Compiling environmental product declarations for wood-based construction products

Instructions for inventory, life cycle assessment and documentation

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<th>Description</th>
</tr>
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<tbody>
<tr>
<td>B2B</td>
<td>Business-to-Business</td>
</tr>
<tr>
<td>B2C</td>
<td>Business-to-Consumer</td>
</tr>
<tr>
<td>CEN</td>
<td>European Committee for Standardization</td>
</tr>
<tr>
<td>EC</td>
<td>European Commission</td>
</tr>
<tr>
<td>ELCD</td>
<td>European Reference Life Cycle Database</td>
</tr>
<tr>
<td>EN</td>
<td>Europäische Norm</td>
</tr>
<tr>
<td>EPD</td>
<td>Environmental Product Declaration</td>
</tr>
<tr>
<td>EU</td>
<td>European Union</td>
</tr>
<tr>
<td>ISO</td>
<td>International Organization for Standardization</td>
</tr>
<tr>
<td>LCA</td>
<td>Life Cycle Assessment</td>
</tr>
<tr>
<td>LCI</td>
<td>Life Cycle Inventory</td>
</tr>
<tr>
<td>LCIA</td>
<td>Life Cycle Impact Assessment</td>
</tr>
<tr>
<td>nZEB</td>
<td>nearly Zero Energy Building</td>
</tr>
<tr>
<td>PCR</td>
<td>Product Category Rules</td>
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</table>
Background

The purpose of this guide is to make it easier to compile environmental declarations for construction products. The guide is meant for data collectors, those making life cycle assessments and those responsible in companies for environmental matters.

The guide was made by interviewing experts who have participated in the preparation of important European standards. Moreover, the data collection for environmental declarations was developed and tested in cooperation with three large Finnish companies.

The purpose of our work is to clarify the interpretation of standards that are used as guidance for the drafting of environmental declarations and provide practical examples for the various stages of the process.

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I Basics
1. What is an environmental declaration and what is it needed for?

Environmental impacts of building products have aroused renewed interest as the in-service energy requirements of buildings are gradually declining towards the nearly zero energy buildings’ (nZEB) class in this respect, in accordance with the EPBD Directive (2010/31/EU). Under these circumstances, a greater portion than before of a building’s environmental impacts could be due to production and waste treatment of building materials.

The European Union's roadmaps are strategic initiatives with which the union aims to guide and motivate its member countries and the representatives of industry in them. The roadmaps related to environmental impacts of construction include the Roadmap for a Low-Carbon Economy (EC 2011a) and the Roadmap to a Resource Efficient Europe (EC 2011b). According to the principles presented in these roadmaps, the purpose is to shift taxation from work towards the direction of environmental impacts. It is emphasised, additionally, that consumers and those making purchase decisions should have clear environmental data to help them in making these decisions. One of the ambitious goals behind the important roadmaps is to decrease greenhouse gas emissions in every sector of society.

The same principle has been presented also in the EU Directive on Public Procurement (2014/24/EU). It was drawn up to make it possible to take into account environmental matters more prominently in public procurements. Public sector is an important construction developer and purchaser of building products. To enable public purchasers to meet the expectations brought by the new procurement directive, the products' environmental impacts should be presented in a clear and uniform way.

In building design, attention is increasingly directed towards the effects of building materials. Especially in public design competitions, the ability to estimate the carbon footprint of building materials has frequently been brought up. In the drafting stage of a building, average environmental data provided by databases for various materials create a sufficiently accurate picture of the building’s carbon footprint and other environmental properties. As the design proceeds towards the procurement stage, the importance of accurate producer-specific information is emphasised. The same product manufactured by different plants can have a quite a different carbon footprint because there may be great differences between the emissions from energy used by these manufacturing
plants. In the same way, transport journeys by supplier chains have their effect on the environmental impacts of the product that satisfies the same final purpose.

In some Central European markets, it is already necessary to be able to show, using a reliable background report or research for this, that products’ environmental claims are true. Without an environmental declaration, it might be difficult to get a permission to use environmental claims in marketing communications.

The most recommended of the existing methods to report on the environmental impacts of building products is the standardised Environmental Product Declaration (EPD). Environmental product declarations of European building products are based on the EN 15804 standard.
2. Standards related to the drawing up an environmental declaration

2.1 Standards to report environmental information

A standard is a technical document designed to be an instruction, decree or definition. It is based on a common agreement, and it is designed jointly with producers, consumers, experts and those enforcing them.

The most important international standards providing guidance to the use of eco-labels and to environmental declarations are:


2.1.1 Standardisation work

The European body responsible for the development of standards is CEN (European Committee for Standardization). Initiative for new standards or reform of existing standards can come, for example, from industry. The practical work is carried out by TC’s (Technical Committees), which consist of experts on the standard’s content field and representatives of industry and the third sector. National-level support groups monitor the work of these technical committees and give their statements on draft standards. During the completion of a new draft standard, still a separate statement round is arranged to enable wider commenting on the draft. After the statement round, usually translations to national languages are created. The European EN standard is the national standard in all EU countries automatically.

2.1.2 Types of environmental labels and declarations

In addition to environmental declaration, there is a number of different environmental labels, the large spectrum of which can make product comparisons difficult. The following is a compact presentation of the environmental label classes.
The environmental declarations of the ISO 14000 class are divided in three groups (types I, II and III):

*Type I* environmental labels are voluntary labels. Their purpose is to indicate products that create the least pressures on the environment. An environmental label describes the product’s or service’s impacts on the environment and its acquisition is based on voluntary action. For this reason, the markets may have unlabelled products which satisfy the label’s environmental requirements. The Nordic environmental label (Swan label) and the EU’s environmental label (EU Flower) are examples of Type I environmental labels.

*Type II* environmental labels consist of companies' and organisations' self-declared environmental claims. The information related to positive attitude towards the environment is presented by the producer, importer or sales outlet; it is not verified by any third party. Possible environmental claims include energy consumption, service time, recyclability and reusability. The Type II environmental label differs from other environmental label groups in that it has no pre-defined form.

*Type III* environmental labels are environmental declarations. They provide quantified environmental information based on life-cycle assessment about the product. Often, environmental declarations belong to some environmental label programme. An environmental declaration can help in bringing out essential facts about the product’s quality and ecological considerations. Currently, drawing up environmental declarations is still voluntary. Environmental declarations are not claims about the superiority of a product when compared to other products.

### 2.2 Environmental declarations for building products

The EN 15804 standard dealing with environmental product declarations (EPD) was drawn up by the CEN/TC350 technical committee. The standard guides in drawing up environmental declarations for building products, environmental indicators they name and the coming in force of the environmental declaration. The standard presents the general rules and principles for drawing up Type III environmental declarations for building products and services. The declarations are related to the environmental impacts of the product on air, ground and water, due to the product’s production, use and recycling. The standard provides the general instructions for an environmental declaration. These include the rules (see Subsection 6.3) for drawing up scenarios, the stages of the life cycle to report about and the processes and limitations they contain. The regulations are there to make it possible to compare building products on the basis of the information given in the environmental declarations. In addition, the standard has the rules
for carrying out Life Cycle Inventory (LCI), for example as related to the quality of information used in calculations.

### 2.3 Product category rules

Product category rules (PCR) define the rules and requirements for drawing up environmental declarations for a certain product category. The product category rules are always based on the main EN 15804 standard related to the drawing up of product declarations. With the help of the product category rules, it is possible to create uniform and comparable product declarations within a product category. The rules are needed because in the manufacture of various end-use products (e.g., insulation or a window) made of different materials (e.g., wood, steel or concrete) there are numerous details requiring explanation and it wouldn't make any sense to record these details in the main standard.

Of the product category rules related to the European standard series, the first one completed was EN 16485, the environmental declaration standard for wood and wood-based products.
3. Types of environmental product declarations

3.1 Life cycle of a building

The purpose of environmental product declarations is to provide environmental information that reflects the proportion accountable to products in the assessment of the environmental performance level of a building. The stages of the building’s life cycle are divided using a modularity principle. This makes it possible to gather building-level information by combining product-level information. Environmental information is divided into the main modules of product stage (A1–3), construction stage (A4–5), use (B) and demolition stage (C) as shown in Figure 1. With the help of the modules, environmental impacts occurring during the life cycle can be targeted to the correct stage of the life cycle.

3.2 The extent of environmental product declarations

According to the EN 15804, an environmental product declaration can be drawn up for three different magnitudes:

1. Cradle-to-gate
2. Cradle-to-gate with options
3. Cradle-to-grave

3.2.1 Cradle-to-gate

The most constricted environmental product declaration possible covers the production stages from cradle to gate. The name refers to the monitoring of the production process from the source of raw material through the production process up to the factory's gate. This includes the following modules of the production stage:

- **A1** Raw material supply
- **A2** Transport
- **A3** Manufacturing of the product and the related processes

The cradle-to-gate environmental declaration is the easiest one to draw up. Its modules must be based on the information collected from the production chain, at least as far as the production is concerned (Module A3). In the assessment of the life cycle, complementary information from databases or environmental declarations can be used as an aid.
3.2.2 Cradle-to-gate with options

In addition to the production stage, this environmental declaration includes a part of the other stages of the life cycle. The modules C1–C4 at the end of the life cycle, for example, can be optional modules. Also the information module D, which describes additional details external to the product's life cycle, can be included, but it is not compulsory. The company that draws up a declaration can itself decide which modules are to be chosen for the environmental product declaration.

3.2.3 Cradle-to-grave

The most comprehensive environmental product declaration includes all the stages from A1 to C4 occurring during the life cycle. It is based, at least partially, on assumptions for example about the end stages of the life cycle. For this reason, the information in the cradle-to-grave environmental product declaration can include an error margin – the bigger the longer the product's life cycle is. If the product is to be recycled after some decades, it is not possible to anticipate the effects of legislative changes to the processes. The assumptions are always based on the information and technologies available at the time of the creation of the environmental product declaration. The information module D can be included in the environmental product declaration, but it is not compulsory.

Figure 1: The stages of a building's life cycle and the extent of environmental product declarations.
4. The work stages for compiling an environmental product declaration

The main stages in the drawing up of an environmental declaration are *collection of data, life cycle assessment* and *verification*. Information collection from a production plant is based on real material flows. With the help of the data collected, a life cycle assessment is carried out and the values for the indicators presented in the environmental declaration are calculated. Verification is needed when the product is directed to consumer markets. Verification is always performed by an external, authorised body that is independent of the designer or provider of the environmental declaration.

4.1 Collection of data

Data is collected of the process to be assessed and of the raw materials used in the production. The stages of the life cycle are created in accordance with the instructions given in the EN 15804 standard. The process is drawn up to correspond to the real production of the building product. Once the process has been described, data about all necessary stages of the life cycle is collected. An important part of the data collection is verification of the quality and reliability of the data.

The standard gives the following instructions concerning the quality of data:

- The data must be as recent as possible.
- General data can be at most 10 years old and producer's specific data 5 years old.
- The data about the product to be examined concerning the production processes under the responsibility of the producer must be one-year averages and possible deviations must be explained.
- The product system must contain the environmental impacts of product, energy and material flows that take place within 100 year period when calculated from the point of time of the unit processes.
- The information related to the process technology must correspond to the technological level of the named product or product range in use at the time of the assessment.
- The information concerning the unit processes within the product range examined must be sufficiently complete, taking into account the requirements set for the limitation criteria.
4.2 Life Cycle Assessment

With the help of the life cycle assessment (LCA), it is possible to find out about the environmental impacts caused by the system or service over their entire lifecycle. The idea is to evaluate the material and energy inputs and outputs as well as environmental impacts over the life cycle. There is no single method for conducting a life cycle assessment; it can be done within the standards' frameworks the way needed.

Life cycle assessment is based on functional units, and therefore it is a relative way to assess environmental questions within certain limits. A functional unit gives information about the effects of a product or service on a certain unit (for example m, m², m³). Life cycle assessment cannot, however, explain the real or accurate environmental impacts of production: it deals with possible environmental effects (Guinée 2002, Antikainen 2010).

The most important standards related to life cycle assessment:

The stages of life cycle assessment are:
- Definition of goals and scope
- Life Cycle Inventory (LCI)
- Life Cycle Impact Assessment (LCIA)
- Interpretation of results

The stages can be carried out iteratively, so that the results and approaches are checked according to Figure 2.

Figure 2: Stages of life cycle assessment.
Implementation of the life cycle assessment is greatly dependent on what the results are intended to be used for. Life cycle assessment can be applied to improve or compare the environmental aspects of individual products or processes. In addition, entirely new products, processes or strategies can be developed with the help of the life cycle assessment. Life cycle assessment can lead, for example, to a possibility of employing environmental labels (Guinée 2002).

Information, such as that in an environmental product declaration or research report provided by other manufacturers can also be utilised in life cycle assessment. In addition, commercial databases that contain life cycle information of various products and processes are available. This information generally is made up of average data from several processes and consists of either country-specific or several countries' (e.g., the EU) average data. The European Union has its own ELCD database (European reference Life Cycle Database), which can be applied to computation.

4.3 Verification

Verification refers to a method which ensures that an environmental product declaration has been made in accordance with valid standards and application instructions. Verification is needed when a product is directed to consumer markets (B2C). If the environmental declaration is used only for business-to-business (B2B) communications, verification by a third party is not necessary. On the other hand, there is no harm of verifying B2B products also. It will increase the reliability of the environmental product declaration and can help the company to improve the assessment and monitoring of environmental impacts.

Verification is always conducted by an external, authorised party which has not participated in creating the environmental declaration or in information collection (the so-called third party). This so-called authoriser should then be provided with an environmental product declaration, a background report on drawing up the environmental product declaration and an explanation about the methods and materials used.
5. Communications

5.1 Intended end use

When compiling an environmental product declaration, it is advisable to pay some thought on how to make use of it in the company's communications. The EN 15942 standard provides instructions about the drawing up of the environmental product declaration intended for communications between companies, indicators to be made known and information related to communications in the environmental product declaration.

Already before drawing up any environmental product declaration, its intended use purpose should be considered. In general, the declaration is used for communications between companies or for customer communications. A company's website can play the part of a distribution channel, or the declaration could be published for example in a national environmental product declaration programme if such a programme is in operation. Environmental product declarations intended for consumer communications must always be verified by an independent third party. An environmental product declaration can be published in national languages. In spite of that, it is advisable to publish the declaration also in English, because a declaration that complies with the standard is automatically valid in all the EU countries.

5.2 Indicators to be reported

The standard series on the sustainability of construction works (EN 15643) defines the indicators to be reported in the environmental declaration (Tables 1 and 2). The environmental product declaration reports on environmental impacts, use of natural resources and on waste and recycling flows.
Table 1: Environmental product declaration’s impact categories.

<table>
<thead>
<tr>
<th>Impact category</th>
<th>Parameter</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global warming</td>
<td>Global warming potential (GWP)</td>
<td>kg CO₂ equivalent</td>
</tr>
<tr>
<td>Ozone depletion</td>
<td>Depletion potential of the stratospheric ozone layer, ODP</td>
<td>kg CFC 11 equivalent</td>
</tr>
<tr>
<td>Acidification for soil and water</td>
<td>Acidification potential of soil and water, AP</td>
<td>kg SO₂ equivalent</td>
</tr>
<tr>
<td>Eutrophication</td>
<td>Eutrophication potential, EP</td>
<td>kg (PO₄)₃ equivalent</td>
</tr>
<tr>
<td>Photochemical ozone creation</td>
<td>Formation potential of tropospheric ozone, POCP</td>
<td>kg Ethene equivalent</td>
</tr>
<tr>
<td>Depletion of abiotic resources-elements</td>
<td>Abiotic depletion potential (ADP-elements) for non fossil resources</td>
<td>kg Sb equivalent</td>
</tr>
<tr>
<td>Depletion of abiotic resources-fossil fuels</td>
<td>Abiotic depletion potential (ADP-fossil fuels) for fossil resources</td>
<td>MJ, net calorific value</td>
</tr>
</tbody>
</table>

Table 2: Natural resources use, waste and recycling flows in the environmental product declaration.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use of renewable primary energy excluding renewable primary energy resources used as raw materials</td>
<td>MJ, net calorific value</td>
</tr>
<tr>
<td>Use of renewable primary energy resources used as raw materials</td>
<td>MJ, net calorific value</td>
</tr>
<tr>
<td>Total use of renewable primary energy resources</td>
<td>MJ, net calorific value</td>
</tr>
<tr>
<td>Use of non renewable primary energy excluding non renewable primary energy resources used as raw materials</td>
<td>MJ, net calorific value</td>
</tr>
<tr>
<td>Use of non renewable primary energy resources used as raw materials</td>
<td>MJ, net calorific value</td>
</tr>
<tr>
<td>Total use of non renewable primary energy resources</td>
<td>MJ, net calorific value</td>
</tr>
<tr>
<td>Use of secondary material</td>
<td>kg</td>
</tr>
<tr>
<td>Use of renewable secondary fuels</td>
<td>MJ, net calorific value</td>
</tr>
<tr>
<td>Use of non renewable secondary fuels</td>
<td>MJ, net calorific value</td>
</tr>
<tr>
<td>Net use of fresh water</td>
<td>m³</td>
</tr>
<tr>
<td>Hazardous waste disposed</td>
<td>kg</td>
</tr>
<tr>
<td>Non hazardous waste disposed</td>
<td>kg</td>
</tr>
<tr>
<td>Radioactive waste disposed</td>
<td>kg</td>
</tr>
<tr>
<td>Components for re-use</td>
<td>kg</td>
</tr>
<tr>
<td>Materials for recycling</td>
<td>kg</td>
</tr>
<tr>
<td>Materials for energy recovery</td>
<td>kg</td>
</tr>
<tr>
<td>Exported energy</td>
<td>MJ per energy carrier</td>
</tr>
</tbody>
</table>
II Data collection instructions
6. The intended usage of the inventory template

The purpose of the inventory template is to gather together all raw data that is needed for drawing up an environmental product declaration. As such, the information collected does not form an environmental product declaration.

Data collection can be carried out by the production plant’s own staff or by an external assessor. Often, environmental data is collected from production plants in any case, because for example environmental permits for the production may require frequent measurements of emissions and other environmental impacts.

There is an open inventory template (Finnish Forest Industries Federation and Aalto University, 2014) to facilitate data collection. This section takes the reader through the main points of this inventory template. As the template can be freely modified, each company or production plant can adapt it to serve its own operations.

6.1 System boundary

One of the first decisions when drawing up an environmental product declaration is to create a system boundary. That means a decision about what product, production plants and life cycle stages the environmental declaration sets out to describe. System boundary should be thought about from the viewpoint of the end user of the environmental declaration while considering what kinds of information the markets will need in the coming years.

When establishing these boundaries, the instructions given in the following standards should be paid attention to:

6.2 Allocation

Allocation may have to be used in processes producing multiple outputs. In such cases, the joint material inputs of the products are allocated to these products in accordance with a clearly defined method. For example in wood product industry, in order to correctly align the material inputs to the main products and by-products, allocation might have to be resorted to.

The allocation methods that are in general use are:
- Economic allocation
- Physical allocation
- Allocation according to energy content (fuels)

Usually, allocation is subjective; therefore, it should be avoided as far as possible. If it is necessary to apply allocation, its use should be clearly and transparently reported.

6.3 Scenarios

If an environmental product declaration covers several stages of the life cycle, it is inevitable that assumptions, referred to as scenarios here, have to be made about the use, maintenance, recycling and waste treatment of the product. The most important thing is to openly and transparently document what the scenarios with which the environmental product declaration was drawn up are.

The environmental product declaration may include one or more alternative scenarios. This is useful especially when the product can be used for several different purposes.

Even though scenarios extend to the future, they nevertheless must be based on what is possible with the existing technologies. Therefore, scenarios cannot include possible environmental advantages or assumptions brought by a technology that is still on an experimental stage. These assumptions may include, for example, the impacts that modifications to the environmental legislation might have on the recycling of the product.
7. Basic product, element and average product

The inventory template can be used for the environmental product declaration for a basic product, element or average product (Figure 3).

7.1 Basic product

Basic product here means a building product that can be used as such in a work site. Examples of basic products include sawn timber, plywood, bricks, thermal insulation and fasteners.

7.2 Element

Element here refers to a building product that is combined of several different basic products. These include wall elements, floor elements and space elements.

The information collection for an element's environmental product declaration can be based on raw data either originating from other basic products' environmental product declarations or from public databases. Nonetheless, at least for element manufacture (module A3), real data measured in the production plant must be used.

The information collection can be carried out by collecting, separately, the information about the basic products required in the assembly of the element while using the information collection form for the basic product for that. This kind of method is handy if the same company manufactures both the basic products and the elements. Also an agreement can be made with suppliers about reporting, with the help of the information collection form, on the environmental impacts of the products or services to be purchased.

When an environmental product declaration is drawn up for building parts (for example, for windows, doors or trusses), it is possible to use the information collection form for the basic product's or the element's environmental product declaration, depending on which of them is easier to modify to correspond to the needs of the production plant.
7.3 Average product

Often a production plant manufactures, in response to customers’ needs, several customised versions of the basic product or element. For example, the shape of a façade board can change according to the target’s architecture. The wind protection slabs and wall panels of a wall element can be changed to another material to meet the requirements for reaction-to-fire performance of the building. It wouldn’t make much sense to draw up an environmental product declaration for each marginal customer change made to the product. In this case, the environmental information for several different product versions can be reported using a so-called environmental product declaration for an average product.

The company may have several production plants which manufacture the same product or a part of the product. Even if the production processes slightly differed from each other, the end product and the customer sector would be the same. In that case, it would make sense to draw up a single common environmental product declaration to cover all the production plants.

The environmental product declaration for an average product must clearly describe the alternatives for its characteristics and materials and also the range of variation between the environmental values that is due to them. In some cases, modifications that may seem slight – such as a change of the tiling of a floor element or change of insulation material – can greatly affect environmental impacts. The EN 15804 standard does not define any largest allowed variation range for the environmental properties of an average product. In fact, that would be cumbersome, because changing one material can cause environmental effects of various magnitudes depending on what impact category we focus on. For example, the effects on global warming potential (GWP), which may be caused by changing the material of a wind protection slab of a wall element, can be small, but they can be large on acidification potential (AP). The manufacturer should thus consider at which stage the variation range of environmental information for average products increases to such an extent that it would be advisable to create several environmental product declarations for the variations of the same basic product.
Figure 3: The stages of compiling an environmental product declaration for different products.
8. Instructions on the use of the inventory template

The following instructions are related to the use of inventory templates by the Finnish Forest Industries Federation. There are also more detailed instructions attached to the information inventory templates.

8.1 Basic details

The basic details page of the information collection form is used for the collection of general information about the company, production plant, product and production amounts.

8.2 Production plant inputs (modules A1–3)

Production plant inputs include information about supply of raw material (module A1), transport to the site of manufacture (A2) and manufacture of the product (A3).

The starting point is a description of the production process. To make life cycle assessment easier, this can also be done in the form of a diagram. In addition, the inputs and transport of production raw materials as well as the energy inputs (energy and heat) of the production are to be listed on the inventory template.

8.3 Material inputs for the product

The information about the materials used and their transport is to be recorded in the material inputs of the production. The materials include both actual raw materials (for example, spruce logs) and other materials needed by the production (for example, hydraulic oil). Total consumption of all material used must be recorded, even if the loss percentage is known.

To make data collection easier, the materials in the form are divided into various main categories:

- Wood-based materials
- Metal-based materials
- Castings, boards and tiles
- Insulations, seals and decking
- Chemicals and coatings
- Technical components
Because production methods vary a lot in accordance with the products, it is advisable to edit the materials’ list to correspond to the own production. If the production takes place in several different work areas, the materials can be compiled separately into individual tables for each work area in order to make the data collection easier.

Example 1: For the manufacturing of a product, glue is needed in three separate production halls. The easiest thing to do might be to collect the materials used by each production hall and add them up later to find out the total consumption of glue.

Example 2: The consumption of glue used for the product can be recorded as allocation of the yearly purchased glue to the products manufactured during the year. The glue supplied for treatment of waste is to be deducted from that amount.

The inventory template includes already filled-in default values for the dry density and moisture percentage of wood products and a number of raw densities of other raw materials. These can be replaced with data to the plant to get the specific result.

### 8.3.1 Transport

Transport of raw materials can form an important part of the environmental impacts of the final product. Transport details for each raw material must be separately recorded for the environmental products declaration. These include the type of vehicle, average utilisation rate of the load and average two-way transport distance. The inventory template is pre-filled with the details of average utilisation rates for road, rail and water transport, based on the EN 16258 standard. The average utilisation rate details can be replaced with more accurate details of the production plant or transport company.

### 8.4 Production’s energy inputs

Energy and heat used in the production are recorded as energy inputs. They should be focused as accurately as possible on the product described by the environmental product declaration. If it is difficult to associate energy consumption with an individual process or product, yearly consumption can be allocated according to the production plant’s yearly production. The allocation can be based on a physical or economical evaluation between the products of the production plant (see 6.2).
Energy inputs are divided into self-generated and purchased energy. There is a space in the information collection form that is reserved for recording the energy generated by wood chips in the production of wood products.

Energy generated through power plants used jointly is to be reported as own energy generation proportional to the share of ownership in the power plant.

8.4.1 Carbon footprint of green electricity

"Green electricity" here means carbon-neutral electricity that has been generated with renewable energy sources. The standards related to environmental assessment do not provide any unequivocal instruction on how to record environmental impacts of green electricity in the environmental declaration.

National energy mix is used as the principal basis for the carbon footprint of electricity. It already includes the share of green electricity of the country's whole electricity generation. This, however, does not motivate production plants to change into green electricity. If a production plant uses for example certified green electricity or if itself generates wind power electricity, its production will not create direct greenhouse emissions. In such a case, it would be natural to let the production plant benefit from the use of green electricity by having it record the share of that green electricity as carbon-neutral in the environmental declaration.

8.4.2 Own heat generation

Process heating required by the wood product industry is often obtained from their own power plants, in which case the heating is generated from the secondary flows of a process (from example, from bark, sawdust or woodchips). Heat generation is divided into own and bought heat generation in the form; there is an individual table for each of these alternatives. When bio-based fuels are used, it is possible to use carbon-neutrality instructions given to renewable energy forms (see 8.4.1).

8.5 Production plant outputs

Recorded as outputs in the information collection form are the products created by the production, the waste with its transport due to the products' manufacture and possible emissions to air or water possibly caused by the production or power plant.
8.5.1 Products

As a special feature in case of wood products, the product's final moisture content must be recorded. It has bearing on calculations of the product’s environmental impacts. In such cases, the proportion of water can be deducted from the weight of wood material and just the environmental impacts of the wood material calculated.

Products to be sold and products for own use should both be listed in the table. The latter might include the use of pellets to be manufactured as a by-product from sawdust and then used in an own power plant.

8.5.2 Waste

Production waste can be divided into recyclable materials, energy waste, landfill waste and hazardous waste. In addition, other waste that is specific to a production plant might be created.

8.5.3 Emissions

Emissions to air, water and ground are to be recorded both for the production plant and for a possible own power plant. If several production or power plants are in operation, their emissions can be reported as averages in accordance with the production relationships among the plants.

8.6 Construction stage (modules A4–5)

The construction stage includes transport of products to the site, possible storage and all construction functions.

Environmental information from the construction stage is often based on scenarios and is therefore prone to errors in assessment. The reliability of scenarios is improved if the intended end use of the product is known. This enables the assessment of environmental impacts due to the construction stage, which precedes the end use. For example, a wall element has only one end use, whereas plywood or concrete can be used for many different purposes. If a product has many uses, it is possible to improve the applicability of the information in the environmental product declaration by drawing up alternative scenarios for the uses of the product.
8.6.1 Transport to work site

The environmental impacts of the transport phase pay attention to the type of vehicle, transport distance, utilisation rate of the transport capacity and bulk density of the products.

Transport is calculated from production plants or warehouses to the work site. For transport, the information about transport distances, utilisation rate and transport equipment should be as accurate as possible (EN 16258). If the information needed is not available, the transport utilisation rate could be assumed to be for example 80% from the production plant to the work site. Transport calculations also include return transport with a 0% utilisation rate (empty return).

8.6.2 Work site functions

The environmental impacts of the building activities carried out in a work site include:

- storage of products,
- use of materials in the installation,
- energy and water used in the installation,
- waste and residue created by the installation and
- work site emissions to air, water and ground.

The energy needs of the work site are subject to great variations, depending on whether the work is done during the warm or cold period of the year. If this is uncertain, the average energy needs of the work site for the year may be reported.

Manufacture of space elements is to be reported in accordance with the current interpretation of the EN 15804 standard as a part of the product stage (A1–3). The impacts of the space elements’ work site phase thus encompasses only the activities required by transport and installation. Because of this way of interpretation, it is recommended that the product’s stage of completeness as a part of the building should be recorded in the environmental product declaration for space elements. This will ensure that, when the environmental assessment for the work site stage of the building is carried out, the environmental impacts of the construction will not be calculated twice: first in pre-fabrication and then at the work site.
8.7 Use stage (module B)

Use stage is usually the longest lasting part of a building product’s life cycle. Usually, modifications and reparations of a building over decades cannot be reliably predicted beforehand. In spite of that, use stage scenarios must be created on the basis of current knowledge and practices.

Assumptions based on scenarios about the environmental impacts during the use of the product can be added to the inventory template. These include

- **B1** intended use of the product in a building,
- **B2** maintenance,
- **B3** repair,
- **B4** replacement of parts,
- **B5** refurbishment,
- **B6** operational energy use and
- **B7** operational water use.

The maintenance and repair cycles are related to the product’s assumed service time. It is recommended that the product’s energy and water use during its life cycle be evaluated using efficiencies in line with current technology. Even if for example energy production was to transform to create lower emissions during the product’s life cycle – thus making the carbon footprint smaller – this kind of a possible environmental benefit cannot be counted as a benefit due to any particular product’s life cycle.

The inventory template for the product stage (A1–A3) and the construction stage (A4–A5) of the products can also be used as a basis of reporting on the environmental impacts of the reparations during the use stage.

8.8 End-of-life stage (module C)

The end-of-life stage of a product, or the end of its life cycle, is based on the assumptions made in the scenarios. These scenarios also include service and maintenance during operation. The scenarios must be based on the current operational environment. For example, the effects of both waste management related laws and improvements of recycling technologies on the environmental impacts of the end-of-life cycle cannot be foreseen as an environmental benefit due to an individual product. Also the varieties of waste from dismantling and their handling are to be assessed in accordance with the current regulations.
The end of a building's life cycle, its end-of-life stage, includes the following stages:

- **C1** De-construction, demolition
- **C2** Transport to waste processing
- **C3** Waste processing
- **C4** Waste disposal

If the demolition waste can be processed in several different ways, the details for module C3 can be reported according to different scenarios. For example, recycling of a wood product to chipboard or pelleting it to bio-energy create different environmental impacts.

### 8.9 Additional details (module D)

In addition to the basic modules A–C of the life cycle it is possible to report impacts extending outside the product’s life cycle. These impacts are separately reported in information module D. These kinds of impacts include possible information that affects the use of the product, information such as release of hazardous substances into indoor air, ground or water bodies. Also recycling of materials, reuse of them and utilisation of energy content belong to the additional details.

Information module D can contain technical details and environmental indicators based on the life cycle assessment. The aim of the additional details is to describe environmental impacts that are external to the product's system boundary and effects to the next product system. The product can possibly be reused, recycled or used to generate energy. This information is reported in module D and is based on the scenarios of the end of the life cycle which have been reported in module C.

The effects on the next product system by material flows leaving the product system are to be included in module D. Among these material flows, there are for example materials which have not been allocated to the category of co-products and materials which no longer are waste and have reached the so-called end-of-waste state.
III Special characteristics and product category rules of wood-based building products

Product category rules (PCR) of European building products are based on the EN 15804 standard. The product category rules provide instructions related to the special characteristics of different materials and products in order to clarify how to draw up environmental product declarations.

The EN 16485 standard defines the product category rules for the drawing up of environmental product declarations for wood-based building products. The rules can be applied to a partial or complete environmental assessment for the life cycle of a wood-based building product.

9.1 The environmental product declaration for wood products

9.1.1 Constricted environmental product declaration for wood products

The least extensive environmental product declaration (cradle-to-gate) includes modules A1–3. For wood products, the special characteristics to be noted in the constricted environmental product declaration are:

- Biogenic carbon stored by trees in their growth phase must be reported as separate technical scenario information. When carrying out an environmental assessment for the whole building, the exact amount of biogenic carbon can then be balanced during stage C3 of the life cycle at the latest (see 9.2).
- The energy content of wood material must be reported at stage A1.
- It is recommended that the uses of the product are reported as a part of the environmental product declaration. This allows prediction of the product's effects in the different parts of the building when the environmental assessment for the whole building is under way.

9.1.2 Partial environmental product declaration for wood products

A partial environmental product declaration contains, in addition to stages A1–3 of the life cycle, an optional part of the other modules. To enable the reporting of wood materials' special characteristics (such as biogenic carbon content and energy content) to end-users, the recommended minimum scope of an environmental product declaration for wood-based building products includes modules A1–3, C and D.
9.1.3 Extensive environmental product declaration for wood products

In the most extensive environmental product declaration (cradle-to-grave), it is possible to describe the environmental impacts of wood products' entire life cycle. The issues to be noted are then:

- Balancing of wood's biogenic carbon storage between modules A1 and C3.
- Balancing of wood's energy content between modules A1 and C3.

9.2 Reporting of biogenic carbon in the environmental product declaration

One of the special characteristics of wood-based building products is biogenic carbon contained by the material. Biogenic carbon refers to atmospheric carbon stored in a growing tree via photosynthesis. To report on biogenic carbon, the following method based on the EN 16485 standard can be recommended:

- According to a product category rule, a wood's biogenic carbon content (kg CO\(_2\)) can be calculated to be included as a negative value to the global warming potential (GWP) of the A1 stage.
- The same biogenic carbon content (kg CO\(_2\)) must be removed as a positive value from the system at the latest in the C3 stage. When an environmental product declaration is drawn up in its constricted form only for stages A1-3, the amount of biogenic carbon content should be reported as technical scenario information in module B1 so that it could be included into the environmental calculation of the whole building at stage C3. Technical scenario information is not added to impact assessment.
- The sum \(\sum_{A1}^{C3} = 0\) for the biogenic carbon content stored in a wood.
- If the wood ends up as fuel for energy generation at stage C, it is possible to report, in module D, the emissions of the substituted fossil fuel as a negative value and make it a part of the global warming potential (GWP) to correspond to the same energy content. This is known as the substitution effect.

Figure 4 describes the biogenic carbon content balance for wood over the product's life cycle in a building. There must be a calculable balance between the different sub-systems of the life cycle stage and for the whole life cycle.
Figure 4: Biogenic carbon content balance for wood over the product’s life cycle.

In the EN 16449 standard, there are the instructions for calculating the biogenic carbon content of wood and its conversion to carbon dioxide.

Equation 1: Calculation guide for calculating the biogenic carbon content of wood according to the EN 16449 standard.

\[ M_{\text{CO}_2} = \frac{3.67}{2} \cdot \frac{\rho_{\text{wo}} \cdot V_{\text{wo}}}{1 + \omega/100} \]

- \( M_{\text{CO}_2} \) = the biogenic carbon oxidized as carbon dioxide emission from the product system into the atmosphere (kg)
- \( \rho_{\text{wo}} \) = the density of the solid wood product at \( \omega \) moisture content (kg/m\(^3\))
- \( V_{\text{wo}} \) = the volume of the solid wood product at \( \omega \) moisture content (m\(^3\))
- \( \omega \) = the moisture content of wood (%)
9.3 Energy content of wood

A special characteristic of a wood product is that it is possible to utilise as bio-energy after its use and recycling. When the energy content stored in a wood product is reported in the environmental product declaration, the following principles should be taken into account:

- The net calorific value of dry wood is 18.3–20.0 MJ/kg.
- The net calorific value (MJ/kg) is the calorific value of dry matter. Energy spent on evaporation of water removed with flue gas (originating from the hydrogen of the fuel) is not included in that calorific value.
- If wood is burned in an energy generation plant with at least 60% efficiency, or with 65% efficiency in plants deployed after 31 December 2008, it is classified as recycled fuel.
- The energy content of wood is dependent on the moisture content; moisture also affects the wood’s density.

\[ \text{Moisture content}\% = \frac{(wet\ mass - dry\ mass)}{dry\ mass} \times 100\% \]

- The moisture content of a growing tree varies according to seasons and the part of the wood. Different tree species, moreover, have different moisture contents. Moisture content is calculated in relation to dry mass, and the calculated moisture content can then exceed 100%. Average moisture content and dry density of logs of tree species used in Finland are listed in Table 3 (Marjomaa & Uurtamo 1996, Kärkkäinen 2003).

<table>
<thead>
<tr>
<th>Material</th>
<th>Average moisture content</th>
<th>Dry density</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spruce log</td>
<td>84%</td>
<td>390.8 kg/m³</td>
</tr>
<tr>
<td>Pine log</td>
<td>112%</td>
<td>402.6 kg/m³</td>
</tr>
<tr>
<td>Birch log</td>
<td>80%</td>
<td>484.3 kg/m³</td>
</tr>
</tbody>
</table>

- The moisture content of wood products used in construction varies between 6 and 20 percent.
9.4 Presentation of special characteristics of wood in the environmental product declaration

In the environmental product declaration, biogenic carbon and energy content must be balanced over the life cycle of a wood product.

The following examples illustrate how biogenic carbon and wood’s energy content can be reported in the environmental product declaration. In spite of the standards, there are differing interpretations of how biogenic carbon and energy content should be reported in the environmental product declaration (IBU 2014 and WoodForGood 2014). For this reason, we present below some alternatives for the drawing up of an environmental product declaration. The examples only show the reporting of wood material characteristics in the environmental product declaration. Also other calculations of the impacts, such as emissions from energy generation, are normally included.

9.4.1 Example: Presentation of a biogenic carbon storage

We assume that a product contains 390 kg of wood. This amount of wood contains about 195 kg of carbon, which corresponds to about 716 kg of carbon dioxide. This biogenic carbon storage (kg CO₂) is calculated, as negative, to the GWP value at the A1 stage. The same carbon storage is removed as positive by the time the C3 stage is reached. If the environmental product declaration includes stages A1–3 and the biogenic carbon storage is calculated to the GWP value at stage A1, the value of the biogenic carbon storage must be reported as technical scenario information (Figure 5). In such a case, the biogenic carbon storage can be taken into account in the construction stage assessment in module C3.

Figure 5: Biogenic carbon storage as a part of the GWP value at the A1 stage.

According to Figure 6, if the environmental product declaration includes also stage C3, the biogenic carbon storage must be removed before that stage is reached.
In stage D, possible substitution effects can be reported. If wood is destined to be incinerated, it can be used to substitute fossil fuels. Substitution effect is calculated in accordance with the emissions caused by the fuel (e.g., natural gas or coal) to be substituted.

### 9.4.2 Presentation of energy content of wood

Wood’s energy content is added to the *Use of renewable primary energy resources used as raw materials* indicator. This content is added to stage A1 as a positive value. Outflow of energy content can be reported at stage C3 either as removable secondary material (Figure 7) or outflow of secondary material and energy content (Figure 8).

**Figure 6: Biogenic carbon balance as a part of the GWP value between modules A1 and C3.**

<table>
<thead>
<tr>
<th>Global Warming Potential (kg CO₂e)</th>
<th>A1</th>
<th>A2</th>
<th>A3</th>
<th>A4</th>
<th>A5</th>
<th>B1</th>
<th>B2</th>
<th>B3</th>
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<th>B7</th>
<th>C1</th>
<th>C2</th>
<th>C3</th>
<th>C4</th>
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**Figure 7: Balance of energy content between modules A1 and C3 according to IBU (2014).**

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<tr>
<th>Indicator</th>
<th>A1</th>
<th>A2</th>
<th>A3</th>
<th>A4</th>
<th>A5</th>
<th>B1</th>
<th>B2</th>
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<th>B6</th>
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<td>Renewable primary energy used as raw materials (energy content) (MJ)</td>
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<td>Use of secondary materials, kg</td>
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**Figure 8: Balance of energy content between modules A1 and C3 according to WoodForGood (2014).**

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<tr>
<th>Indicator</th>
<th>A1</th>
<th>A2</th>
<th>A3</th>
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<th>A5</th>
<th>B1</th>
<th>B2</th>
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<th>B6</th>
<th>B7</th>
<th>C1</th>
<th>C2</th>
<th>C3</th>
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<tbody>
<tr>
<td>Global Warming Potential (kg CO₂e)</td>
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<td>Renewable primary energy used as raw materials (energy content) (MJ)</td>
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It is recommended that a scenario or scenarios be drawn up to illustrate the end of the life cycle. The effects that remain outside the system boundary can be reported in information module D. The scenario may depict the use of the product as recycled fuel, reuse of the product or recycling it to a new product.

If a wood product is utilized into energy to substitute fossil energy, the wood is reported as secondary fuel in module D and its substitution effect is taken into account in the GWP value in accordance with the fossil fuel to be substituted. In the following examples, natural gas is substituted by wood in energy generation. Greenhouse emissions from natural gas have been calculated into the GWP value in module D (Figures 9 and 10).

**Figure 9: Balance of energy content among modules A1, C3 and D (according to IBU).**

<table>
<thead>
<tr>
<th>Indicator</th>
<th>A1</th>
<th>A2</th>
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**Figure 10: Balance of energy content among modules A1, C3 and D (according to WoodForGood).**

<table>
<thead>
<tr>
<th>Indicator</th>
<th>A1</th>
<th>A2</th>
<th>A3</th>
<th>A4</th>
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Sources


EN 15643-1:2012 Sustainability of construction works. Sustainability assessment of buildings. Table 1: General framework.


EN 16258:2013 Methodology for calculation and declaration of energy consumption and GHG emissions of transport services (freight and passengers).


ISO 14021+A1:2012 Environmental labels and declarations. Self-declared environmental claims (Type II environmental labelling).


The purpose of this guide is to make it easier to compile environmental declarations for construction products. The guide is meant for data collectors, those making life cycle assessments and those responsible in companies for environmental matters.

The guide was made by interviewing experts who have participated in the preparation of important European standards. Moreover, the data collection for environmental declarations was developed and tested in cooperation with Finnish wood-working companies.