Building construction emissions database methodology

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Content

1 Purpose of the database

The *building construction emissions database* (co2data.fi/rakentaminen) has been developed by the Finnish Environment Institute (SYKE) on behalf of the Ministry of the Environment, in cooperation with experts in the life cycle assessment of construction products and buildings.

The main objective of the construction emissions database is to support the planning of low-carbon and resource-efficient construction by providing open and typical environmental information on products, services and systems to support the assessment and comparison of alternative design solutions. An open and public database enables the preparation of comparable low-carbon assessments in various construction projects.

The database and its maintenance are provided for in the new *Construction Act*[1], which will enter into force on 1 January 2025. The database plays a part in building climate declaration in accordance with the *Ministry of the Environment Decree on the building climate declaration and the list of construction products*[2]. A separate *method for the whole life carbon assessment of buildings* will specify the rules for preparing a climate declaration.

This *building construction emissions database methodology* provides an open description of the database's content, its compilation and maintenance, and the sources used in selecting and comparing data. The methodology description is essentially based on the information presented in a previous publication[3].

The database's content is kept up to date with regular updates and is also expanded on a small scale. Separate further development is carried out according to the needs, including Nordic cooperation[4].

2 Database items

The national construction emissions database service CO2data consists of two databases: the building construction emissions database and the infrastructure construction emissions database. This methodology discusses the building construction emissions database.

The database contains information on over 250 commonly used products, systems and services. Construction products include numerous concrete products, steel and metal products, timber products, building boards, insulation, coatings, earthworks products, building services products and systems, and furniture and equipment. Services and processes include energy consumption during use, transportation to construction sites, construction and demolition, waste management processes and carbon handprint. In addition, typical system and service life information is included.

[1] Rakentamislaki 751/2023 - Säädökset alkuperäisinä - FINLEX ®
[2] Ympäristöministeriön asetus rakennuksen… 1027/2024 - Säädökset alkuperäisinä - FINLEX ®
[3] LCA database for building products, services, and systems – Description of the content and working methods (helsinki.fi)
[4] Frontpage | Nordic Sustainable Construction

The data units, or *items*, selected for the database have been considered to cover a significant part of the carbon footprint of buildings. The following table presents a general compilation of the database items by category.

The following is a list of the construction product categories in the database, as well as a general description of the items included in them:

- **Insulation and water proofing**
  - *Mineral wool, plastic insulation (EPS, XPS, PIR, PF), cellulose wool insulation, lightweight aggregate, foam glass aggregate, vapor barrier plastic, bitumen membrane roofing*
- **Building boards**
  - *Plywood, particle board, fiberboard, fiber cement board, OSB board, gypsum cardboard boards*
- **Concrete**
  - *Ready-mixed concrete, concrete elements, concrete piles, concrete aggregate, concrete blocks and bricks, reinforcement*
- **Steel and other metals**
  - *Steel, stainless steel and copper sheets, pipes and wires, light steel and aluminum profiles, load-bearing steel structures, sandwich panels*
- **Solid wood**
  - *Sawn and planed wood, impregnated wood, heat-treated wood, log structures, CLT, LVL and GLVL, GLT*
- **Mineral materials and glass (excluding concrete)**
  - *Fired and sand-lime bricks, masonry and plaster mortar, aerated lightweight concrete blocks, ceramic tiles, glass and glazing*
- **Floorings and surface materials**
  - *Floor screed, floor tiles, parquet, textile flooring, vinyl flooring, acrylate-, epoxy- and silicate paints*
- **HVAC products and electrical installations**
  - *Pipes, ducts, pumps, radiators, ventilation units, wires, cables and cable ducts, luminaires, electrical group center, solar thermal collectors and panels, elevators, bathroom fittings*
- **Supplementary products**
  - *Doors, windows, partitions, bathroom and kitchen cabinets, stairs, steel chimneys, glass bricks*
- **Infra, yard, and foundations**
  - *Asphalts, soil, recycled materials, natural stones, frost insulation, geotextiles, stabilizers, concrete piles, pipes and wells, seedlings*

The following is a list of the service and process categories in the database, as well as a general description of the items included in them:

- **Energy**
  - *Electricity consumption, district heating, district cooling, separate heating with fossil or biofuels*
- **Transportation**
  - *Road transport in urban or rural areas: semi-trailer combination, distribution truck, earthmoving truck; container train, container ship, bulk carrier, transport of construction materials (m2)*
- **Construction process**
  - *Residential construction, other buildings, earthworks, stabilization*

- **Demolition and waste processing**
  - *Demolition, waste treatment by material type, waste incineration*
- **Carbon handprint**
  - *reuse, material recycling, renewable energy, carbon storage effect, carbonation*

The following is a list of the system and service life categories in the database, as well as a general description of the items included in them:

- **Building services**
  - Building services system (HVACS) for residential, detached and semi-detached houses, hotel, office, commercial, educational, hospital and assembly buildings
- **Service life**
  - Short and normal service lives for different areas, buildings, facilities and building services components

In addition to the building construction emissions database, the *infrastructure construction emissions database* (co2data.fi/infra) was later developed on behalf of the Finnish Transport Infrastructure Agency for the needs of infrastructure construction projects. However, the services are separate, although a few products and items can be found in common in both databases. The Ministry of the Environment will issue separate guidelines on the possible use of the infrastructure construction emissions database in building construction projects.

3 Database information content

The database consists of numerical *indicators* that describe the environmental impacts of the database items. Up-to-date indicator values can be found directly in the database, and the justification for their compilation can be found in background reports.

The following subsections describe the types and accuracy of the database data, as well as the different indicators used.

3.1 Typical and conservative data

The database consists of so-called *generic* or *typical* data, the purpose of which is to represent the average level of Finnish construction as accurately as possible. This information describes, for example, the average value of a specific construction product, based on the specific information, e.g. *environmental product declarations* (EPD) presented by the relevant manufacturers in Finnish market. Often, accurate data on the market shares of different manufacturers' products in Finland is not available, so when determining typical values, considered assumptions must be made.

The database includes a so-called *conservative value conversion factor* with value of 1.2. Conservative value conversion factor is intended only to increase the typical fossil carbon footprint values of the manufacture of generic building products (A1-A3).

For example, the BY-low carbon classification[5] categories presented in the database are not multiplied by this factor, as they are not generic carbon footprint data of the national emissions database, but instead other environmental characteristic data determined using a generally accepted uniform method. However, the classes are presented in the emissions database because the aim is to promote the use of voluntary calculation methods developed by different product sectors for their product groups.

Multiplying the *typical value* with conservative value conversion factor results in *conservative value*. Conservative values are intended to be used in calculations in accordance with the climate declaration.

The conservative value conversion factor has been established to ensure that the use of typical values does not lead to overly optimistic emission estimates, especially when the variance of the specific data on which the data is based has been high. The value of 1.2 has been defined as an average based on the variance of EPD data within different product groups. The use of conservative values can encourage the creation of new EPD data.

3.2 Global warming potential and potential climate benefits

The main indicator of the database is the *Global Warming Potential* (GWP). Its selection and definition have been carried out in accordance with the main principles of the EN 15804 + A2:2019 standard at different stages of the construction project life cycle, considering the limitations of the available information and the calculation method.

The database defines total GWP values for different construction products, services and systems. The indicator is called the carbon footprint, and it is defined as the total amount of greenhouse gases generated during the entire life cycle of the building, and its unit is kilograms of carbon dioxide equivalents (kg CO2e). Carbon dioxide equivalent considers the effects of all greenhouse gases converted to the corresponding effect of carbon dioxide. The database can report GWP values separately for fossil, biogenic and land use and land use change (LULUC) effects. The sum of these is the total GWP.

The database also defines values for the *carbon handprint*, i.e. potential climate benefits that could not be achieved without the construction project.

The GWP values for the manufacture of construction products (A1-A3) are expressed in kilograms of carbon dioxide equivalents per kilogram of product (kg CO2e/kg). It considers the life cycle stages: production of raw materials (A1), transport to the manufacturing site (A2) and the product manufacturing process (A3). The aim is to also indicate a conversion factor for construction products, which allows emissions to be reported in different units such as m, m2 or m3. GWP values are not separately stated for product replacements (B4) but can be estimated using the service life data found in the database. GWP values per building surface area (kg CO2e/m2) have also been determined for building services systems, considering both manufacture (A1-A3) and future replacements (B4).

The GWP values for transport services (A4, C2) are reported per load and transport distance (kg CO2e/t km). The values for transport services can also be used when assessing transport in other life cycle stages (A5, B4). GWP values per building area (kg CO2e/m2) have also been defined for transport of construction products (A4, C2). The

[5] In English – Vähähiilinen betoni

values for transport of construction products also consider minor transport in other life cycle stages (A5, B4).

The GWP values for construction (A5) and demolition (C1) site activities of buildings are reported per building area (kg CO2e/m2). The values for construction and demolition consider minor construction and demolition activities in other life cycle stages (B4).

The GWP values for energy services (B6) are reported per unit of energy consumed (kg CO2e/kWh). Future emission scenarios have been defined for energy services.

The GWP values for typical waste processing (C3) for different materials are reported per kilogram of material (kg CO2e/kg). The typical GWP value for final disposal (C4) is reported per kilogram (kg CO2e/kg).

The typical carbon handprints for different materials are also reported per kilogram of material (kg CO2e/kg).

The principle of declaring waste processing GWP values and carbon handprints for specific construction product items in database is described in more detail in section 3.2.2.

3.2.1 Biogenic and LULUC climate impacts

The biogenic GWP is calculated for the proportion of wood contained in building products, i.e. the carbon dioxide bound by the growth of the tree (A1) and the carbon dioxide released at the end of the tree's life cycle (C3). The biogenic GWP value of the A1 phase is negative and the biogenic GWP value of the C3 phase is positive, so that their sum is 0. The value used for the carbon dioxide bound by wood is 1.6 CO2e kg/kg.

The underlying assumption is that the wood used in the products has been felled from a sustainably managed forest. Other biogenic impacts are considered so minor that they are not considered.

The GWP impacts of land use and land use change (LULUC) on building products are also so small in relation to the fossil GWP impacts that they are consider zero.[6]

3.2.2 Climate impact of waste processing and carbon handprints per construction product item

Each construction product item is assigned a C3 (or C4) value, as well as carbon handprint values. These are calculated directly based on the typical material composition of each construction product and the material-specific waste processing items and carbon handprint items in the database. The idea is that the different materials in a construction product can be recycled separately. Construction products also often consist of different materials with different carbon handprints.

For each construction product item, one C3 or C4 value is calculated and defined, as well as any negative carbon handprint values.

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[6] LCA database for building products, services, and systems – Description of the content and working methods (helsinki.fi)

3.3 Material properties

For construction products, the proportion of recycled and renewable materials used in them is declared. In addition, any content of harmful substances (SVHC) is declared. All proportions are reported as mass percentages (%).

3.4 Waste factor

The database defines a waste factor for construction products, which describes the typical material waste caused by the installation of the product on the construction site. In the case of prefabricated parts, the waste caused at the factory is described. The factor is expressed as a decimal number, which typically varies between 1 and 1.15. The factor describes the ratio of the material consumed in the work and the material bound to the structure. A factor of 1 means that no waste is generated.

The following are typical waste factors generally used for different construction products.

- **1.01**: complementary parts, HVAC parts
- **1.03**: metal products, engineered timber products, glass, thermal insulation, prefabricated concrete products, supplementary parts, ducts and pipes
- **1.05**: mineral products, building boards, floor coverings
- **1.10**: waterproofing, bitumen roofing, paints, mortars, geotextiles, ceramic bricks, sawn timber

3.5 Service life

The database defines conservative service life assumptions in years for the site, building, space and HVAC components according to Talo 2000 classification system[7]. Conservative service life assumptions are presented in accordance with the EU Level(s) method as *short* and *normal* service life. Normal service life reflects normal conditions and short service life demanding conditions. The values are presented as a separate table in the database.

Service life assumptions are not presented for a period longer than the length of the assessment period, i.e. 50 years, but for a service life longer than this, the value ReqSLB (Required Service Life of Building) is presented, i.e. the required service life.

The loss factors or service lives are not based on statistical information but describe general understanding. They have been prepared in cooperation with experts in construction and building products.

3.6 Other general information

For each item in the database, a few general data fields are presented, which are: category, description, background report, ID and version. The category categorizes the item, mainly affecting how it is found in the database. The description field provides written description of the key characteristics of the item, focusing on key issues affecting its GWP. The background report field provides a link to the background report, where a more detailed description of the item can be found, as well as the background for determining its

[7] Talo 2000 -nimikkeistöt (rakennustieto.fi)

values and the justification for the choices. The background reports are also version-numbered, which is evident from the name of the report downloaded. The ID field provides a unique, unchangeable identifier for each item in database. The version field presents the version of the database in which the item information was last updated.

For items that are construction products, the following data fields are also presented: harmonised standard, classification / Talo 2000 and market. The harmonised standard presents the harmonised product standard[8] (hEN) given to the product, in which the key characteristics of the product are defined. The classification / Talo 2000 field indicates the Talo 2000 classification system categories that best describe the construction product item. The Market field is written description of the market for the construction product, especially trying to specify the most important products and manufacturers in the product group.

3.7 Accuracy of values

The accuracy of the values of the indicators declared in the database is determined according to the rules of following table.

Table 1. Accuracy of the indicator value.

Value	Roundening	Result
x = 0	integer	0
0 < x < 1	2 significant digits	e.g. 0.00025, 0.40 tai 0.99
1 ≤ x < 10	1 decimal	e.g. 1.0, 6.2 tai 9.9
10 ≤ x	integer	e.g. 10 tai 137

4 Creation of information content

The database has been prepared in cooperation with representatives of manufacturers of different product groups and other experts, considering the products, services and systems that are key to calculating the carbon footprint of buildings.

The following paragraphs present the sources of the database's information, its relevance, the method of information creation and its maintenance.

4.1 Information sources

Information on construction products is retrieved using the ECOPlatform[9], which brings together over 20 different EPD databases, including:

- Environdec
- EPD HUB

[8] Harmonisoitu tuotestandardi hEN - henHelpdesk
[9] ECO EPD Programmes - Eco Platform en (eco-platform.org)

- RTS EPD (Rakennustieto)
- EPD norge
- IBU

Information is also retrieved directly from these EPD databases, and from manufacturers' product pages. Information is also compared with other generic databases, such as:

- Klimatdatabasen (boverket)
- Ökobaudat

Generic data is also utilized, where appropriate, from other European and international sources, such as:

- Plastics Europe
- European Aluminium
- Copper Alliance
- Eurobitume
- EFCC model EPDs

The data source for transport services is LIPASTO, which is the Finnish Open Unit Emissions Database for Transport. The LIPASTO values have been supplemented with fuel supply chain emissions according to the *JEC Well-To-Wheels*[10] report.

For the whole building items, i.e. construction, demolition and building services systems, the data sources have been many case studies of emissions and energy consumption from construction projects, with an emphasis on domestic studies. For building services systems, the values are based on the results of an external study.

For energy services, the data source has been the WEM-P baseline scenario for long-term emissions prepared in the VN TEAS PEIKKO project[11], as well as other sources.

4.2 Information relevance

When assessing the relevance of the information, special attention is paid to the domesticity of the information, since the domesticity of construction materials and services is typically high. Other Nordic results are also useful, because there are similarities between the countries, especially in the manufacturing methods and markets of many construction products, although there are differences in energy systems compared to Finland. For some products with a high import, EPDs from foreign manufacturers can describe the Finnish market well. Other, mainly European, information sources are used if better market-specific information is not available.

EPDs according to the latest version of the standard EN 15804 are preferred.

4.3 Information creation method

The construction product item is created and updated in the database as follows:

[10] JRC Publications Repository - JEC Well-To-Wheels report v5 (europa.eu)
[11] Perusskenaariot energia- ja ilmastotoimien kokonaisuudelle kohti päästöttömyyttä (PEIKKO) - Valto (valtioneuvosto.fi)

1. The environmental and market data of the construction product are searched from different databases and other sources
2. The data are compared with each other and the relevance of the data is assessed
3. The best public data is selected, and a typical value is declared in one of the following ways:
    a. The most representative value or values are selected from the available data, on which the typical value is based
    b. If the data is very incomplete, the total emissions of the product can be estimated more roughly by other means, such as the emissions and weights of the product's most significant main materials (e.g. metals, plastics) or by comparison with similar products
4. When necessary, the views and comments of the manufacturers and experts of the product group are utilized, especially concerning larger updates
5. The updates are imported into the database approximately four times a year as follows:
    a. The product description and market data, reference sources assessed, and the justifications of the choices made, are updated in the background report
    b. The database is updated with the changes.

Creating and updating the waste processing (C3, C4) and carbon handprint items for different materials is based on EPD data and the method described above.

Creating and updating any non-construction product items is done in outline the same way, but instead of EPD data, the emphasis is on other sources of information such as scientific publications, case studies and statistical data.

4.4 Information maintenance

The information content is maintained regularly and prioritized by category (e.g. insulation, concrete and building services), focusing on updating the data sources of the selected categories to the latest, and checking the assumptions and boundaries made. Maintenance takes place in interaction with experts of the field.

The information content can also be expanded if, due to feedback received or changes in the Finnish construction products market, it becomes clear that a typically used construction product is missing from the database.

Errors found in the database are corrected as a priority.

When the values in the database change, a new database version with changes is published, the versions of the updated background reports are updated, and the changes are noted in the change history presented in the CO2data service.