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Environmental product declarations in accordance with EN 15804 and EN 16485 — How to account for primary energy of secondary resources?

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ABSTRACT

As a core product category rule (PCR), EN 15804 defines rules for conducting the life cycle assessment (LCA) of building products in the context of environmental product declarations (EPDs). This European standard is complemented by EN 16485, which provides further guidance for specific aspects for the LCA of wood and wood-based construction products. For all life cycle stages under consideration, the *renewable* and *non-renewable primary energy* employed for energy generation or material use is accounted for. Furthermore, the inputs and outputs of *secondary materials* (SM), *renewable secondary fuels* (RSF) and *non-renewable secondary fuels* (NRSF) have to be reported. Especially in the end-of life stage as well as in the production stage, the standards do not exactly rule the accounting method of the primary energy contained in SM, RSF and NRSF. As both standards leave room for interpretation, we wrote this discussion article to introduce this issue to the LCA community and to present our developed accounting specifications. In general, we consider EN 15804 and EN 16485 as helpful tools for the LCA of building products. We hope that our ideas on certain aspects contribute to a better understanding of the standards, possibly leading to further improvement in the course of the standardization process.

1. Introduction

After receiving a mandate issued by the European Union in 2005, the European committee for standardization developed a set of horizontal standards which enables the sustainability assessment of buildings. Beside framework documents (EN 15643—1 to 4) for the assessment of ecological, economic, socio-functional and technical aspects of a building along its entire life cycle (CEN, 2010, 2011a, 2012a,b), the environmental assessment of building products is specifically ruled by EN 15804 (CEN, 2013). In case of wood-based products, complementary product category rules (PCR) are available (EN 16485 (CEN, 2014)). Life cycle assessment (LCA) data for building products in line with EN 15804 and EN 16485 provide the necessary information for the assessment of the environmental performance of whole buildings as defined in EN 15978 (CEN, 2011b).

EN 15804 — *Sustainability of construction works — Environmental product declarations — Core rules for the product category of construction products* (CEN, 2013) is the core-PCR for the environmental assessment of building products within the framework of type III environmental declarations (EPD) according to ISO 14025 (ISO, 2006a). For the LCA part of an EPD, EN 15804 sets a convention for several issues where ISO 14040/44 (ISO, 2006b,c) leave space for adjustment. According to EN 15804, the LCA for building products needs to subdivide the different life cycle stages and requires displaying the results separately (CEN, 2013) (Fig. 1). While the reporting of the production stage (modules A) is mandatory, the use stage of buildings (modules B), the processes that take place in the end of life stage (modules C) and the benefits and loads beyond the defined system boundary (module D) can be considered optionally. Module D is considered to only comprise supplementary information beyond the system boundary. For each module, results are calculated for various parameters describing environmental impacts, the use of resources as well as waste flows and other outputs. In particular, calculation procedures—especially those concerning allocation of flows—are also dealt with in the standard. After the first revision in 2013, EN 15804 additionally defines the characterization factors to be used as those published by the Centrum voor Milieuwetenschappen (Leiden University Institute of Environmental Sciences; CML (Guinée, 2002)).

In case of wooden building products, EN 16485 — *Round and sawn timber — Environmental Product Declarations — Product category rules for wood and wood-based products for use in construction* (CEN, 2014) complements EN 15804. This standard especially contains a method for the accounting of material inherent properties of wood based products, such as the amount of biogenic carbon and the renewable and non-renewable primary energy content of the raw materials.

Also at building level, the subdivision into modules and the whole range of environmental parameters is available (EN 15978). Within these modules the LCA results of each product are multiplied straight by the specific quantity of the product used. Finally for every parameter

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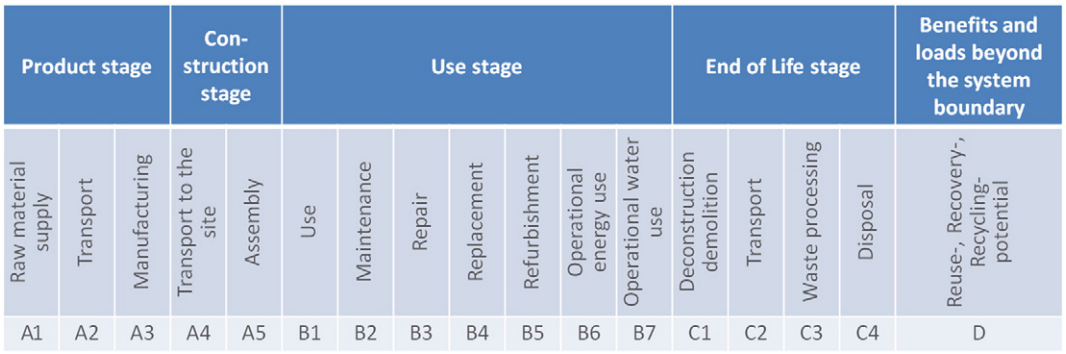

Fig. 1. Life cycle modules of a building according to EN 15804/EN 15978.

the results for the specific quantities of all products are summed up in each module.

As we will show in this discussion article, the set of standards leaves room for interpretation of two specific aspects with high relevance for the environmental assessment at building level. EPDs following different interpretations are available and their combination at building level produces inconsistent results, probably unnoticed. Since the described standardized approach is widely used in Europe and tightly connected to governmental regulations (e.g. Belgium, France, Germany; see Passer et al., 2015), this situation needs to be improved.

We conducted several LCAs for wooden building products according to EN 15804 and EN 16485 in the context of EPDs as well as for scientific publications (Rüter and Diederichs, 2012; IBU, 2013a,b,c,d,e,f; Diederichs, 2014a,b; IBU, 2014a,b; Wenker et al., 2015; Wenker, 2015, Wenker and Rüter, 2015, Achenbach and Rüter, 2016). Based on this experience we understand very well that finding 100% unambiguous expressions while developing standards is a very difficult task. With this article, we would like to support the work of standardization by describing the named problems, presenting our approach and opening a discussion.

We noticed two relevant points which leave room for interpretation and therefore led to different accountings in the past:

- The accounting of primary energy of secondary resources beyond the system boundary in case of thermal utilization
- The accounting of primary energy of secondary resources used in the product system

The issue will be discussed and illustrated by fictional LCA results for the production stage (modules A1–A3) and two end of life options (modules C2–C3/D_m/D_t) of 1 m^3 particle board (see Table 1). Whereas the chapters 2, 3 and 3.1 give important contextual information on the accounting of primary energy according to EN 15804 and EN 16485, the chapters 3.2 and 4 contain our proposals on the two above mentioned points.

2. Primary energy used as raw material within the product system (modules A–C)

EN 15804 specifies 25 parameters for the LCA of building products. Table 1 shows LCA-results for 1 m^3 particle board for the parameters that are summarized under the term *resource use*.

Regarding the energy demand of building products, six different parameters are distinguished. The demand of renewable energy is quantified by the parameters PERE, PERM and PERT, the required non-renewable energy is quantified by the parameters PENRE, PENRM and PENRT (Table 1). The parameters PERE and PENRE display the use of renewable respectively non-renewable primary energy, except the energy used as raw materials. Latter is given by the parameters PERM and PENRM. The parameters PERT and PENRT sum up the results for PERE and PERM respectively PENRE and PENRM.

Renewable primary energy is used as raw material embodied in the wood contained in the particle board (A1–A3, PERM, 9487 MJ). Non-renewable energy is embodied in the fossil based additives and glues of the particle board (A1–A3, PENRM, 580 MJ). According to the complementary PCR for wood-based products (EN 16485) these properties are material inherent and need to exit the system under study in module C3. Thus, the balances of PERM and PENRM are neutral over the entire life cycle (A-C). At this point it should be noted that in context of EN 15804 and EN 16485 primary energy is obviously not seen as the "direct use at the source, or supply to users without transformation, of

Table 1
Proposed accounting of resource use parameters in case of a fictional particle board.

Parameter	Unit	Production Stage	End of Life		Benefits and loads beyond the system boundary	
		A1–A3	C2	C3	D_m	D_t
		Raw material supply, transport, manufacturing	Transport	Waste processing	Material recycling	Thermal utilization
PERE	[MJ]	**1714**	0.0109	5	−33.4	**9086**
PERM	[MJ]	**9487**	0	**−9487**	**0**	0
PERT	[MJ]	11,201	0.0109	−9482	−33.4	**9086**
PENRE	[MJ]	3928	8.29	88	−332	**−12,533**
PENRM	[MJ]	**580**	0	**−580**	**0**	0
PENRT	[MJ]	4508	8.29	−492	−332	**−12,533**
SM	[kg]	**110**	0	0	523	0
RSF	[MJ]	**1150**	0	0	0	**7890**
NRSF	[MJ]	0	0	0	0	580
FW	[m^3]	2.52	0.155	0.91	−0.057	−0.052

PERE = Use of renewable primary energy excluding renewable primary energy resources used as raw materials; PERM = Use of renewable primary energy resources used as raw materials; PERT = Total use of renewable primary energy resources; PENRE = Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials; PENRM = Use of non-renewable primary energy resources used as raw materials; PENRT = Total use of non-renewable primary energy resources; SM = Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of non-renewable secondary fuels; FW = Use of net fresh water.