Short report
EPDs for transparent construction elements

Topic	The development of environmental product declarations for transparent construction elements – windows and glass – for assessing the sustainability of buildings
Short title	EPDs for transparent construction elements
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1 Aim of the research project

Product category rules and EPDs for windows or flat glass in construction need to be compiled within the framework of the project "*Development of environmental product declarations for transparent construction elements – windows and glass – for assessing the sustainability of buildings*" based on requirements of the society, the environment, politics and the demand in the market.

The prEN 15804:2008, "*Environmental Management – Life cycle assessment – Principles and framework*" [1] and the DIN ISO 14025 "*Environmental labels and declarations – type III, environmental declarations – Principles and procedures*" [2] formed the basis for this purpose. Moreover, the method followed while preparing the life cycle *assessments* was in accordance with DIN EN ISO 14040:2006 "*Environmental management – Life cycle assessment – Principles and framework*"[3] and DIN EN ISO 14044:2006 "*Environmental management – Life cycle assessment – Requirements and guidelines*" [4].

Environmental Product Declarations so far, have covered only a part of the life cycle. In most cases, this means from the "cradle to the gate". The manufacturers can provide specific information for this purpose. However, everything that goes beyond this must be presented with the help of scenarios, since it is not known at the product level what happens to it during the stages of utilisation and reuse. The aim of the research project was to reproduce the entire life cycle from the "cradle to grave" and to formulate appropriate and relevant scenarios for this purpose.

Moreover, uniform rules and regulations should be formulated with the PCR documents based on which manufacturers are in a position to have other Environmental Product Declarations prepared.

The Environmental Product Declarations compiled within the scope of the research project need to be used for building certification. In this manner, architects and building designers may access these documents directly and obtain data required for building certification. In addition, the EPDs serve as a source of information for occupants, owners and people interested in the buildings.

2 Execution of the research project

The research project was executed in close cooperation with the Institute Construction and Environment e.V. (*Institut Bauen und Umwelt, IBU*), PE International GmbH and **ift** Rosenheim. During execution, the tasks of **ift** Rosenheim focussed on project coordination and providing know-how from specific industries. It was the task of PE International GmbH to create the life cycle assessments for the EPDs. The Institute Construction and Environment e.V. specified the general rules and regulations for the preparation of the PCR and EPDs. The PCR documents have been validated by an independent IBU technical experts' committee and the EPDs have been checked by an independent IBU auditor. The supportive work on the contents has been done by the associations involved in the project. These are the Bundesverband Flachglas e.V. (*Federal Association of Flat Glass*), the Fachverband Schloss- und Beschlagsindustrie e.V. (*Professional Association of the industry for locks and hardware fittings*), the Qualitätsverband Kunststofferzeugnisse e.V. and the Verband Fenster + Fassade (*Association Windows & Facades*).

To begin with, the basis of the research project was the *Guideline Sustainable Building* [5] of the Federal Ministry for Transport, Building and Urban Affairs and the study requested by the Federal Environmental Agency for the discussion regarding the contents, methodology and procedure for quantitative EPDs of type III including life cycle assessment. Moreover, the PCR documents of the IBU e. V. [6] and the Swedish market [7] also served as the basis. Additionally, the general guideline of the IBU e.V. "*Guideline for the formulation of requirements for the product categories of the environmental declaration (type III) for building products"* [8] was used. In cooperation with the Professional Association of the industry for locks and hardware fittings e.V. the IBU e.V. has already worked out a separate PCR for locks and fittings [9] and several EPDs prior to the project. These documents have been incorporated in the project and the life cycle assessment data has been used as the basis. In addition, the results of the research project, "*Harmonisation of basic data*" (report on methods), and the study, "*Holistic balancing of windows and facades*" [10], in which windows and facades have already been considered and analysed, were also taken into consideration.

Work on the research project was carried out as follows in accordance with the work schedule Figure 1 **Project plan**

In the first step, it was defined that the entire **life cycle** (WP1, WP2) needs to be considered, that is, from the cradle to the grave.

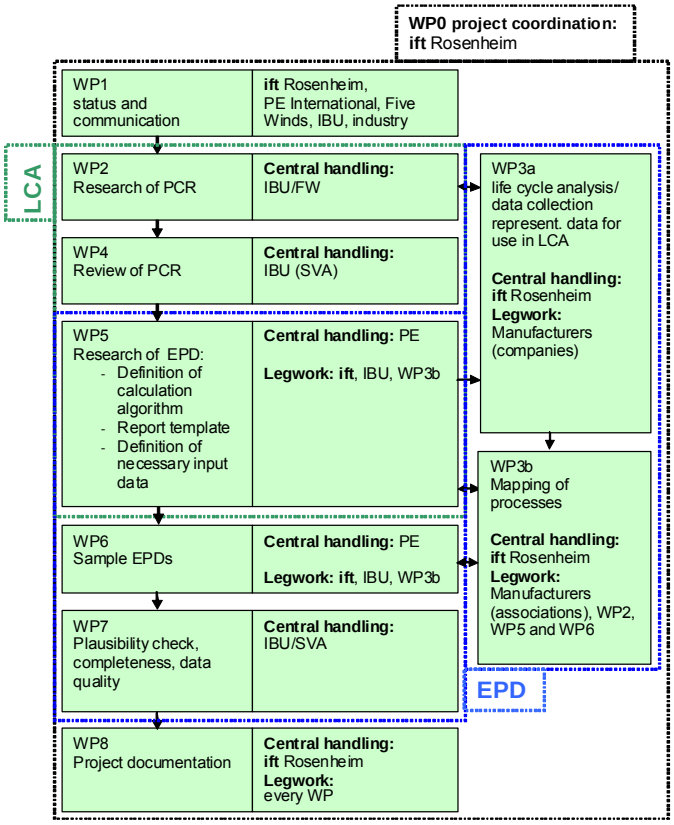

Figure 1 Project plan

PCR documents (WP2) were prepared in the next step. They include the general rules for the preparation of the EPDs. The PCR documents were validated by a technical experts' committee of the IBU (WP4).

Sensitivity analyses (WP5) were prepared as a decision-making aid to have better understanding of the validity of the products to be declared and to be able to decide on the system limits. After conducting the sensitivity analyses, manufacturer-specific data, such as, for example, energy consumption, water consumption, and even the incidental waste are gathered by a **data acquisition** system (WP3a). Since it is almost impossible to gather information pertaining to the raw materials or material-specific data (highly time-intensive), the data used for this purpose was taken from the generic data available in the database GaBi 4 [11]. Finally, the **life cycle assessments** (WP3a, WP3b) could be calculated based on this data, with the help of which the significant impact of the products on the environment (e.g. greenhouse potential or primary energy consumption) can be represented. Moreover, life cycle assessment reports that document all the data were prepared, and this data is taken into consideration in checking and auditing the EPDs. Finally, the **EPDs** (WP6) could be prepared. After preparation, all EPDs had to be checked by an independent IBU auditor (WP7).

3 Summary of the results

According to the justification for the application of the research project, sample EPDs should be formulated for the windows and doors industry taking the entire life cycle (cradle to grave) into consideration. For this purpose, it was first necessary to work out appropriate product category rules. They were worked out in line with DIN ISO 14025 [2], prEN 15804 [1] and the requirements of the IBU's "*Guideline for the formulation of requirements for the product categories of the environmental declaration (type III) for building products"* [8]. As a result, an international approach as desired by the industry could not be followed.
While defining the declared unit, it became apparent that the preparation of sample EPDs for construction systems (e.g. windows) cannot be done uniformly as in the case of simpler construction products such as bricks, for example. As a result of the diversity of variants in window systems, among others, the reproduction of an industrial cross-section and the required and detailed definition of the products was complex. Based on the sensitivity analyses conducted, however, an almost practical description of the declared unit could be found regarding the definition of three variants. Accordingly, one variant for the description of the declared unit needs to be selected while preparing (sample) EPDs.
Variant 1 is oriented only at the product standard DIN EN 14351-1 for windows and doors and describes the declared unit by the standard windows (1.23 m x 1.48 m) and standard doors (1.23 m x 2.18 m) defined in the standard. Variant 2 is defined with the help of the frame portion of the window and variant 3 permits a specific definition of the unit.
The following documents including the defined life cycle scenarios have been cleared by the IBU technical experts' committee:

- PCR windows and doors
- PCR flat glass in construction

Moreover, scenarios covering the entire life cycle have been worked out. These are expected to provide the building auditor with realistic and representative scenarios of the windows and doors for an assessment of the building.

Life cycle assessments were calculated on the basis of generic data and data from the industry for the preparation of the EPDs. Data acquisition in the respective divisions of the industry was somewhat difficult on account of the scope.

Life cycle assessments and finally, EPDs over the entire life cycle were prepared for the following products within the scope of the project:

- Sample EPD for wooden windows
- Sample EPD for aluminium windows
- Sample EPD for plastic windows
- Sample EPD for flat glass, single-layer safety glass and laminated safety glass
- Sample EPD for 2-layer and 3-layer insulated glazing

When considering only the manufacturing stage, the type of material, the upstream manufacturing chain of the respective material and coatings, if any, affect the impact on the environment. In contrast, the analysis of different window types showed that by considering the entire life cycle taking the energy requirement during the utilisation stage into consideration, the choice of the frame materials has a negligible impact.

4 Acknowledgement

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5 Bibliography

[1] prEN 15804:2008-04
Nachhaltigkeit von Bauwerken – Umweltproduktdeklarationen für Produkte – Regeln für Produktkategorien
Berlin, Beuth Verlag GmbH

[2] ISO 14025:2006
Umweltkennzeichnungen und -deklarationen – Typ III Umweltdeklarationen – Grundsätze und Verfahren
Berlin, Beuth Verlag GmbH

[3] DIN EN ISO 14040:2006
Umweltmanagement – Ökobilanz – Grundsätze und Rahmenbedingungen
Berlin, Beuth Verlag GmbH

[4] DIN EN ISO 14044:2006
Umweltmanagement – Ökobilanz – Anforderungen und Anleitungen
Berlin, Beuth Verlag GmbH

[5] Bundesamt für Bauwesen und Raumordnung
„Leitfaden Nachhaltiges Bauen“
2. Nachdruck (mit redaktionellen Änderungen). 2001.

[6] Institut Bauen und Umwelt e.V.
„PCR Faserzement“. Königswinter, 2010.

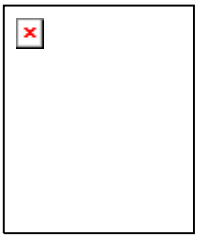
[7] Cormo soc. coop.
“Product Category Rules (PCR), for preparing an environmental product declaration (EPD) for windows”
San Martino in Rio, Italy, 2008

[8] Institut Bauen und Umwelt e.V.
„Leitfaden für die Formulierung der Anforderungen an die Produktkategorien der Umweltdeklaration (Typ III) für Bauprodukte“
Königswinter; 2006

[9] Institut Bauen und Umwelt e.V.
„PCR Schlösser und Beschläge“
Königswinter, 2011

[10] Kreißig, J.; Baitz, M.
„Ganzheitliche Bilanzierung von Fenstern und Fassaden“
Forschungsbericht. Universität Stuttgart, 1997

[11] PE International GmbH und LBP Universität Stuttgart
GaBi 4/ 2009/ Software und Datenbank zur ganzheitlichen Bilanzierung;
http://www.gabi-software.com; 70771 Leinfelden-Echterdingen



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