

# The European standard FprEN 15804 for EPD in the construction sector and the application of the modularity principle

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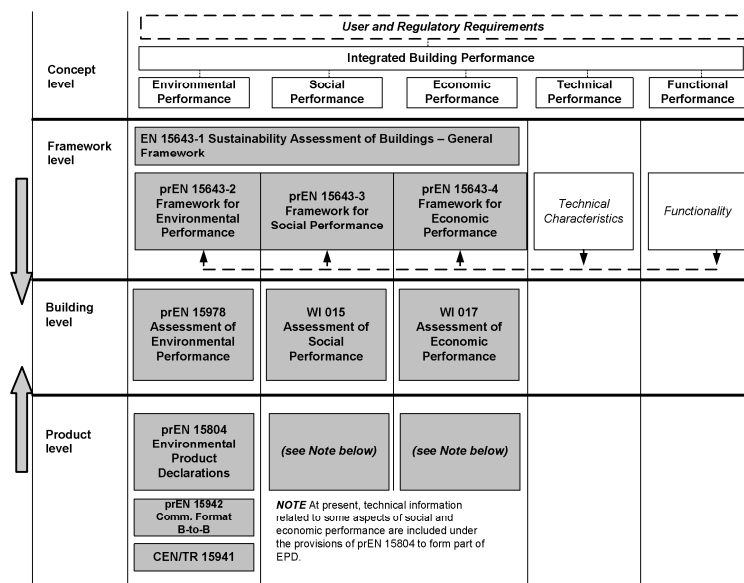
**Abstract** The European standard FprEN 15804 [1] provides the rules for declaring a construction product's environmental performance based on LCA. This declared performance of construction products is a necessary input into the European assessment scheme for sustainable construction according to FprEN 15978 [2]. A set of indicators derived from an LCA study is declared, indicating the product's performance in a sequence of defined modules. The modules encompass specified unit processes in the product's life cycle e.g. raw material extraction, transportation, manufacture, installation, application/installation, maintenance, repair, waste processing, deposition, potential recycling etc. The system boundary of any construction product system is congruent with the system boundary of the building in which such a product has its function. An additional module describes the consequences connected to recycling or recovery processes. The modules are calculated as independent entities and can be combined in different ways, due to common indicators, consistent system boundaries, calculation rules and data quality requirements. Examples are given.

## 1 Description of information modules in FprEN 15804

The European standard FprEN 15804 "Sustainability of construction works — Environmental product declarations — Core rules for the product category of construction products", describes the core product category rules (PCR) for an environmental assessment of construction products within an assessment scheme for buildings and constructions, based on the LCA methodology. The results of this product assessment are declared in an environmental product declaration (EPD). The EPD, a Type III environmental product declaration based on ISO 14025 [4], had already been introduced in the construction sector as a useful tool for communicating the environmental performance of construction products through the standard ISO 21930 [5] "Building construction - Sustainability in building

construction – Environmental declaration of building products. The ISO standard provides a *framework* for developing Product Category Rules (PCR) for EPD.

Both the ISO and the European standard are part of a larger family of standards produced by ISO TC 59/SC17 and CEN TC 350 respectively. The “family” is on one hand owed to the necessity of including the different columns of sustainability (environmental, social and economic), on the other hand to the fact that building assessment is largely based on information from construction products defining the material composition of a building. Consequently both standard families treat buildings (and constructions) as well as products. However while on ISO level the interdependency is recognised but not executed in detail, the European family of standards provides a strictly consistent scheme of building and construction product assessment.



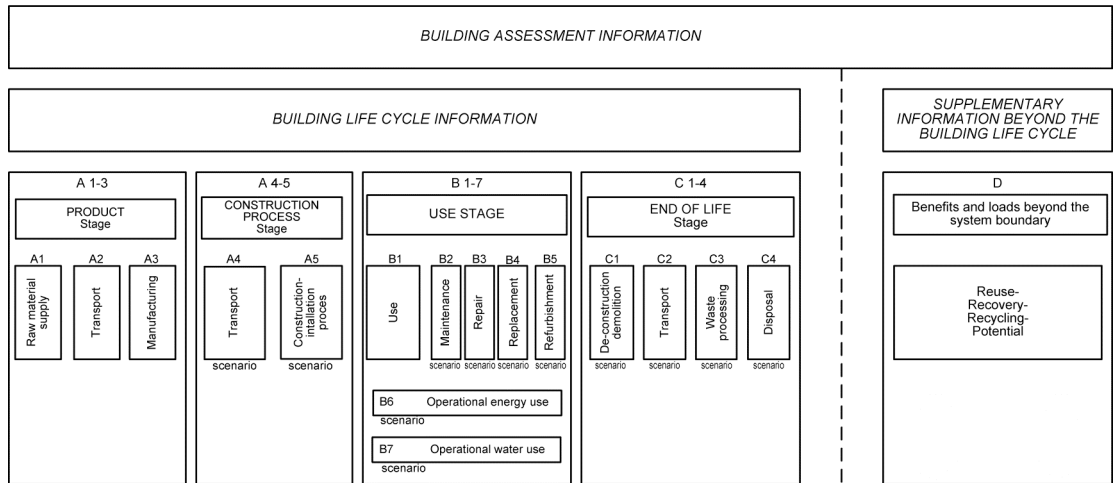
**Fig.1: the structure of the standardisation project of CEN TC 350 as described in EN 15643-2 “Sustainability of construction works — Assessment of buildings — Part 2: Framework for the assessment of environmental performance”.**

Figure 1 also shows the top down and bottom up development of the building assessment scheme:

- **The concept level** lists the main performance issues to be addressed in a sustainability assessment: the classical 3 issues of environmental, social and economic performance complemented by the technical and functional performance of the building.
- **The framework level** provides the consistency between the two levels: building and product.
- **The building level** defines the information demand on products for the building assessment and the rules how to aggregate product information, considering at the same time specific requirements on building level e.g. from the client's brief, regulation or climatic conditions.
- **The product level** provides in the case of environmental performance the conditions for collecting and calculating the product related LCA data to be applied in the environmental assessment of a building. In the case of the assessment of the social performance only a selection of aspects can be aggregated from the products to the building, e.g. indoor air quality, or acoustic comfort. Other social aspects, like participation of inhabitants cannot be derived from the product level. In case of the economic level products contribute to the economic performance of the building, e.g. the conservation of value through products of long service life. The methodology applied is based on Life Cycle Costing.

The requirement of equivalency across the three columns of sustainability is addressed in the general framework EN 15643-1 [7] document by defining a common object of assessment as well as a common view of the building life cycle for each column of sustainability

In order to enable the use of product data on the building level more detailed requirements of consistency for the environmental assessment on product and building level are given in the environmental framework standard Part 2, EN 15643-2 [6]. ISO 14044 [8] is introduced as a normative reference. Four categories of indicators to be used as the pre-set parameters for the environmental assessment are defined in EN 15643-2. They shall satisfy the information demand for the assessment of the environmental performance of a building and are based on LCA. The information modules applied for the description of the building system are defined, describing in detail the different life cycle stages of a building: product stage (modules A1-A3), construction stage (modules A4 and A5), use stage (modules B1-B7) and the end-of-life stage (C1-C4). Outside the building system, but part of the assessment is module D, which describes potential benefits from secondary products or fuels leaving the building system for any next system. This modular build up is visualised as a common figure on product or building level.



**Fig. 2: Display of modular information for the different life cycle stages of the building as well as for the building assessment information, taken from Fig. 5 in FPrEN 15978. The modules are: product stage (A1-A3), construction process stage (A4-A5), use stage (B1-B7) End-of-life stage (C1-C4) and benefits and loads beyond the system boundary (D).**

## **2 Information modules simplify your LCA**

### ***2.1 Modularity needs consistency***

Key for the consistency of the environmental assessment of building and product are the following topics:

- Common pre-set parameter descriptions and measurement
- Consistent system boundaries
- Consistent calculation rules e.g. for allocation: no system expansion for any module
- Consistent data quality

These topics have been addressed in detail in the two standards FprEn 15978 (buildings) and FprEn 15804 (products) of the CEN TC 350 standards family. There are 4 groups of pre-set parameters or indicators (altogether 22 indicators), which are exactly the same on building and product level:

- Indicators describing environmental impacts
- Indicators describing resource use
- Indicators describing waste categories
- Indicators describing the output flows leaving the system

On the product level “additional information on release of dangerous substances to indoor air, soil and water during the use stage” is required as additional information, which should be dealt with in the social building assessment document.

All information modules A1-A5, B1-B7, C1-C4 and D have defined system boundaries. All modules A1 have the same system boundaries for any construction product or any building. The same applies respectively to all other modules. They all apply the same calculation rules and refer to the same requirements for data quality. Common allocation rules, e.g. the exclusion of system expansion, are necessary to maintain the modularity principle: “The principle of modularity shall be maintained. Where processes influence the product’s environmental performance during its life

cycle, they shall be assigned to the module in the life cycle where they occur” (clause 6.4.3.1 in FPrEN 15804).

CEN TR 15941:2010 [3] (Sustainability of construction works — Environmental product declarations — Methodology for selection and use of generic data) gives guidance for the application and selection of generic data. To ensure consistency also for the quality of generic data used in the LCA for an EPD, it is recommended that this data go through a pre-validation step according to the requirements of FprEN 15804.

## ***2.2 Application of information modules in building assessment***

DGNB (Deutsche Gesellschaft für Nachhaltiges Bauen) or BNB (Bewertungssystem Nachhaltiges Bauen für Bundesgebäude), building certification schemes in Germany already apply product data from EPD for the environmental performance assessment. Consistency is a necessary condition for assembling the product related data to describe the environmental performance of a building. All the EPD provided by the Institut für Bauen und Umwelt e.V., [11] (IBU, EPD program operator in Germany) are consistent with respect to the requirements for the LCA based data. The LCA results for the product stage of the building can thus be calculated from the results of the built in products. The construction stage, use stage, end of life stage as well as the potential benefits from secondary products or fuels leaving the building system can only be calculated if consistent scenarios are given on product level, in the EPD. The FPrEN 15804 standard provides guidance for scenario development. Many manufacturers already include the relevant data on use scenarios as well as end- of life and recycling information modules in their EPD, e.g. EPD for flooring products published on the IBU website ([www.bau-umwelt.de](http://www.bau-umwelt.de)).

In order to supply sufficient data, also including construction products that have not declared their environmental performance in an EPD, the German Federal Ministry of Transport, Building and Urban Development provides on its website a freely accessible database, “Oekobaudat” [9] which is based on the same requirements as the IBU EPDs, which are also integrated into the Oekobaudat. In addition DGNB is developing a “Navigator” web based data base, which will provide all the product information needed for the DGNB sustainability certificate, also including EPD information.

### ***2.3 Modularity for SME***

An increasing number of the bigger organisations in the construction sector are using EPD as tool to provide the market with credible and useful information (e.g. Rockwool, Xella, KME, Interface). In fact the recitals for the new European Construction Product Regulation (CPR, replacing the European Construction Product Directive and approved by the European parliament in January 2011 and to be implemented by January 2013), propose the use of EPD to provide the requested information on climate change, resource management and results of harmonised testing for emissions to indoor air, soil and water when available. This is a strong incentive for manufacturers to investigate their products' performance on these topics. Next to this, EPD facilitate access to procurement for certified buildings and allow useful insights into the production processes of the value chain for product development.

However for the many small and medium sized enterprises (SME) in the construction sector, a LCA study is difficult to handle, and only very few have developed this kind of information so far. Some associations have taken advantage of the modularity of EPD and have provided their member SME with pre-calculated modules covering processes common to all members and including the possibility to vary certain input parameters.

### ***2.4 Examples***

***Carpets:*** The Textiles & Flooring Institute GmbH (TFI) in Aachen, Germany provides carpet manufacturers, many of them SME, with an EPD through a pre-calculated model, which allows exchanging certain information modules for production processes (tufting, weaving, needlefelt production) or in end-of-life stages (e.g. recycling processes) according to the specific product group and with parameterized combinations of raw material input (yarns, recycled content). The manufacturers participate in the GUT labelling scheme, which requires the confidential disclosure of the material content, which in turn allows to control the input data.

***Windows:*** Windows normally have a relevant impact on the environmental performance of buildings. Enterprises assembling complex products from commodities, e.g. windows or facades from aluminium profiles, glass, insulation materials, gaskets, fittings etc. also profit from modularity. The designer's inventory database of parts and materials nor-

mally include functional and technical information of those parts and materials. This information can be combined with the respective LCA information modules. A selection of parts and materials ordered by the manufacturer can thus be supplied with its specific technical, functional and environmental information. For an LCA of the complex product the modular information will have to be combined considering the functionality and technical requirements of the complex product, as well as the respective service life times.

These aspects have been implemented in a web based tool e.g. by the European Aluminium Association [14], who was the first to support their members, national associations and European window system providers. With the tool SME manufacturers can develop their specific EPD, based on the dimensions and elements of their specific product, specific European averaged data for aluminium and generic data for all the other materials. Others have followed: the data base for a similar scheme is developed as a research project funded by the Federal institute for research on buildings, urban affairs and spatial development [10] [16]. Next to the "Institut für Fenstertechnik e.V. Rosenheim" (ift, [13]) as project leader, IBU, PE International [12], producers of aluminium, PVC and wooden profiles, glass, gaskets, fittings, gases etc. are cooperating in this project, with their specific German averaged data and their LCA experience.

**Mortars:** SME manufacturers of mortars normally have a very low degree of vertical integration. From a process perspective the LCA of mortar production is simple. However inputs vary extremely. Mortar manufacturers of the association "Industrieverband Werkmörtel e.V." [15] (IWM) grouped their products according to similar inputs. A sensitivity analysis helped to understand which of the components influenced the LCA at what degree. For each group representative data was collected and the upstream production modules for the different inputs calculated. The LCA studies for the different groups were calculated and the results integrated into an EPD. Manufacturers producing mortar of the same composition in types and amounts of inputs can use the pre-calculated EPD directly within limits given by the sensitivity analysis. Manufacturers producing mortar of the same composition in types but with different amounts of inputs can use the parameterized modules of the LCA, vary the input amounts and integrate the new results into the same EPD template. Manufacturers producing mortar of different composition in types and amounts of inputs cannot use the modules.



### **3 Summary and outlook**

The modularity of LCA as applied in the standards FprEN 15804 and FprEN 15978 enhances the applicability of LCA for EPD, especially for SME. The principle of modularity can only be maintained, if a number of requirements, especially the requirement of consistency of the building and product level applications, but also for different construction products are met. However even if EPD of different construction products are fully consistent, comparability is not always given. Different construction products EPD can only be used for comparison, if the products' functional context in the building is taken into account. Nevertheless manufacturers can obtain via the LCA for an EPD valuable insights on their own processes e.g. efficiency potentials, and a robust set of data to communicate the environmental performance of their products, e.g. for the new construction products regulation.

## 4 References and links

- [1] FprEN 15804:2011 Sustainability of construction works — Environmental product declarations — Core rules for the product category of construction products.
- [2] FprEN 15978:2011 Sustainability of construction works — Assessment of environmental performance of buildings — Calculation method.
- [3] CEN TR 15941:2010 Sustainability of construction works — Environmental product declarations — Methodology for selection and use of generic data.
- [4] EN ISO 14025:2006 Environmental labels and declarations — Type III environmental declarations — Principles and procedures.
- [5] ISO 21930:2006 Sustainability in building construction — Environmental declaration of building products.
- [6] EN 15643-2:2010 Sustainability of construction works — Assessment of buildings — Part 2: Framework for the assessment of environmental performance.
- [7] EN 15643-1:2010 Sustainability of construction works — Sustainability assessment of buildings — Part 1 General Framework.
- [8] ISO 14044:2006 Environmental management — Life cycle assessment — Requirements and guidelines.
- [9] Oekobaudat <http://www.nachhaltigesbauen.de/baustoff-und-gebaeuedaten/oekobaudat.html>
- [10] "Entwicklung von Umweltproduktdeklarationen für transparente Bauelemente - Fenster und Glas - zur Bewertung der Nachhaltigkeit von Gebäuden", Government aid by Bundesamt für Bauwesen und Raumordnung Forschungsinitiative Zukunft Bau. Participants: ift Rosenheim e.V., PE International, Institut Bauen und Umwelt e.V. Laufzeit 2009 -2011.
- [11] IBU: [www.bau-umwelt.de/](http://www.bau-umwelt.de/) Accessed 15.04.2011
- [12] PE International: [www.pe-international.com/](http://www.pe-international.com/) Accessed 15.04.2011
- [13] ift Rosenheim [www.ift-rosenheim.de/](http://www.ift-rosenheim.de/) Accessed 15.04.2011
- [14] EAA : [www.eaa.net/](http://www.eaa.net/) Accessed 15.04.2011
- [15] IWM: <http://www.mineralisch.de/mineralische-baustoffe/werkmoertel/> Accessed 15.04.2011
- [16] BBSR: <http://www.bbsr.bund.de/> Accessed 15.04.2011