PEIKKO

WHITE PAPER

EPDS IN PLAIN LANGUAGE

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1. Introduction

Environmental Product Declarations (EPDs) are documents that transparently communicate the environmental impact of building products. They are typically one of the cornerstones for the Building Life Cycle Assessment. They are also used to identify ways to streamline manufacturing processes, like using renewable energy and reducing waste etc., in order to reduce emissions. EPDs also enable the comparison of the environmental performance of similar products and their equal treatment. A genuine competition between product manufacturers leads to a genuine will to reduce their greenhouse gas (GHG) emissions. In a short period of time, EPDs have became a measure of competitiveness similar to price, which has encouraged product manufacturers to purchase renewable energy and recycled raw materials as well as to reduce emissions from the logistics. This measure works well, because it may not only improve environmental figures but also economic figures. This happens, for example, if the waste streams of the production are optimized.

Peikko first prepared its first EPD documents over 10 years ago, when the environmentally conscious clients required all information to be available in one compact document. Nowadays, having just an EPD is no longer enough, but the actual content and figures decide whether we are involved in construction projects or not – this is how the competition works!

Requirements of EPDs are defined in the International Standards for Environmental labels and declarations – Type III environmental declarations – Principles and procedures (ISO 14025). At a bare minimum, they should be objective, give comparable information within the same product group (PCR) and be third-party verified for life cycle assessment (LCA), life cycle inventory (LCI), and the information it contains.

This White paper explains the Life cycle Assessment using a case study of the EPD making process of DELTABEAM® Composite beam (*Figure 1*), produced in the Peikko manufacturing plant located in Lahti, Finland. It also explains the most important factor, GWP (Global Warming Potential), which is usually the most searched and compared by viewers.

Figure 1. DELTABEAM® Composite Beam.

DELTABEAM® is a composite slim-floor system for multi-storey buildings of any kind. It allows flexible layouts through the whole life cycle of the building, as well as easy HVAC installations.

2. Overview of the EPD creation process

All EPDs are created following a set of rules also called Product Category Rules (PCR). DELTABEAM® Composite Beams are considered to be a metal product which follows Core Product Category Rules of EPD HUB [1].

To create an EPD, Life cycle analysis (LCA) must be conducted. The LCA reflects the environmental impacts from manufacturing, transportation and end-of-life stages of the product.

An LCA is always performed for a declared unit of the product. In case of steel products, 1 kg of product is usually a meaningful unit. It means that all analysis inputs (raw materials, energy, transportations) and side streams (wastes) are allocated for producing 1 kg of DELTABEAM® Composite Beam, painted.

An LCA is produced using the most current data from the product manufacturer. Data period must be always 12 running months. All production consumables and their origin for manufacturing and performing an LCA for 1 kg of DELTABEAM® Composite Beam in the production unit of Peikko Finland (year 2022) are listed in *Table 1.*

Table 1. Consumables and their origin for producing 1 kg of DELTABEAM® Composite Beam, painted.

Raw materials	Steel plates	1.14 kg	EU
	Reinforcing steel	0.12 kg	EU
	Welding consumables	0.008 kg	EU
Chemicals	Paint	0.005 litres	Finland
	Tinner	< 0.001 litres	Finland
Oils	Hydraulic oils	< 0.001 litres	Finland
	Cutting fluids	< 0.001 litres	Finland
	Light fuel oil	0.001 litres	Finland
Gases	Argon	< 0.001 litres	Finland
	CO_2	< 0.001 litres	Finland
	Oxygen	< 0.001 litres	Finland
	LPG	< 0.001 litres	Finland
	SK	< 0.001 litres	Finland
	Others	< 0.001 litres	Finland
Energy	Electricity	0.338 kWh	
	District heating	0.200 kWh	
Water	Tap water	< 0.001 litres	

In addition to consumables as inputs, all production related waste streams must be taken into account.

After conducting an LCA, all reporting is written to the background report. A published EPD document is a summary from an LCA and this background report. Before publishing the EPD, the background report must be third-party verified by EPD registers, such as EPD HUB or RTS.

3. Parts of an LCA

An LCA for DELTABEAM® has been conducted for the whole life cycle of the product, excluding the use stage (modules B1 – B7). It means that the scope of the LCA analysis is Cradle-to-gate with options, which is the minimum requirement for all Construction Products under EN 15804+A2 [2]. Product life stages are presented in *Figure 2*.

A1 – A3	A4 – A6	B1 – B7	C1 – C4	D
Product Stage	Construction process	Use (Not in our Scope)	End of Life	Benefits and Loads beyond the system boundary
A1: Raw material supply *(steel plates, rebar, welding filler, paint)* A2: Transport *(distance from supplier to Lahti)* A3: Manufacturing *(welding gases, lubricating oils, energy, water, packaging, fuel for forklift)*	A4: Transport *(distance from Lahti to Customer)* A5: Construction / Installation *(construction waste – wood pallets)*	B1: Use B2: Maintenance B3: Repair B4: Replacement B5: Refurbishment B6: Operational energy use B7: Operational water Use	C1: De-commissioning/ Demolition *(fuel in demolition machine)* C2: Transport *(distance from site to waste processing/ disposal)* C3: Waste processing *(95% recycled)* C4: Disposal *(5% landfill)*	Reuse / Recovery / Recycling potential *(benefit comes from recycling on the virgin parts)*
Cradle-to-gate: A1–A3, (only for carbon footprints), not applicable in EN 15804+A2:2019				
Cradle-to-gate with options: A1–A3, C1–C4, & D mandatory, A4–A5, B1–B7, are optional – minimum requirement for all Construction Products under EN 15804+A2				
Cradle-to-grave: A1–A5, B1–B7, C1–C4, & D are mandatory.				
Cradle-to-cradle: A1–A5, B1–B7, C1–C4, D are mandatory – waste stage exchanged with reuse or recycling.				

Figure 2. Product life stages.

Raw material acquisition (A1)

The process starts by defining the required raw materials needed for production (*Figure 3*). In case of DELTABEAM®, the total composition considered in the current EPD is as follows:

- Steel plates, 89.6 %
- Reinforcing steel, 9.3 %
- Welding consumables, 0.6 %
- Paint, 0.5 %

Figure 3. Main raw materials for producing DELTABEAM®.

In the LCA analysis, raw materials are input to produce 1 kg of DELTABEAM®, which is the declared unit. Total 1.26 kg of steel material is required to manufacture 1 kg of DELTABEAM® Composite Beam, which results 1.14 kg of steel plates and 0.12 kg of reinforcing steel. In steel-based products, raw material acquisition generates most of the environmental impact when considering the full life cycle of the product (about 80 %).

The leftover of steel material (0.26 kg) can be used partly as coproduct for other products and the rest is recycled.

Raw material transportation (A2)

Here we need to specify means and distance of raw material transportation to the production unit of DELTABEAM®. The Finnish factory acquires raw materials from European steel mills, so the transportation distances are measured in thousands of kilometres (*Figure 4*). The transportation vehicle (ship, lorry) must also be specified to assess the real emissions from transport.

In the LCA analysis, the environmental impact of transportation is defined for 1 kg of the product. Transportation of raw materials has a smaller effect than raw materials itself, but it is still significant part of the life cycle analysis. For example, steel plates are transported to the production unit for Peikko Finland from an average distance of 2,800 km.

PRODUCT RAW MATERIAL MAIN COMPOSITION

Raw material category	Amount, mass- %	Material origin
Metals	100	EU
Minerals	-	-
Fossil materials	-	-
Bio-based materials	-	-

Figure 4. Raw material origin presented in EPD.

Production (A3)

In the production stage, the environmental impact is generated from used energy (electricity and district heating), ancillary materials such as gases and oils, as well as water and packaging materials. Transportation of ancillary and packaging materials must also be considered. *Figure 5* provides views from manufacturing facility of DELTABEAM® in Finland.

Figure 5. Manufacturing processes of DELTABEAM®.

When manufacturing DELTABEAM®, steel plates are plasma cut to desired dimensions from stock-sized plates, which are delivered to the production unit as raw material. Similarly, rebars are cut to suitable lengths from stock lengths. This means that the manufacturing process also generates steel waste (scrap), which must be taken into account in the LCA. Since 1.26 kg steel material is needed for producing 1 kg of the product, 0.26 kg of remnant is generated.

Product transportation (A4)

Similar to transportation of raw materials, manufactured product must be transported to the construction site. In EPDs, transportation distance and means are usually scenario-based and for an LCA for DELTABEAM® Composite Beam, painted, it is assumed that 1 kg of product is transported 110 km (from Lahti to Helsinki) by 32 metric ton lorry (Euro 6). The effect of transportation is highlighted in *Figure 6*.

In cases where the transportation distance differs from 110 km, it is possible to calculate a more precise value by scaling the scenario-based environmental impact from A4 with ratio X/110, where X is the real transportation distance between the factory and the construction site. As an example, if the transportation distance is 300 km instead of 110 km, then the more precise effect of transportation, $A4_{act}$:

$$A4_{act} = 0.00959 \text{ kgCO}_2\text{e} * 300/110 = 0.026 \text{ kgCO}_2\text{e}$$

Impact category	Unit	A1	A2	A3	A1-A3	A4
GWP – total	kg CO_2e	2,22E0	2,91E-1	1,24E-1	2,63E0	9,59E-3

Figure 6. Scenario-based effect of transportation (A4) in an EPD.

In cases where the mode of transportation differs significantly from a scenario-based lorry, it is recommended to contact Peikko support team for more detailed calculations.

Product assembly (A5)

Module A5 accounts for material loss during installation. For DELTABEAM® Composite Beam, painted, there is no waste as the product is delivered and used as whole. The only waste comes from the packaging material, the wooden pallets. However, it is assumed that the wooden pallets can be reused up to 10 times (research based) before being disposed of.

End-of-life – Demolition/deconstruction process (C1)

End-of-life modules are all scenario-based and must comprise 100 % share of the product end-of-life treatment, i.e., 1 kg since that was defined as declared unit.

Module C1 needs to account for the fuel/energy consumption during the demolition/deconstruction process. This can be modelled by using datasets for fuel consumption or electricity. For 1 kg of DELTABEAM® Composite Beam, painted, 0.01 kWh energy consumption has been assumed in the LCA.

End-of-life – Transportation of waste from the demolition site (C2)

It has been assumed that transportation distance for steel waste delivered from the demolition site to the recycling facility and the landfill is 50 km.

End-of-life – Waste processing for reuse, recovery and/or recycling (C3)

According to World Steel Association [3], 95 % of steel scrap from demolition site can be recycled. It means 950 g from 1 kg of the product.

End-of-life – Waste disposal (C4)

The remaining 5 %, which cannot be recycled, is assumed to be sent to landfill.

Benefits and loads beyond the system boundary (D)

95 % from 1 kg of a demolished product is taken to recycling facility. This steel (scrap) can be used as raw material for producing new steel plates and reinforcing steel. The benefit comes from avoiding the production of steel from virgin raw materials. This benefit applies only for virgin raw materials in DELTABEAM® Composite Beam, painted since the scrap steel benefit had already been accounted in module A1. Recycling content of plates is a minimum of 25 %, which means that there is a maximum of 0.896 kg × 0.75 = 0.672 kg virgin steel material, and 95 % from that can be used for production of new steel plates.

Energy production from burning the wooden pallets related to module A5 can also be accounted for here.

4. Third-party verification

Verification must be always carried out by an independent body. The verification is to ensure accuracy, reliability, and that the LCA and EPD both conform to the requirements of the relevant applicable standard and PCR. A background report (or LCA report) is used to support the verification process. Any discrepancies, inconsistencies or mistakes must be brought to the attention of the EPD author who must correct or make additional justification with evidence. The program operator (e.g., EPD HUB or RTS) will process, register, and publish the EPD once the third-party verifier has approved it. A signed verification statement is found on the last page of the EPD document.

5. Interpretation of the results

During the LCA process, a large amount of very different data is collected for covering material extraction, manufacture, waste streams, by-products etc. To make reporting more manageable, this data is grouped into impact categories. Impact categories are aspects such as Global Warming Potential (GWP), Ozone Depletion Potential, Acidification Potential, Impact on Human Health, etc. The common unit examples are kgCO_2e representing GWP, kgCFC11e representing ozone depletion and so on.

To understand what is actually measured during an LCA, think of a carbon footprint, which assesses lifetime Global Warming Potential (GWP). GWP was developed to allow comparisons of the global warming impacts of different Greenhouse gases (GHG). It is a measure of how much energy the emissions of 1 ton of a GHG will absorb over a given period of time, relative to the emissions of 1 ton of carbon dioxide (CO_2) [4]. Greenhouse gases (like water vapour, CO_2, methane) warm the earth by trapping some of the heat that results when the sunlight heats the Earth's surface and slowing the rate at which the energy escapes to space (illustrated in *Figure 7*).

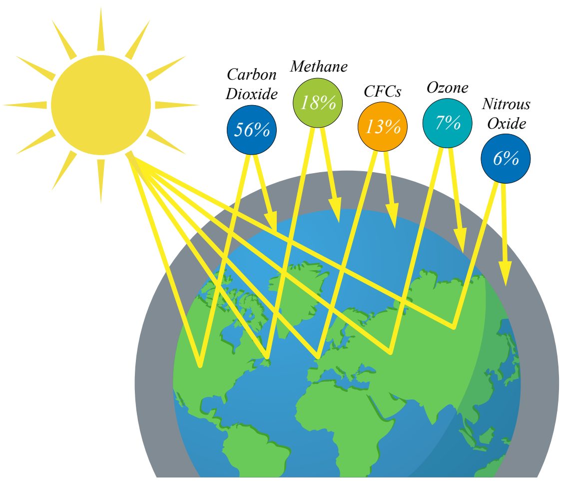

Figure 7. Illustrating the effect of GHG.

The larger the GWP, the more that given gas warms the Earth compared to CO_2 over that time period. All other gases are converted to CO_2 equivalent because CO_2 always has a GWP of 1 regardless of the time period used and it remains in the climate system for a very long time (thousands of years). The GWP total is the most important impact as it shows the climate change potential of the product and is the sum of GWP-fossil, GWP-biogenic, GWP-land use and land use change (LULUC). All important values are written in summary form on the second page of EPD documents.

Modules A1-A3 are most important as they have the biggest impact and are based on measured values, other modules are mostly scenario based (*Figure 8*). Special attention should be paid on module A2, transportation of raw materials. For connection part producers, such as Peikko, steel plates and reinforcing steel are the raw material (A1), which must be transported from the steel mill (A2). In Finland, there are a limited amount of steel mills for hot rolled steel plates and none for reinforcing steel bars since the 1990s. This means that companies like Peikko are forced to buy their raw materials outside from Finland, which increases transportation distance between the steel mill and production unit. This is an example about facts, which should be transparently communicated through EPDs.

ENVIRONMENTAL DATA SUMMARY

Declared unit	1 kg of DELTABEAM®, painted
Declared unit mass	1 kg
GWP-fossil, A1-A3 (kgCO2e)	2,65
GWP-total, A1-A3 (kgCO2e)	2,63

Figure 8. Summary of GWP-total in EPD.

6. Conclusions

EPDs have quickly become strong arguments for business decisions and investments. But a deeper understanding about their content is still scarce. Decision makers are comparing numbers, especially GWPs, of different manufacturers, but may not be aware of all principles and assumptions behind those. Peikko aims to provide clarity and transparency about EPDs for the other stakeholders of the construction sector by explaining the LCA and EPD creation process. This should also help the clients to compare EPDs of different manufacturers and avoid intentional or unintentional green washing of construction products.

References

[1] Core Product Category Rules. EPD Hub Limited. Version 1.0 – 1 February 2022

[2] EN 15804:2012 + A2:2019. Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products

[3] World Steel Association. 2020. Steel industry key facts – Steel is at the core of a green economy

[4] Understanding Global Warming Potentials. United States Environmental Protection Agency. 2023. https://www.epa.gov/ghgemissions/understanding-global-warming-potentials

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