

Construction Products Key Environmental Indicators

A white paper by

Rumela Atanasova

Sr. Digital Construction Researcher at Cobuilder

Table of Contents:

1. Abstract.....	2
2. Background.....	2
3. EPDs as sources of environmental information.....	3
4. Overview of sustainability initiatives and policies and a cross – reference to EPD usage.....	5
4.1. EU Green Deal	5
4.2. Level(S)	5
4.3. Green Public Procurement (GPP).....	6
4.4. Green building certification schemes	6
4.5. Klimaplan Norway	7
6. Cross-reference results.....	9
7. Conclusions	11
How to respond to this document?.....	12
References.....	14

1. Abstract

The construction industry has been identified as one of the largest consumers of energy and raw material resources in the world. Now, with the growing number of concerns about climate change and the non-renewable nature of some resources, there is a huge pressure on the industry to reduce its negative impact on the environment. There are many areas where the industry has a negative impact on the planet, however, what has been of interest lately is the indirect impact, and more particularly – the impact of construction products. The path to a sustainable future is related to the responsible use of materials and energy, improving manufacturing processes and lowering emissions. Responsibility, as we all know, starts with making well-informed decisions.

With that said, in this paper we want to draw your attention to the evaluation, assessment and analysis of the environmental performance of products. In the following sections we offer an overview of different sustainability initiatives and how they relate to the assessment of the environmental performance of construction products. As there are many different aspects to consider when we try to evaluate environmental impact, our aim is to provide value to our readers by compiling a set of key environmental parameters for construction products by cross-referencing the listed influential initiatives and standards.

The ultimate goal of this document is to lower the threshold for actors in the industry to start implementing and monitoring their assets' sustainability performance. Therefore, the matrix we provide at the end of this study can serve as a guide for the minimum set of parameters to be used when setting environmental requirements on construction projects.

2. Background



Key messages:

In 2019, CO₂ emissions from construction reached the highest level ever recorded.

Construction products account for 10 out of 38% CO₂ emissions worldwide.

There is a need for credible environmental information aligned with International and European standards.

Sustainable and circular construction is becoming a major focus for governments around the world due to the growing concerns over climate change. The UN Environment Programme 2020 Global Status Report for Buildings and Construction [2] states that *“despite stable energy demand, energy-related CO₂ emissions from building operations and construction reached their highest level ever recorded in 2019. Together with manufacturing, transportation, and use of construction materials, they account for 38% of the global CO₂ emissions”* (see Fig. 1).

Table 1 - IEA Buildings operation and construction emissions estimates, 2019

	2019 (MtCO ₂)	Share
Buildings use phase	9953	
Coal	496	9% direct emissions
Oil	939	
Natural gas	1663	
Electricity and heat	6855	19% indirect emissions
Buildings construction	130	10% indirect buildings and construction value chain emissions
Construction energy use	130	
Material manufacturing	3430	
Cement- and steel- manufacturing for construction	2038	
Other	1391	
Buildings and construction value chain	13512	38% of total energy related emissions

Source: (IEA 2020b). All rights reserved. Adapted from "Energy Technology Perspectives 2020"

Figure 1 – Buildings operation and construction emissions estimates, 2019

The selection of green building materials is an integral and important part of the design of sustainable buildings. In fact, the global green building materials market is forecasted to grow at a rate of 11.3% from USD 254.76 Billion in 2019 to USD 573.91 Billion in 2027. For instance, interior materials are estimated to be the second-largest market due to consumers' growing awareness of the environmental benefits they offer, such as better aesthetics, improved lighting, and better indoor air quality. The upward trend in demand is also supported by the increase of government-led sustainability initiatives promoting the use of more eco-friendly and energy-efficient construction products. [3]

As a result, credible environmental information about construction products has become a necessity. Logically, this information is provided by construction products manufacturers, who follow the same procedures and rules. EN 15804:2012+A1:2013 [1] is a standard for developing reliable and verifiable life cycle assessment-based studies (LCA), reported in the format of Environmental Product Declarations (EPD). In the next section, we will take a closer look into this standard as we see it as the fundamental basis for solving the environmental information need.

3. EPDs as sources of environmental information



Key messages:

EPDs are documents summarising the environmental performance of construction products over their full life cycle.

They are created in accordance with a European standard (EN 15804), providing transparent and trusty methodology.

EPD information goes through a verification process performed by an independent verifier, ensuring credibility.

EN 15804:2012+A1:2013* [1] is a standard setting the common rules for the life cycle assessment (LCA) of construction products, making environmental information credible, transparent, and comparable.

Where EN 15804 sets the general common rules for LCA of construction products (such as assessing indicators for Global Warming Potential), Product Category Rules (PCRs) define the rules for specific product groups (e.g., windows, concrete, insulation etc.), in addition to the EN 15804 core rules. As part of the common rules, EN 15804 also provides a common set of environmental indicators which are the result of the conducted LCA.

While these indicators provide the complete picture of the environmental impact of a product, their sheer number is intimidating and somewhat confusing for actors who are part of the construction process, but are not environmental experts themselves. These actors are looking to introduce sustainable practices in their organisations and evaluate different design options. It is also worth mentioning the latest version of the standard, as at present, both are valid and used – EN 15804:2012+A2:2019 [5] – which also defines the common rules and set of environmental indicators for construction products, but is more aligned with some major sustainability initiatives like Product Environmental Footprint (PEF) [6].

So, Cobuilder identified the need for guiding EPD non – expert users on how environmental indicators can be used to achieve their sustainability goals in line with governmental initiatives, which are more likely to affect regulations and laws in future. Therefore, in this paper we will provide an overview of different sustainability initiatives and their relation to the assessment of the environmental performance of construction products. Ultimately, we will provide a **set of key environmental indicators** for construction products by cross – referencing some of the most important and influential initiatives and EN 15804. This will help non-expert users with a minimum requirement set for sustainable construction products, based on EN 15804 parameters, that will ensure a good starting point for achieving sustainability goals set by their government and market initiatives.

***Note:** EN 15804 indicators are not always explicitly referred in the initiatives described below, so their mapping to the initiatives is our interpretation based on our knowledge and understanding of these documents.*

4. Overview of sustainability initiatives and policies and a cross – reference to EPD usage



Key messages:

The otherwise voluntary provision of EPDs becomes part of governments' sustainability strategies and policies.

This section provides a brief overview of important sustainability initiatives, as the aim is to underline the core role of the otherwise voluntary provision of EPDs in governments' sustainability strategies and policies.

4.1. EU Green Deal [7]

The European Green Deal was presented at the end of 2019 and was slowly rolled out and introduced throughout the EU in 2020. It can be described as: *"The European Green Deal provides a roadmap with actions to boost the efficient use of resources by moving to a clean, circular economy and stop climate change, revert biodiversity loss and cut pollution. It outlines investments needed and financing tools available and explains how to ensure a just and inclusive transition."* [8].

The actual EU Green Deal document is not a law itself, however, it will affect Member States' laws. For instance, the Green Deal led to the drafting of a climate law that codifies the carbon neutrality goal by 2050. The law would empower the Commission to assess the progress made by the Member States towards the goal and to review the trajectory towards carbon neutrality every five years starting in 2023 [9].

Most importantly, with regards to the focus on credible environmental information, the EU Green Deal document states *"Reliable, comparable and verifiable information also plays an important part in enabling buyers to make more sustainable decisions and reduces the risk of 'green washing'. Public authorities, including the EU institutions, should lead by example and ensure that their procurement is green."* [13].

We can clearly see a requirement for the reduction of greenhouse gasses, or global warming potential, as well as an increase in demand for structured environmental information. And yet, the goals and requirements set in the EU Green Deal remain on a high level whereas the Level(S) framework defines requirements on a level that we can relate to more easily.

4.2. Level(S) [10]

Officially launched in October 2020 by the European Commission, Level(S) has become the first European voluntary reporting framework for the sustainability assessment of buildings and construction works. The idea is to monitor several indicators deemed critical to the sustainable performance of buildings and to identify certain "hot spots" where that performance is particularly bad. Even though it is voluntary, the framework has its serious back-up by the EU Green Deal, as mentioned above, but also by the Circular Economy Action Plan. The Circular Economy Action Plan

promotes the use of Level(S) as the way to integrate life cycle assessment in public procurement and the EU sustainable finance framework [11].

Level(S) indicators that require the use of EN 15804 indicators (EPD parameters) are: Indicator 1.1 – Use stage energy performance, Indicator 1.2 – Life cycle Global Warming Potential (GWP) and Indicator 2.2 – Construction and demolition waste and materials.

***Note:** EN 15804 indicators are not directly referred in Level(S) indicators, however, EN 15804 is sometimes referred as a calculation method and reference standard.*

Most indicators refer to EN 15978 which is a standard for the assessment of environmental performance of buildings, so it measures environmental indicators on a building level, whereas EN 15804 measures indicators on product level. However, the calculation procedures in EN 15978 require EN 15804 indicators' results/values.

To be able to accurately monitor and assess the indicators set by Level(s) framework, the availability of structured product information is critical. Having reviewed this initiative we can clearly see that EPDs lie at the basis for the successful application of Levels(s).

4.3. Green Public Procurement (GPP)

Green Public Procurement is a voluntary instrument that ensures that Member States use common criteria which will avoid distortion of the single market and a reduction of EU-wide competition. There are two types of criteria – the core criteria, addressing key environmental impacts and the comprehensive criteria, which are suitable for those who wish to purchase the best environmental products available on the market [12].

Even though the use of GPP is voluntary, the European Green Deal Investment Plan states: “*The Commission will propose minimum mandatory green criteria or targets for public procurements in sectorial initiatives, EU funding or product-specific legislation. Such minimum criteria will ‘de facto’ set a common definition of what a ‘green purchase’ is, allowing collection of comparable data from public buyers, and setting the basis for assessing the impact of green public procurements.*”[14]

The European Commission has developed more than 20 common GPP criteria, as the priority sectors for implementing GPP were selected through a multi-criteria analysis. The GPP criteria that require the use of EN 15804 indicators is EU GPP Criteria for Office Building Design, Construction and Management [15].

EN 15804-compliant EPDs enable the flow of “comparable” product information which is the core of the GPP initiative.

4.4. Green building certification schemes

Green building certification schemes can be defined as tools that are used to assess the sustainable performance of construction projects. Certified sustainable buildings ensure the outperformance compared to other conventional buildings and, therefore, support sustainable agendas like the UN Sustainability Development Goals or the EU Green Deal. Currently, there are hundreds of schemes around the world, but some of the most recognizable and used ones are BREEAM, LEED, DGNB, HQE, WELL etc.

These schemes set different types of criteria that the building will be assessed by. Each criterion sets a specific sustainability requirement and evidence that would prove compliance. In most certification schemes EPD information based on EN 15804 is considered evidence. For the purpose of this study, we used CEEQUAL [16] as an example.

CEEQUAL is a sustainability certification scheme part of the BREEAM group of manuals, that specifically targets infrastructure projects. In section 7, centered around material and energy use, there is a simplified LCA assessment scheme described, which focuses specifically on global warming potential, water use, and waste generated.

4.5. Klimaplan Norway [17]

We have chosen Klimaplan Norway as an example of a good alignment between national sustainability policies and sustainability goals set by the EU Green Deal and Circular Economy Action Plan. Klimaplan is Norway's climate action plan for the 2021 – 2030 period that deals with emissions in the non-quota sector, i.e., transport, construction, agriculture, and waste.

Klimaplan will set requirements specifically on public buildings and property in the civilian sector with a focus on the re-use of materials and the use of environmentally friendly materials. As for some of the other sustainability initiatives, Klimaplan does not refer to specific EN 15804 indicators, however, it explicitly declares the Government's plans on reducing CO₂ emissions, reusing and recycling materials, and reducing waste. With that said, we can state that EN 15804 indicators of interest would be global warming potential, secondary materials, components for re-use, exported electrical and thermal energy, materials for energy recovery, materials for recycling, hazardous and non – hazardous waste, and radioactive waste.

Based on the review of this initiative, we can clearly see the rising demand for environmental information about construction products. Not only this information is required, but there is a demand for credible environmental information, and this is what EPD provides. To analyze and correctly assess the sustainability of any construction product, you need to base your assumptions on trusted and reliable information.

5. Challenges with the use of EPD



Key messages:

EPD information complexity is solved by Data Templates.

Data Templates reduce manual review and interpretation of large documents and serve as the basis for information checks and validations automation.

Although EN 15804 sets quite clear rules in regard to the creation of EPDs and the information that they hold, this all remains very complex. Here are some of the major issues non – expert EPD users are facing:

- **Number of indicators** - EN 15804:2012+A1:2013 sets 24 environmental indicators in total, and its latest version sets even more – 36 indicators.
- **Life cycle stages** – all of these indicators can be declared in all 15 life cycle stages, which raises the number to 540 possible values (indicators * life cycle stages).
- **Naming of indicators** – some of these indicators have very long names composed of terms that would be incomprehensible to someone who is not an LCA expert. Sometimes these long names are represented by abbreviations, which confuses non-expert end-users even more.
- **Definitions of indicators** – end-users who are not familiar with the indicators and their meaning are not able to find any definition in EPDs.
- **Amount of information** – one EPD can be composed in more than 10 pages. In addition to the environmental indicators, EPDs hold other types of information like technical information about products, administrative information about the manufacturer, additional environmental information etc. So, the amount of information makes navigation through the document almost impossible for non-expert users.

Based on the previous discussion, we have provided evidence that the industry has identified the need to make EPD information available to a broader non – expert audience and ensure that this information is used properly and on time. We have seen that most significant initiatives like the UN Sustainability Development Goals, EU Green Deal, Circular Economy Action Plan, Klimaplan etc., have identified **digitalisation as a key enabler**. Therefore, there is significant and largely untapped potential to use digital solutions for delivering construction products information to meet sustainability goals set by governments.

To enable this, a structured way of collecting data has been developed and described in **EN ISO 23387 [18]** and the upcoming **ISO 22057 [19]**, which has defined the indicators from both versions of EN 15804 in a data template. The aim of ISO 22057 is to structure EPD data in a proper digital format, a.k.a. data template, that will allow users to:

- Easily set requirements on the environmental performance of construction products;
- Search and compare conformant products;
- Predict project's performance based on accurate environmental data, provided by manufacturers;
- Set the basis for future benchmarks and policies.
- Use EPD data in a format compliant with (BIM) standards developed to support the digital transformation and future for the construction industry.
- Support the provision of EPD scenarios information, enhancing the meaning of environmental results and making them more accurate.

Shortly on data templates. Data templates are sets of digital concepts, logically connected to each other, describing a product and its relevant characteristics of all kinds – technical, environmental, geometric, operation & maintenance etc. The logic set by the connections between concepts ensures products information interpretability by a software application, and thus, relieving humans

with the operation of information otherwise held in unstructured formats like PDF or Word that normally require manual review and interpretation. With that said, data templates dramatically reduce manual effort of reading and interpreting documents, transform information into structured data models which are the basis for future automation of information checks and validations, and reduce miscommunication between different actors.

Read more about the Data template methodology for the construction industry in [this article](#).

6. Cross-reference results

Based on the cross-reference of initiatives' requirements and EN 15804 indicators, we have identified a "hot spot" or a minimum set of indicators to start with when setting requirements for construction projects through any means but most importantly through data templates. We believe that this set is a good starting point for the preparation of future legislative sustainability requirements and will enable actors to make better-informed decisions.

Below in Fig. 2 and Fig. 3, you will find the results of this cross-reference work, a matrix showing EN 15804 indicators and their relevance to each of the studied initiatives/documents. Also, based on our experience with customers and dialogue with some environmental experts, we have highlighted the ones with the biggest impact in green.

EN 15804:2012+A1:2013	Level(s)	GPP	CEEQUAL	Klimaplan
depletion of abiotic resources - elements		✓		
depletion of abiotic resources - fossil fuels		✓		
acidification for soil and water		✓		
ozone depletion		✓		
global warming	✓	✓	✓	✓
eutrophication		✓		
photochemical ozone creation		✓		
use of renewable primary energy excluding renewable primary energy resources used as raw materials	✓			
use of renewable primary energy resources used as raw materials	✓			
total use of renewable primary energy resources (primary energy resources used as raw materials)	✓			
use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	✓			
use of non-renewable primary energy resources used as raw materials	✓			
total use of non-renewable primary energy resources (primary energy and primary energy resources used as raw materials)	✓			
use of secondary material				✓
use of renewable secondary fuels				
use of non-renewable secondary fuels				
net use of freshwater	✓		✓	
hazardous waste disposed	✓		✓	✓
non-hazardous waste disposed	✓		✓	✓

radioactive waste disposed	✓		✓	✓
components for re-use	✓			✓
materials for recycling	✓			✓
materials for energy recovery	✓			✓
exported energy				✓

EN 15804:2012+A2:2019	Level(s)	GPP	CEEQUAL	Klimaplan
abiotic depletion potential for fossil resources				
abiotic depletion potential for non-fossil resources - minerals and metals				
acidification potential, accumulated Exceedance				
depletion potential of the stratospheric ozone layer		✓		
eutrophication potential, accumulated exceedance		✓		
eutrophication potential, fraction of nutrients reaching freshwater end compartment		✓		
eutrophication potential, fraction of nutrients reaching marine end compartment		✓		
global warming potential - biogenic	✓	✓	✓	✓
global warming potential - fossil fuels	✓	✓	✓	✓
global warming potential - land use and land use change	✓	✓	✓	✓
global warming potential - total	✓	✓	✓	✓
tropospheric ozone concentration increase		✓		
water (user) deprivation potential, deprivation-weighted water consumption				
potential comparative toxic unit for ecosystems				
potential comparative toxic unit for humans - cancer effects				
potential comparative toxic unit for humans - non-cancer effects				
potential human exposure efficiency relative to U235				
potential incidence of disease due to PM emissions				
potential soil quality index				
non-renewable primary resources used as an energy carrier (fuel)	✓			
non-renewable primary resources with energy content used as material	✓			
non-renewable secondary fuels				
recovered energy				
renewable primary resources used as an energy carrier (fuel)	✓			
renewable primary resources with energy content used as material	✓			
renewable secondary fuels				
secondary materials				✓
consumption of freshwater	✓		✓	
components for re-use	✓			✓
exported electrical energy				✓
exported thermal energy				✓

materials for energy recovery	✓			✓
materials for recycling	✓			✓
hazardous waste disposed	✓		✓	✓
non-hazardous waste disposed	✓		✓	✓
total radioactive waste disposed	✓		✓	✓

7. Conclusions

With this study, Cobuilder aimed at identifying a set of key environmental indicators for construction products by cross-referencing some of the most important and influencing sustainability initiatives and industry standards.

The main goal is to make credible environmental information about construction products easy to understand so that more construction stakeholders could benefit from it and correctly assess the impact of their construction products.

Our knowledgeable experts, who keep track and refer to all significant green-innovation initiatives and industry standards, identified that **comparability of the information** is the intersection point between all of them.

To create a more sustainable built environment, supported by today's digital technologies for delivering construction products information, we need to find a structured and standardised way of collecting and evaluating environmental data. A potential solution to this challenge is the Data Templates methodology, which lies in the heart of Cobuilder's software platform.

At Cobuilder, we harness the power of data by stepping on the latest technological innovations and international standards.

If you are curious to learn more about our research on sustainability in construction, you can read the following articles:

- [Using technology to reduce embodied carbon: From EPDs to PDTs](#)
- [Towards sustainable construction: Understanding the industry's impact](#)
- [Towards sustainable construction: How each construction party can help](#)

This study is published in June 2021.

How to respond to this document?

This study is a suggestion and is open to comments and feedback for improvement. We would like to encourage people and organisations from across the industry to respond to this document and provide their views on the notions put forward.

Please send your responses to rumela.atanasova@cobuilder.com

Main Author:



Rumela is part of the Research and Data Quality Team at Cobuilder. She specialises in environmental data and its use in BIM. At the present moment, Rumela is working on her doctoral dissertation which focuses on the digitisation of product information and its application in sustainable construction.

Rumela Atanasova

Digital Construction Researcher at Cobuilder

Co – author:



Peter Andonov

Sr. Digital Construction Researcher and Data Science Engineer at Cobuilder

Peter got his master's degree in Civil Engineering at the University of Architecture, Civil engineering and Geodesy in Sofia. Currently, he is a team member of the Research and Data Quality Team at Cobuilder but his passion for extracting knowledge and insights from structured and unstructured data is moving him to Data Science Engineer

References

- [1] EN 15804:2012+A1:2013 - Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products
- [2] 2020 GLOBAL STATUS REPORT FOR BUILDINGS AND CONSTRUCTION: Towards a zero-emissions, efficient and resilient buildings and construction sector, UN Environment Programme, 2020
- [3] <https://www.reportsanddata.com/report-detail/green-building-materials-market>, last visited on 25.04.2021
- [4] ISO 14025:2006 – Environmental labels and declarations — Type III environmental declarations — Principles and procedures
- [5] EN 15804:2012+A2:2019 – Sustainability of construction works. Environmental product declarations. Core rules for the product category of construction products
- [6] <https://ec.europa.eu/environment/eussd/pdf/footprint/PEF%20methodology%20final%20draft.pdf>
- [7] EU Green Deal - https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en#documents
- [8] <https://ecochain.com/knowledge/eus-green-deal-lca-preparation/>, last visited on 26.04.2021
- [9] <https://blogs.lse.ac.uk/euoppblog/2020/07/16/what-are-the-prospects-for-the-european-green-deal/>, last visited on 25.04.2021
- [10] Level(s) - <https://susproc.jrc.ec.europa.eu/product-bureau/product-groups/412/documents>
- [11] European Commission, Circular Economy Action Plan, For a cleaner and more competitive Europe, 2020
- [12] https://ec.europa.eu/environment/gpp/index_en.htm, last visited on 25.24.2021
- [13] https://eur-lex.europa.eu/resource.html?uri=cellar:b828d165-1c22-11ea-8c1f-01aa75ed71a1.0002.02/DOC_1&format=PDF
- [14] <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52020DC0021&from=EN>
- [15] https://ec.europa.eu/environment/gpp/pdf/swd_2016_180.pdf
- [16] CEEQUAL - <https://www.ceequal.com/downloads/>
- [17] Klimaplan - <https://www.regjeringen.no/contentassets/a78ecf5ad2344fa5ae4a394412ef8975/nn-no/pdfs/stm202020210013000dddpdfs.pdf>
- [18] EN ISO 23387 - Building information modelling (BIM) — Data templates for construction objects used in the life cycle of built assets — Concepts and principles
- [19] ISO/DIS 22057 - Sustainability in buildings and civil engineering works – Data templates for the use of EPDs for construction products in BIM