PROPOSAL FOR AN ESTONIAN CALCULATION METHOD ON THE CARBON FOOTPRINT OF CONSTRUCTION MATERIALS

31 AUGUST 2021

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Date	31 August 2021 Revised January 2022

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1. INTRODUCTION

A national calculation method for carbon footprint of construction products is used for creating a consistent national generic construction product carbon footprint database.

The database in turn is required for assessment of buildings using the national construction project calculation method.

The database provides generic (that is, not manufacturer or product specific) carbon footprint values for the most common construction products and enables the calculation of whole life carbon of construction projects. The database should cover all main construction products.

The methodology described in this paper has been designed considering following design factors:

- Representativeness. The database is required to represent the market for construction products as they are used in construction projects in Estonia.
- Consistency. The database is required to be consistent, so that competition between materials is not distorted.
- Time efficiency. The database is required to be delivered at very limited time and expense.
- Comparability. The database is required to be overall comparable with the national generic databases, especially Finnish, Swedish and German databases for similar products.

The methodology suggested in this paper is based on the European EN 15804+A2:2019 standard.

2. METHODOLOGY

2.1. ENVIRONMENTAL IMPACTS CONSIDERED

The assessment methodology focuses on the environmental impact category of climate change (carbon footprint) pursuant to standard EN 15804+A2:2019. The impact category measured is the Global Warming Potential Fossil (GWP-fossil) and it follows the definition of the EN 15804+A2:2019 standard. This indicator accounts for the Global Warming Potential from greenhouse gas emissions that originate from oxidation or reduction of fossil fuels or materials that contain fossil carbon.

For clarity, it is stated that biogenic carbon emissions and impacts of land use and land use change are excluded from consideration.

Other environmental impacts, such as ozone depletion, acidification and eutrophication, are not considered in this assessment.

2.2. DECLARED UNIT

The results shall be provided for one kilogram of material for all product types for consistency. In addition, conversion factors to other units, such as m^2 or m^3, shall be presented whenever appropriate.

2.3. ESTONIAN CONSTRUCTION CLASSIFICATION SYSTEM

Estonia follows closely the development of the international CCI classification system. Domestic classification systems include the established material classification for cost calculations, EVS885:2005. A new Estonian construction classification system aims to create a unified classification system to manage construction information, and it covers the whole life cycle of the building. The name of the system is “CCI-EE”, Ehituse ühtne klassifitseerimissüsteem. https://eehitus.ee/timeline-post/cci-ee/. The CCI classification system is based on ISO 12006-2:2015. The products in the database are proposed to be connected to a national construction classification system at an appropriate level, possibly the CCI-EE classification in case of E-Ehitus.

2.4. SYSTEM BOUNDARY

The system boundary for the generic database is set to cover only the A1–A3, product stage. The product stage includes the following:

- A1, raw material extraction and processing and the processing of secondary material inputs
- A2, transport of the raw materials to the manufacturing facility
- A3, manufacturing (herein including also the energy use in the manufacturing)

including provision of all materials, products, energy and waste processing or disposal during the product stage. All three modules A1, A2 and A3 are declared as one module A1–A3.

2.5. CONSERVATIVE VALUES USED

The emissions between different manufacturers and their products can differ, depending for example on the exact raw materials used and the efficiency of the manufacturing phase. Also, the energy grid used can have substantial effects on the manufacturing emissions. Thus, the product impacts are considered by applying a factor that represents the inherent uncertainty in choosing an unspecified product. The factor depends on the product type and in particular it’s sourcing range variability. Similar principle is used in the referenced Finnish, Swedish and German generic databases as well.

3. GENERIC MATERIALS DATA PRODUCTION STEPS

3.1. CREATE BASELINE LOCALIZED VALUE FOR GENERIC MATERIAL FOR ESTONIA

Creating the generic datasets starts by creating the baseline localized values for Estonia. This happens within One Click LCA building LCA software by creating a building project located in Estonia, by setting LCA Parameters to use the “Material manufacturing localisation method” v2, and by setting as localisation target Estonia, with electricity profile IEA-2019. Material manufacturing localisation adjusts the material manufacturing process emissions for grid electricity and energy efficiency to the desired country instead of the original country the material is produced in. The amount of consumed electricity is estimated on material sub-type level (e.g. plastic flooring / XPS insulation etc).

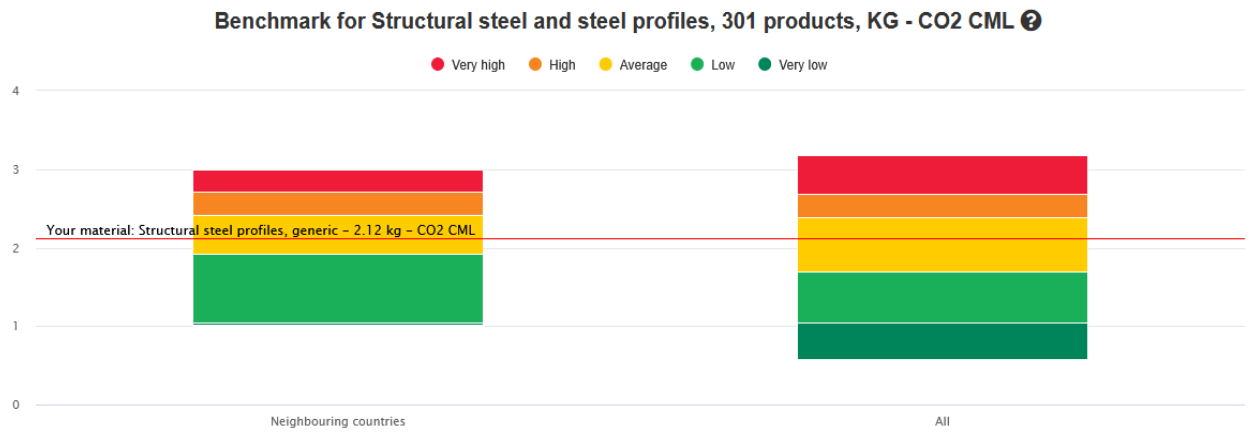
Thereafter, go to Building materials query, set “Type” filter generic and as “Data source” One Click LCA. Try to find the base material matching your target material. If the material can not be found, remove filter for “Data source” and extend search to cover “SYKE”, “Boverket” and “OKOBAUDAT” databases (while keeping the generic filter on). If you choose a datapoint from one of the latter databases, note down the top-up factor applied on the datasets in the original database.

Only use datapoints that DO NOT embed assumptions about secondary or recycled feedstock.

3.2. REVIEW THE VALUE FOR PLAUSIBILITY AND CONSISTENCY USING BENCHMARKING

Choose selected benchmarking values from local or Baltic products with EPDs (when available) and also the Finnish, Swedish and German averages for comparable products. Consider the plausibility of the value with the benchmarking set. You can also use the more extended visual benchmarking as shown below.

If the product is globally traded, consider also global benchmark value ranges.



Factor	Unit	Estonia	Neighbouring countries	All
Products in area	product	0	58	300
80th percentile	kg CO2e/kg	0	2.71 - Use as benchmark	2.69 - Use as benchmark
Average	kg CO2e/kg	0	2.048 - Use as benchmark	1.944 - Use as benchmark
Median	kg CO2e/kg	0	2.245 - Use as benchmark	2.025 - Use as benchmark

3.3. CLASSIFY THE DATASET INTO APPROPRIATE SOURCING REGION

Classify the dataset to one of the regions and apply to it an uncertainty factor based on the region. Uncertainty factors are needed, as every product category has variance across the product manufacturing impacts. The purpose of these uncertainty factors is to ensure that products with higher-than-average impacts are not masked by the too low generic values, and that manufactures have incentive to improve.

Note that if your dataset originates from one of the other government databases, the underlying top-up factors must be previously removed from the data. In general, Boverket uses a factor of 1.25, OKOBAU.DAT a factor of 1.3 and SYKE uses a factor of 1.2 to top up factor for their generic values. This means, that all of the generic values in these databases are already higher than assumed statistical average value.

Materials category	Uncertainty factor
Locally or regionally sourced materials	+20 %
International or globally sourced materials	+40 %

3.4. AMEND THE DATASET WITH OTHER NECESSARY INFORMATION TO SUPPORT UTILISATION

Classify the dataset to one of the regions and apply to it an uncertainty factor based on the region. Note that if your dataset originates from one of the other government databases, the underlying top-up factors must be previously removed from the data.

Life cycle stage	Required additional information	Notes
A4 Transport	Product transport distance	Use 500 km for local and regional and 3000 km for other material categories
A5 Construction Site	Construction site wastage %	As per material category
B4 Replacement	Service life of material in building	As per material category
D Beyond system boundary	Recycling or recovery benefits of the product after it's lifecycle	Separate reuse, recycling and incineration impacts.
Mass conversion factors	Density, mass per m^2, etc.	

3.5. DOCUMENT DATASET APPLICABILITY

As the generic database is a limited one, few datasets need to represent a range of products. Explain the products or materials the dataset is intended to represent so the domain of legitimate use is fully clear. For example, if a window dataset is in question, it could be amended with explanation that it can also be used for balcony doors (which contain somewhat similar proportions of different materials). Similar documentation should be used also for concrete products, which are on one hand important construction products, and on the other hand have significant permutation of different strength classes.

3.6. DOCUMENT DATASET CREATION PROCESS AND PRODUCT MARKET SITUATION

Document the dataset creation process and steps taken, and key observations. Document product market for known suppliers in Estonia, and lack of domestic manufacturing when such is the case.

Document scenario for module D Beyond system boundary: reuse, recycling or incineration, or their mix.

4. OTHER GENERIC DATA PRODUCTION

4.1. ENERGY CONSUMPTION ENVIRONMENTAL IMPACT PROFILES

Using Estonian government figures is recommended. However, the authors recommend using a degressive factor to represent impact of the Estonian national energy and climate plan (NECP 2030) on the grid emissions.

4.2. TRANSPORT ENVIRONMENTAL IMPACT PROFILES

When no other information is available, the authors recommend for simplicity using a single transport scenario representing transport of one kilogram of material for one kilometre using a mix of transport methods.

Authors further recommend multiplying resulting figure by a factor of 1.33 to consider partially empty return loads that occur. This represents a lack of commercially viable return trips for 50 % of the transports. While many return trips are assumed to be fillable with other goods, all can't be. The top-up of 33 % is the ratio of fuel consumption on the one half of the empty return trips vs. fully loaded deliveries.

4.3. REFRIGERANT ENVIRONMENTAL IMPACT PROFILES

Authors recommend ignoring the refrigerant manufacturing impacts and only focusing on refrigerant leakages to the atmosphere. For the GWP impact of leakages, the values published in IPCC Fifth Assessment Report (AR5) shall be used. For refrigerants that do not have a factor provided in AR5, can use a factor published by European Commission.

4.4. MODULE D ENVIRONMENTAL IMPACT PROFILES

Authors recommend creating these based on substitution of primary material in manufacturing or substituted primary energy production in Estonia.

5. PROPOSED CORE MATERIALS LIST

The authors recommend using the following as the basis for the materials list.

Materials category	Materials	Sourcing region
Construction metals	Reinforcement steel Structural steel Aluminium profiles or sheeting	International or global
Concrete	Ready-mix concrete, C25/30 and below Ready-mix concrete, C30/37 Ready-mix concrete, C40/50 Ready-mix concrete, C60/75 and above Precast concrete, structural elements Precast concrete, hollow core slabs Precast concrete, external wall element Precast concrete, internal wall element Other reinforced precast concrete product Non reinforced precast concrete product	Local or regional
Insulation	Mineral wool EPS insulation XPS insulation Other insulation	Local or regional
Wood-based	Sawn timber Fibreboard Plywood Cross-Laminated Timber	Local or regional
Local mineral-based	Asphalt Gypsum board Natural stone slabs Masonry mortar Cement Levelling screed Fired clay bricks Bitumen waterproofing membrane	Local or regional
Other non-local	Float glass Ceramic flooring tiles Flooring material, unspecified Construction plastic, unspecified Paint (interior or exterior)	International or global

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