricity losses occur, no maintenance, replacements or operational energy use is applicable for this transformer as the transformers are designed to operate 35 years without replacement of parts. In case of the unlikely event of failure, the transformer is replaced completely.

Electricity consumption is calculated according to the formula from the PCR EPD Italy – Power transformers, as shown below.

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

Table 1 Parameters for electricity consumption in use phase

	400 kVA	Explanation
P_{load}	3,25	Determined by Končar D&ST.
K_{load}	0,7	Depends on specific distribution, the in the PCR [6] suggested 70% is used.
P_{noload}	0,387	Determined by Končar D&ST.
P_{aux}	0	Is zero for the transformer under study because they are naturally cooled.
F_{aux}	0	Is zero for the transformer under study because they are naturally cooled.
Y_{year}	8760	Conforms default value from the PCR [6].
RSL	35	Conforms default value from the PCR [6].

End-of-life stage, deinstallation
The processes required to remove the transformers can differ based on the location. For this stage a worst-case assumption is done in which the transformers are removed with a large crane.

In this stage 500 km transport per truck is assumed as average distance for transformers to a waste sorting facility in Europe.

End of life scenarios per material are given by the EN 50693. Despite that recycle rates for the metals are expected to be higher, the default scenarios from the PCR are the most conservative option and therefore used.

It is assumed for the disposal rate (incineration and landfilling) of metals is that 100% goes to landfilling and 0% to incineration. It is assumed that for the disposal rate (incineration and landfilling) of plastics, wood and paper is that 50% goes to landfilling and 0% goes to incineration.

Additional environmental information

Končar D&ST within its scope of business special and medium power transformers commits to respect legal regulations of the Republic of Croatia, obligations arising from the acceptance of the ISO 14001:2015 and ISO 45001:2018 standard requirements as well as the applicable requirements of the interested parties. Certificates confirming compliance with ISO 14001:2015 and ISO 45001:2018 can be found via https://koncar-dst.hr/en/about-us/environmental-protection/ and https://koncar-dst.hr/en/about-us/occupational-health-and-safety/ respectively. Certification for those two management systems was provided by Bureau Veritas Certification (Certificate No.: HR007598 and HR007611).

Company management supports the implementation and development of an environmental and OH&S protection system in order for successful implementation of the strategy and objectives and continuous improvement of the management system.

Aware of the environmental protection we are committed to continuous management of the company´s environmental and OH&S impact:

- Timely and effective prevention of possible soil, water and air pollution, as well as ensuring safe and healthy working conditions for job-related injury and disease prevention to eliminate the danger;
- Rational use of natural resources;
- Reduction of waste quantities and proper waste sorting;
- Acting on the awareness of all employees and contract partners and the use of administrative measures, including training;
- Choosing environmentally friendly raw materials and replacing existing processes with less hazardous processes, operations, materials or equipment;
- Planning and introduction of cleaner manufacturing processes and ecological product design with the use of engineering measures and reorganization of work;
- On the involvement of workers in counselling and participation to eliminate hazards and reduce OH&S risk using appropriate personal protective equipment.

Končar D&ST encourages interested parties to apply environmental protection and OH&S principles.

Moreover, Končar's products are manufactured in conformity with all applicable environmental legislation. Končar's products are not under suspicion related to environmetal applicable legislation.

Declaration of hazardous materials

None of the substances contained in the product are listed in the "Candidate List of Substances of Very High Concern for authorisation", or they do not exceed the threshold with the European Chemicals Agency.

Moreover, Končar D&ST complies with the regulations as laid down: (EU)1907/2006 (REACH) and (EU)1272/2008. Meaning no hazardous substances are released to air, water or soil during the production and use of the transformers as produced by Končar D&ST.

References

[1] LCA report Končar D&ST Distribution transformers, April 2022.
[2] EN 50693:2019 Product category rules for life cycle assessments of electronic and electrical products and systems.
[3] ISO, 2006. "Environmental management. Life cycle assessment - Principles and framework". ISO 14040:2006/AMD1:2020.
[4] ISO, 2006. "Environmental management. Life cycle assessment – Requirements and Guidelines". ISO 14044:2006/AMD1:2017/ AMD2:2020.
[5] ISO, 2006. "Environmental labels and declarations – Type III environmental declarations", ISO/TR 14025:2006.
[6] EPD Italy Core PCR for electronic and electrical products and systems.
[7] EPD Italy 018 PCR for Power transformers, revision 3.5, 13-12-2021.
[8] International Electrotechnical Vocabulary, Chapter 421: Power transformers and reactors.
[9] Pavlos S. Georgilakis: Spotlight on Modern Transformer Design, Springer, 2009.
[10] Regulations of the EPDItaly Programme, Rev. 5.0