

Carbon footprint of oil-immersed transformers

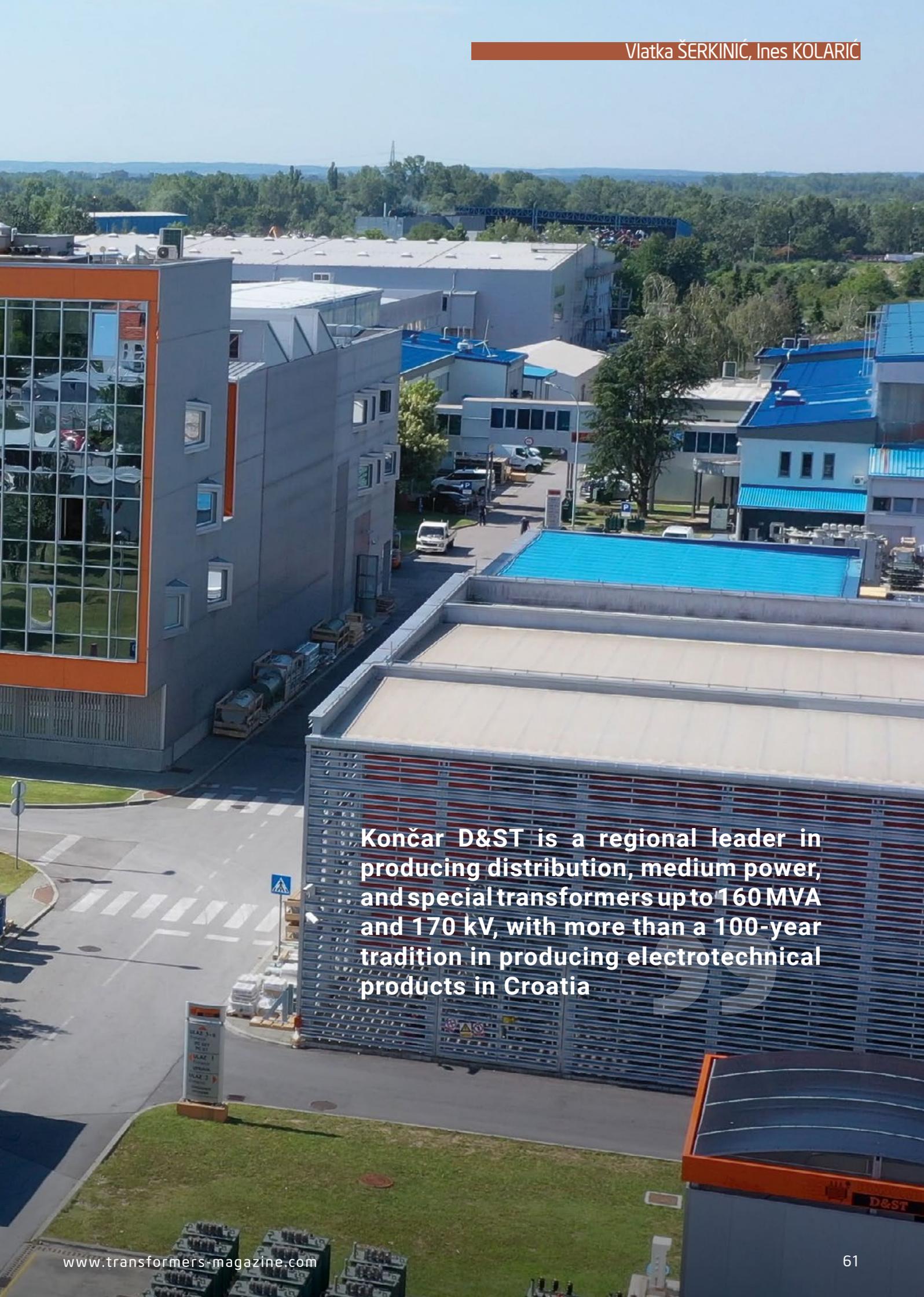
ABSTRACT

Končar Distribution and Special Transformers, a company in Croatia, has recognized the importance of fighting climate change and reducing CO₂ emissions. To quantify the environmental impact of their products, they have conducted carbon footprint studies based on the ISO 14067:2018 standard and used the life cycle assessment (LCA) method. The LCA covers three

phases: upstream, core, and downstream, and applies to various industries. The result of the analysis is expressed as CO₂ equivalent using the single impact category of climate change.

KEYWORDS:

climate change, global warming, CO₂ emissions, life cycle assessment, carbon footprint of products, eco-friendly transformer



Končar D&ST is a regional leader in producing distribution, medium power, and special transformers up to 160 MVA and 170 kV, with more than a 100-year tradition in producing electrotechnical products in Croatia

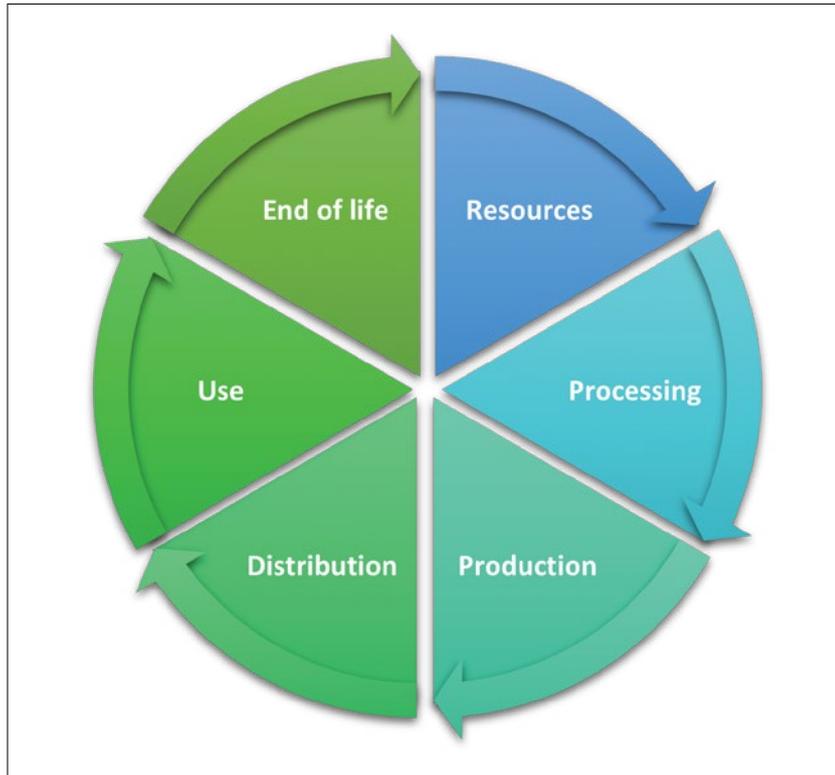


Figure 1. Life cycle assessment

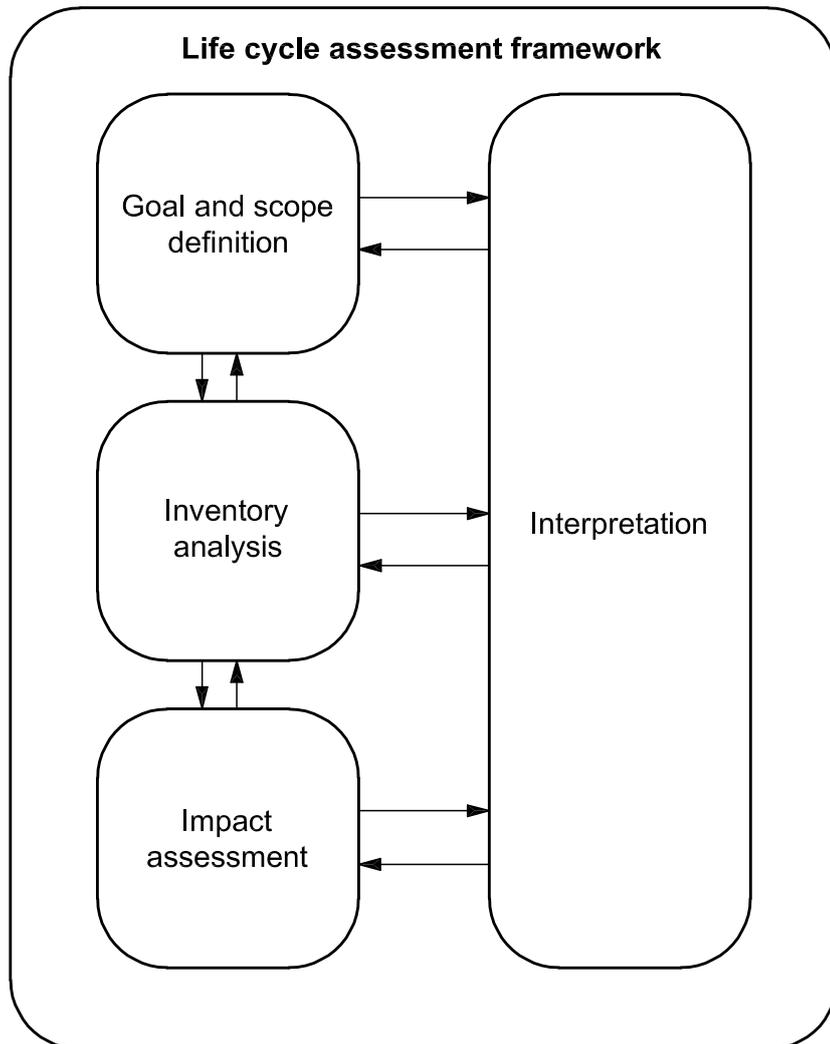


Figure 2. Stages of LCA

Everything starts from raw material production, through the production of the final product and then until the product's final disposal or materials recycling

1. Introduction

In the last few decades, we are all aware that climate change and global warming have emerged as important environmental issues. Like all other EU countries, Croatia is obligated to reduce CO₂ emissions set by the Paris Agreement. At this moment, fighting climate change has become one of the primary goals for everyone, and the company Končar Distribution and Special Transformers has already recognized the importance of this topic. Končar D&ST, a regional leader in producing distribution, medium power, and special transformers up to 160 MVA and 170 kV, follows a more than 100 years' tradition in producing electrotechnical products in the capital of Croatia, Zagreb. The company already has around 750 employees and is certified by three different management systems for quality, environment health and safety. Some of the topics related to Carbon footprint in Končar Distribution and special transformers will be presented in this article. Basically, everything that is important about life cycle assessment (LCA) is shown in Figure 1, where all the phases of the carbon footprint of products related to environmental impacts can be seen.

2. Fighting climate change

As already known, there are seven different greenhouse gases in the atmosphere. They are all responsible for global warming, and each greenhouse gas has a different contribution to global warming. This term was established to allow comparisons between the global warming impacts of different gases. [1] It is agreed that the reference gas would be CO₂, and its value would be one. On the other hand, for example, the global warming potential of methane is 25, which means if you emit-

ted one kilogram of methane, it is the same as if 25 kilos of CO₂ equivalent were emitted. The result of every CFP analysis is kilograms of CO₂ equivalent.

3. Carbon footprint of product

CFP stands for the carbon footprint of a product, and by its definition, it's the sum of the GHG emissions and GHG removals in a product system, expressed as CO₂eq and based on an LCA using the single impact category of climate change. [2] The base for the calculation is ISO standard 14067:2018, which contains requirements and guidelines for quantification, and the main part of the CFP is the LCA. We can tell that it is a method for the quantification of the environmental impacts of individual products. In Figure 2 [3], all phases of a LCA can be seen. Everything starts from raw material production, through the production of the final product and then until the product's final disposal or materials recycling. The functional unit can be either a product or a service, and in Končar D&ST, it was the product - oil immersed transformer in several variations. This approach aims

to show where the environmental impact in the overall chain takes place, which can serve as an opportunity to improve a specific process or product parts.

There are several relevant standards from the ISO 14000 family of standards. The base for the calculation, as mentioned above, was ISO 14067:2018. After the calculation and preparation of the CFP study report and, of course, the CFP verification, the end result was a verification statement with total quantities of CO₂ equivalent. The main thing to point out is that the standard is applicable for the CFP study and deals with only one category of impact climate change. For the projects in Končar D&ST, the most important article in this standard was 6.2, the use of PCR which stands for Product Category Rules. It says that where relevant PCR exists, it should be adopted. [2] This document imposes rules for the preparation of the CFP study for various industries and is above all relevant standards from the ISO 14000 family of standards (Figure 3 [4]).

When the PCR document imposes system boundaries "cradle-to-grave," that

means that calculation should be done for all three phases of the lifecycle of the product: upstream, core, and downstream (Figure 4 [4]). The upstream part is called "cradle to gate" and is related mostly to the suppliers.

The core part is called "gate to gate," and it refers to the production of the final product and the calculation of waste and energy consumption as well. The last phase is the downstream phase – "gate to grave." It has a distribution phase, a use phase, and the end-of-life phase, and it refers to 35 working years of the transformer.

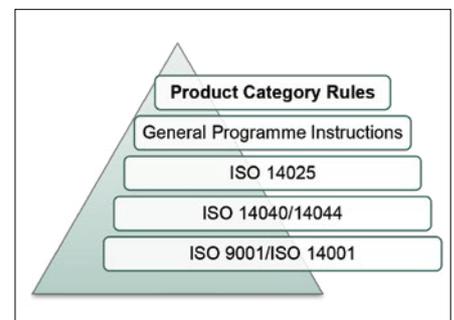


Figure 3. Illustration PCR in relation to the hierarchy of standards and other documents

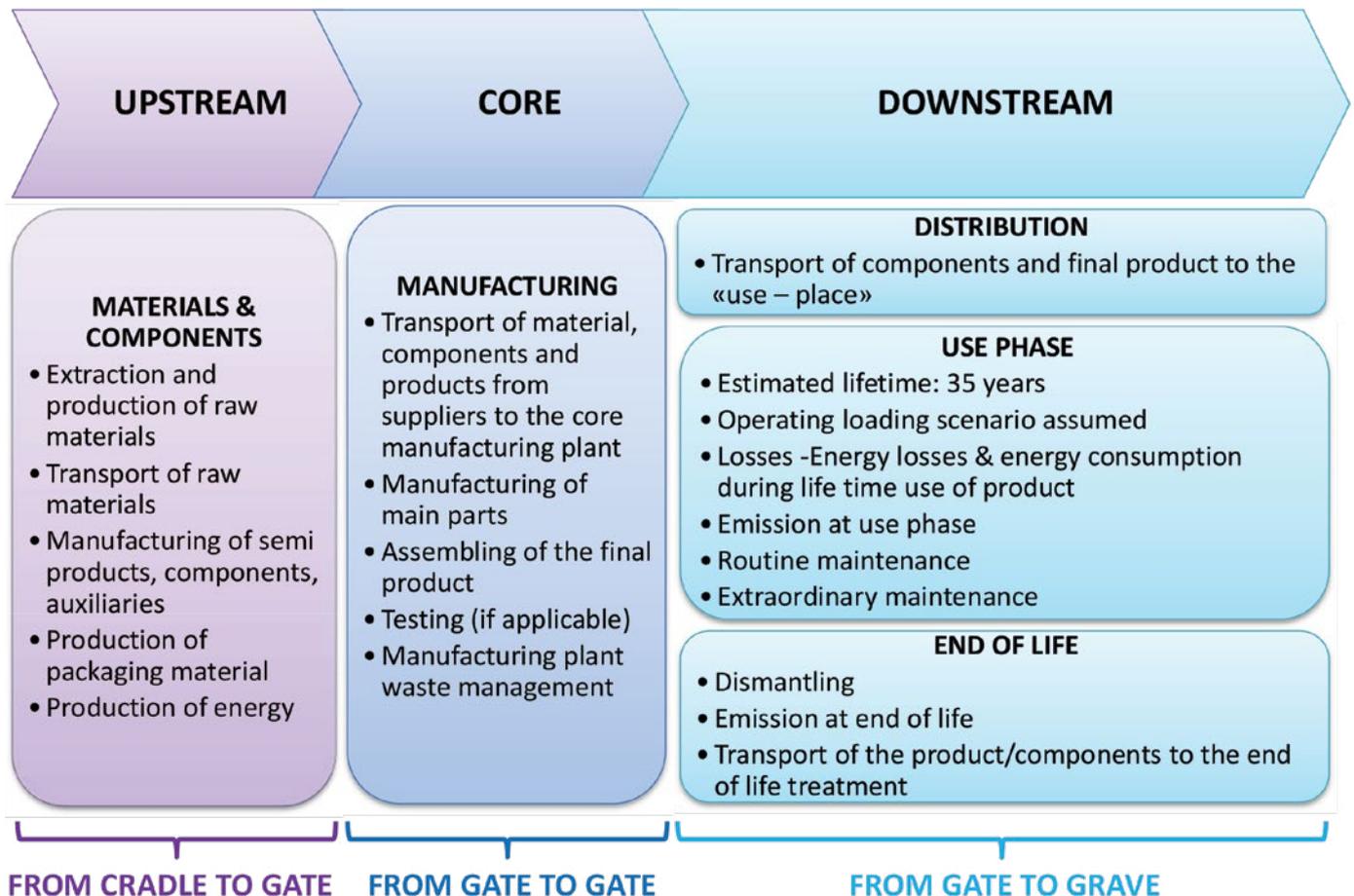


Figure 4. PCR system boundaries

The first project on the carbon footprint of products in Končar D&ST started in 2018 upon the request of the end customer, which resulted in one of the first carbon footprints evaluation for products in Croatia

4. CFP projects in Končar D&ST

The first project on the carbon footprint of products in Končar D&ST started in 2018 upon the request of the end customer. This specific project was finished in 2019 and resulted in one of the first carbon footprints of products in Croatia.

It lasted about 12 months, and after that, Končar D&ST was engaged in several similar CFP projects, both for medium power transformers and distribution transformers. The project's duration depends on different factors, such as the number, type, and complexity of the products, the scope, and the availability of the resources inside and outside the company.

In Končar D&STs case, different departments in-house were engaged, such as Technical Department, Production Planning, Purchase, Sales, Dispatching & Packing, etc. Also, primary data on LCA were collected from the suppliers of strategic materials (with a certain mass percentage within the total mass of the transformer). Furthermore, suppliers were asked to share specific information on their supply chain and production processes needed for the LCA calculation.

The software which was used for the calculation is called SimaPro, and it is one of the two most used software programs for this type of analysis in the world. It contains the database called Ecoinvent. The Ecoinvent Database is a Life Cycle Inventory (LCI) database that supports various types of sustainability assessments. IPCC methodology was used as a characterization method for the estimation of greenhouse removals according to International Panel on Climate Change.

As for the CFP study itself, it is publicly unavailable because it contains confidential details on different methods of calculation and specification of the product, such as a list of materials and suppliers, energy and waste quantities, transportation, and disposal.

All CFP studies were audited and verified by an independent accreditation body, which emphasizes the accuracy of data and the scientific basis of calculations.

For the first CFP project, the scope was “cradle to gate,” and for all other projects, the “cradle to grave” methodology was used



Figure 5. DT CFP verificate

5. CFP verificates

In Figure 5, you can see an example of the verification statement for distribution transformers. This one is from our

first carbon footprint project in 2019. The scope for this project was “cradle to gate,” while for all later projects, the “cradle to grave” methodology was used.

Figure 6 shows an example of the first carbon footprint verification for a medium power transformer.

The most important part of the verification statement is the display of the total quantities of carbon footprint in kilograms equivalent for one year for all phases of the transformer life-cycle

Verificate also contains company details, accreditation body details, relevant standards, PCR data (if it exists), and product details. It holds verification process information, roles, responsibilities, objectives, and criteria. The most important part of the verification statement is the display of the total quantities of carbon footprint in kilograms equivalent (CO₂ eq) for one year for all phases of the transformer lifecycle. Of course, if applicable, it can contain CO₂ quantities for all phases of the whole lifetime of the transformer.

A question that is often asked is what is the purpose of this kind of calculation, and what are the benefits? By calculating the carbon footprint of your product certainly, you can achieve more efficient production processes, improved environmental efficiency, and better achievement in business overall while you're showing all interested parties your continuous improvement on climate change.

We recognized the possibilities for CO₂ footprint reduction by planting trees in Calabria, Italy, where 398 beech trees were planted in 2020 (Figure 7). Every one of these trees will absorb 22 kg/year of our carbon footprint of products.

Končar D&ST was also engaged in publishing the first environmental product declarations both for distribution and medium power transformers

6. Environmental product declarations

Besides CFP, Končar D&ST was also engaged in publishing the first environmental product declarations (EPD) both for distribution and medium power transformers. EPD is a summarized carbon footprint study with the mandatory LCA scope. It is important to say that EPD is in compliance with different ISO standards (EN ISO 14025

[6], ISO 14040 [3], ISO 14044 [5], and other regulations). It is used as a tool for comparing related industries/processes/products.

The difference from the CFP is that EPD is publicly available and is usually published on some international environmental portals such as EPD Italy [10] or Environdec [11]. Končar D&ST published its EPDs on the EPD Italy portal.



Figure 6. MPT CFP verificate



Figure 7. Certificate for planting trees



Figure 8. EPD for DT

By calculating the carbon footprint of your product, a better insight into the product can be achieved, and it can be a mighty tool in developing and improving company sustainability goals

Figure 8 shows an example of environmental product declaration. It is also verified by an independent accreditation body, published for five years, and should be revised if necessary (in case of any changes in production or in the product itself).

7. Possibilities for the future

By calculating the carbon footprint of your product, a better insight into the product can be achieved. It can be a mighty tool in developing and improving company sustainability goals. Since the calculation is set on primary and secondary data (primary data from production processes and supplier information and secondary from the Ecoinvent database), the final result is science-based.

This way, the company can achieve a better insight into the product itself. Also, it helps to identify opportunities for improvement and gives additional value to the product. Projects like the carbon footprint of a product can lead towards savings in, for example, raw materials, energy use, and total costs, and a more sustainable product that can be used as a promotion point when selling the product.

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[10] <https://www.epditaly.it/>

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Figure 9. Končar D&ST's eco-friendly transformer

Authors



Vlatka Šerkinić currently works as a sustainability specialist in Končar Distribution and Special Transformers Inc. and has 10 years of experience in environmental topics in the transformers production industry. In recent years she has been working as a team leader on Carbon Footprint of Product projects for distribution transformers which help to determine the environmental impact of a single distribution transformer. Furthermore, she's working on the development of Končar D&ST sustainability strategy as well as the preparation and coordination of sustainability reports.



Ines Kolarić joined Končar Distribution and Special Transformers Inc. in 2019 in the position of management system development engineer. Her previous work experience was as an expert advisor in the Ministry of Environmental Protection and Energy. Ines has over a decade of experience in environmental topics. In Končar D&ST, she has been working as a responsible person for environmental protection, sustainability, waste management, and chemicals. In recent years she has been working as a team leader on Carbon Footprint of Product projects for medium power transformers.