Declaration of the End-of-Life for Building Products

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Trinius W, Goerke J

Ingenieurbüro Trinius GmbH, Barmbeker Str. 9a, 22303 Hamburg, Germany

thinkstep AG, Hauptstraße 111 – 113, 70771 Leinfelden-Echterdingen, Germany

trinius@trinius.de

Abstract. Increasing energy efficiency and related environmental performance improvements of buildings direct stronger focus on the environmental impacts related to building products. For product manufacturers, the provision of information in terms of environmental product declarations (EPD) is a market tool of continuously rising importance.
The increasing concern related to environmental and resource efficiency promotes the concept of circular economy, especially reuse and recycling procedures at the end-of-life (EoL) play an increasing role in decision making. Manufacturers are often unsure how to include late life cycle stages in their product declarations. At the same time users of the information are confused as to what provided information really refers to.
The concept of modular EoL-declarations with clearly identified and described scenarios aims to facilitate the inclusion of the full life cycle in EPDs based on reliable and realistic data. At the same time EoL-declarations promote the communication between the production and EoL-actors and enhance understanding of provided information, including judgements on potential demand and procedures for adaptation of provided information.

1. Introduction

Buildings account for 36% of global final energy consumption and nearly 40% of total carbon emissions [1] [2]. Construction and demolition waste accounts for 25 to 30% of all waste generated in the EU [3] an equally large share of the overall figures. The savings potential in the building sector is therefore considered to be high, according to government and industry.

In recent years, certification systems for sustainable buildings have been established, including DGNB (Deutsche Gesellschaft für Nachhaltiges Bauen e.V.) [4] and LEED (Leadership in Energy and Environmental Design) [5], providing a framework for improving sustainability in the construction sector. Within these certification schemes, a building Life Cycle Assessment (LCA) can be conducted as a means to evaluate the environmental performance of the building over its life cycle. To enable the architect or planer to calculate such a building LCA, it is essential to have access to environmental information for specific construction products. The concept of Environmental Product Declaration (EPD) in accordance with EN 15804 [6] has been established as an important instrument for declaring and communicating the environmental performance of the different building products in the context of a building LCA.

Furthermore, product manufacturers use EPDs in order to communicate environmental product information both internally and externally. With the increasing recognition of resource efficiency, end-of-life information is becoming more frequently requested and provided, leading to the clear demand to strengthen common practice in providing and applying such information.

2. Environmental Product Declaration (EPD)

An EPD is a document that communicates verifiable, accurate, non-misleading environmental information about products and their applications, thereby supporting scientifically based, fair choices and stimulating the potential for market-driven continuous environmental improvement. The results of a life cycle assessment (LCA) in accordance with ISO 14040/44 [7] [8] are declared in an EPD as impact (category) indicators, such as: global warming potential, acidification potential, primary energy and water consumption.

EPD information is expressed in life cycle stages and subdivided into information modules, which facilitates a coherent structure and expression of data packages throughout the life cycle of the product [6]. The modular structure groups significant life cycle stages into product stage (A1-A3), delivery and installation in the construction stage (A4-A5), use stage (B1-B7) and end of life stage (C1-C4). Additionally, benefits and loads from, for example, recycling or thermal treatment, can optionally be declared in module D. Figure 1 gives an overview of the stages and modules covered by an EPD according to EN15804 [6].

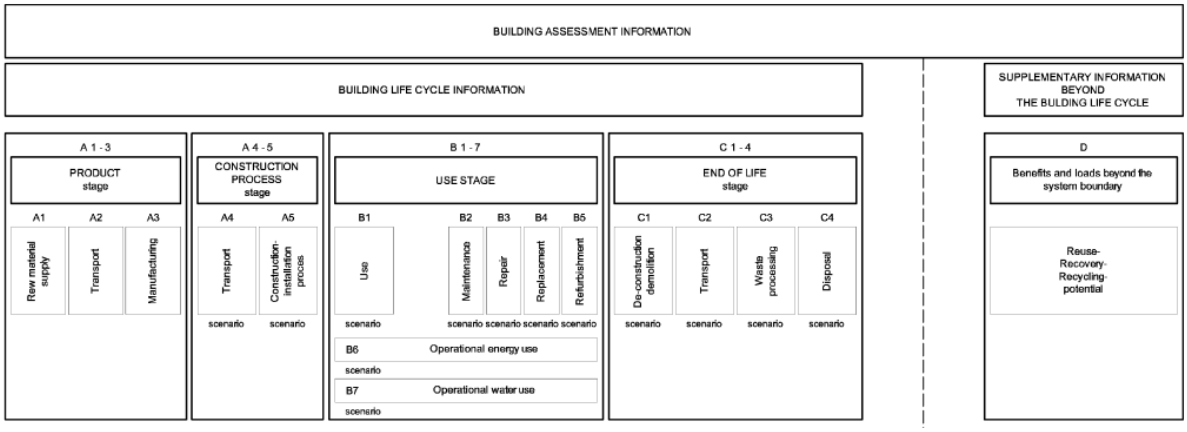

Figure 1 Life cycle stages and modules according to EN 15804

Today, most EPDs focus on the production stage (modules A1-A3 according to EN 15804 – "cradle to gate"); the subsequent modules are included less frequently. Frequently mentioned reasons for focusing on the initial life cycle stages include aspects such as the manufacturers direct involvement and responsibility through to the hesitance to include scenario-based information about later life cycle stages in a declaration for which the manufactures may be held liable. The declared environmental product performance may as well depend significantly on aspects well outside the influence of the manufacturer. Instead user-related aspects (e.g. frequency of product application) or contextual systems (e.g. changes in the energy supply system, or technologies being replaced in situations of changing demand) may have a significant or even decisive influence on the declared information. Consequently, the content of such an EPD may vary between scenarios.

While the loss of the generic value of the presented information may be considered a drawback, scenario-based information can also strengthen the quality of the information provided in an EPD, as the information may be adapted to case-specific boundary conditions, and scenario parameter variations may demonstrate the dependency and sensitivity of declared information to selected parameters.

3. Scenarios in Environmental Product Declarations

One way to declare the subsequent life cycle stages to A1-A3 in an EPD is to use a scenario. Scenarios support the calculation of information modules covering processes that deal with any one or all of the life cycle stages of the construction product, including the end-of-life. In order to define such a scenario, EN 15804 does not give further specifications but generally states that a scenario shall be realistic and representative of one of the most probable alternatives. Thus, currently it is the responsibility of the owner of an EPD to specify the scenario and declare these modules. To make informed decisions about scenarios, EPD owners need access to reliable and realistic data.

For the modules of the product stage (A1-A3) and installation (A4 - A5), manufacturers rely on their own data or generic data. Generic data describe processes that could, in principle, be traced back to the provision of raw materials and thus, for example, reflect the entire upstream chain of raw material or energy generation.

For the end-of-life, there are two processes/scenarios commonly included/described in EPDs: landfill and waste incineration (for production and post-consumer waste). For recycling, generic datasets for common recycling processes – e.g. steel or aluminum recycling – are available. But if a specific recycling process is to be declared in an EPD, then appropriate information for the recycling scenario must be available – often, this is not the case. In the context of circular economy and the promotion of recycling, it is important to close that gap and to enable manufacturers to address the complete life cycle in their declarations. Consequently, to enable manufacturers, they need to have access to robust data to develop reliable partly scenario-based EPDs. Such data, however, can only be obtained from the waste management and recycling industry. There is, thus, an information gap between the manufacturer at the beginning of the product's life cycle and the actors at the end-of-life of the building. The situation is complicated further by the necessity to identify substances and boundary conditions that might have an influence on the applicability or the efficiency of the processes involved in an end-of-life route such as the impurities or harmful components that might influence choice and applicability of an EoL route.

4. End-of-Life Declarations (EoLD)

With the aim of supporting the modelling of the entire life cycle in the context of a (real/true) circularity of buildings the research project: Resource efficient buildings - EPD for construction products: dismantling and recycling information (Module C and D) including hazardous substances funded by the German Federal Environment Agency (Umweltbundesamt, UBA) has started in 2017. Within this research project, the idea of an End-of-Life Declaration has been developed in order to close the information gap between manufacturer and the stakeholders at the end-of-life of the building.

An End-of-Life Declaration (EoLD) calls for the recycling and disposal industry to provide specific data in a form and format that can be integrated in a building product EPD according to EN 15804, which provides the modularity needed for the building LCA. In this way, all actors for production, use and disposal can be liaised. For waste collectors or recyclers, one benefit of declaring environmental information for the end-of-life procedure in an EoLD is the ability to present the environmental quality of their processes in a "readable" and EPD-compliant manner to the manufacturer. Recyclers can thus also describe the input conditions for the respective recycling process in terms of pollutants and impurities. Such information is essential for the correct choice of a scenario and can also be very helpful for producers by enabling the optimization of the product content in the context of better recyclability.

Within the research project, the format of the EoLD has been defined and aligned with the EPD format and content. The EoLD contains company specific, technical and LCA relevant information. It gives a description of the EoL route and the materials and conditions in which the material is accepted by the waste treatment companies. The LCA results are declared in the same systematic as in an EPD in order to link both documents in a consistent way.

The aim of the EoLD is mainly to promote information exchange between stakeholders over the life cycle of a product. By opening lines of communication during the creation of a product EoLD, actors are presented with opportunities to improve their stage of the product life cycle: from design to installation, disassembly, and waste treatment at the product end-of-life.

An EoLD should include a realistic selection of waste treatment at the end-of-life stage of a building or product, enabeling comparing recycling processes with landfill and incineration on the basis of reliable and specific information. To define the end-of-life treatment process for a product, producers must communicate with waste processors to find out which treatment processes are proven to be economically and technically feasible. On the other end, producers must decide, when defining an EoL scenario scope for a product, how the product is (designed/intended) to be installed and disassembled. Information about installation requirements for products, insofar as they enable the proposed EoL scenario, should be verified as realistic common scenarios.

Through the process of learning about how their products are, in practice, installed, maintained, disassembled, and processed at EoL, manufacturers gain valuable information for making improvements within their main sphere of influence: the product design phase. By exchanging information with a recycler, a manufacturer may learn how to improve product's recyclability, for example, regarding separability of materials, and can then make informed changes in the product design. The EoLD includes prerequisites for achieving high-quality recycling at the product EoL. Here, the planning and installation phases are significant. Manufacturers must provide targeted supporting information on the proper application and installation of products to enable the achievement of higher recycling rates.

For waste processors, the EoLD creation process presents the opportunity to learn about manufacturers' intentions for their products and, through access to LCA data and improved information exchange, to improve to their own processes. For example, as recycling companies learn more from the manufacturers about specific product properties and ingredients, they may be able to improve recycling rates by avoiding contamination and impurities, or by improving separability. Better understanding of the product may also lead to innovations in the recycling process. With strong communication pathways, recyclers can communicate with manufacturers about both established and new treatment processes in a way that meets the requirements of sustainable certification systems.

As EoLDs become established through the manufacturing industry, the EoL modules in EPDs will become much less sparse. And while, initially, the bulk of EoLDs will be issued by product manufacturers, once created, EoLDs can also provide a basis for associations or product TCs in international harmonization and standardization to establish reference scenarios for a product group. Based on robust EoLD data, such reference scenarios can then improve the comparability of EPDs. Over time, robust, reliable data on the environmental information about the end-of-life of construction products will become readily available. A larger dataset of EPDs covering the product end-of-life (/all periods of a product's life cycle) will provide reliable data to be used by planers on the building level.

5. Conclusion

As interest in improving the environmental performance of buildings continues to grow – and expand beyond energy efficiency – a stronger focus is directed towards environmental impacts related to building products. For product manufacturers, environmental product declarations (EPD) are a market tool of continuously rising importance, providing a way for producers to share information about the environmental impacts of their products.

The increasing concern related to environmental performance and resource efficiency promotes the concept of circular economy. Reuse and recycling procedures at the end-of-life (EoL) play an increasingly important role in decision making. Manufacturers, however, are often unsure how to include late life cycle stages in their product declarations. At the same time, users of the information are confused as to what provided information really refers to.

The concept of modular EoL-declarations with clearly identified and described scenarios aims to facilitate the inclusion of the full life cycle in EPDs based on reliable and realistic data. At the same time, EoL-declarations promote the communication between the production and EoL-actors and enhance understanding of provided information, including judgements on potential demand and procedures for adaptation of provided information.

While acknowledging that continued use or reuse of products is presumed to be a preferred option, the upcoming standards for environmental product declarations will require the inclusion of the complete life cycle, especially the inclusion of the end-of-life stages. The underlying research aims to identify a transparent procedure enabling actors along a product's life cycle to make well informed decisions, and to potentially adapt provided information to his or her current decision making context and the associated conception of reasonable scenarios for information relating to future situations.

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References

[1] Transition to Sustainable Buildings, Strategies and Opportunities to 2015, International Energy Agency, OECD and IEA 2013
[2] Energy Efficiency: Buildings, International Energy Agency 2018, Inforamtion available at www.iea.org 2019
[3] European Commission, Waste Statistics, Construction and Demolition Waste, Information available at ec.europa.eu 2019
[4] Deutsche Gesellschaft für Nachhaltiges Bauen (DGNB), DGNB System – Kriterienkatalog Gebäude Neubau, 2018
[5] US Green Building Council, LEED Version 4.1, 2019
[6] EN 15804:2012, Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products, CEN 2012
[7] ISO 14040, Environmental management - Life cycle assessment - Principles and framework, ISO 2006
[8] ISO 14044, Environmental management - Life cycle assessment - Principles and framework, ISO 2006