

Background report – carbon handprint

Updated 25.03.2025.

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1 Carbon handprint

A conservative approach was applied for the assessment of potential benefit. The applied typical scenario for organic materials is energy recovery and for mineral products landfilling. In the case of landfilling and other similar (low value) recycling methods, the potential benefit is considered zero. This scenario was applied for all mineral products excluding reused natural stones which are partly reused and partly directed to landfilling. The applied typical scenario for metal-based products and bitumen is recycling.

2 Renewable energy

The carbon handprint is created by the production of surplus renewable energy, equipped with a fixed transmission connection, located in the building, at the construction site, or near the construction site. Carbon handprint is calculated using the formula and principles presented in Regulation 1027/2024¹.

3 Material recovery of metals: steel, aluminum, and copper

Steel scrap is assumed to reach the end-of-waste status once it is shredded and sorted, thus becoming input to the product system in the inventory. Credit is given for the net scrap that is produced at the end of a final product's life. This net scrap is determined as follows:

$$\text{Net scrap} = \text{Amount of steel recycled at end-of-life} - \text{Scrap input} \qquad (\text{Eq. 1})$$

For example, the EPDs published by SSAB (such as RTS_48_20, Rakennustieto 2022), the impact of recycling is calculated using World Steel Association's (2017) method. The compensation is calculated as the difference between the primary and secondary production of a steel perceived with the acquisition of the recycling process. In addition, the ratio of the need of recycled steel to produce 1 kg of steel in secondary production is considered as well as the use of scrap steel in steel production. If the recycling rate is 0.9, the need of scrap is assumed to be 1.1 in relation to the amount of steel produced, by assuming no scrap use in primary production, and by using emission values 2.5 and 0.9

¹ [1027/2024 | Suomen säädöskokoelma | Finlex](#)

kg CO₂e/kg for primary and scrap-based steel in accordance with Boverket (2022), the benefit beyond the life cycle becomes -1.3 kg CO₂e/kg.

Correspondingly, we can calculate the potential benefit for aluminum (-3.5 kg CO₂e/kg) by using emission values 6.0 and 1.7 kg CO₂e/kg for products based on virgin raw materials or scrap, and for copper (-3 kg CO₂e/kg) by using emission values 4.0 and 0.5 kg CO₂e/kg (CO₂DATA).

4 Material recovery of bitumen roofing

The recycling potential of bitumen roofing can be assessed to be rather good. Recycled bitumen roofing can be used as direct replacement for virgin bitumen in asphalt. Potential savings have been assessed to be roughly 0.2 kg CO₂e/kg (Katepal 2022). The value 0.1 kg CO₂e/kg was chosen while assuming half of deconstruction waste is recycled in asphalt.

5 Reuse of materials: natural stones

The potential benefits of reuse are based on avoiding the emissions that would have occurred if products were made from virgin raw materials. Many construction products have been recognized as having potential for reuse, but due to current techniques and practices, reuse is still meager. Values for potential benefit are given only for natural stones, due to their extensive and well-known reuse at the end of their lifecycle. Since the determination of the potential benefit is in this case tied to the emissions from manufacturing (GWP A1-A3), a generic value is not given to reuse. The potential benefit of reuse is determined for natural stones assuming 50 percent reuse at the end of life. The potential benefit of reuse is determined as follows:

$$\text{Potential benefit of reuse} = \text{Share of material reused at end-of-life} * \text{emission value of the material (GWP A1-A3 conservative)} \quad (\text{Eq. 2})$$

6 Carbon storage of organic materials

Generic value is given for wooden products (wood and engineered wooden products) and applied to other organic materials (cellulose insulation and tree seedlings) as their impact in the volume of building construction is small compared to wood products. If the role of other organic materials in construction increases, it is necessary to reassess the generic values for organic materials' carbon handprint. The consideration of potential benefit mainly corresponds to the idea of benefits beyond the system boundary as defined in EN 15804 (2019). However, the benefit because of carbon storage is an additional aspect. The consideration of this aspect is related to VN (2022), and to the inclusion of carbon storage aspect in the proposal for a new energy performance directive (Article 7 in COM 2021)².

Carbon storage of wood is also considered in the method according to the standardization, but EN 15804 directs to report it as carbon instead of carbon dioxide.

The justification for the consideration of potential benefit because of carbon storage is related to the arguments³ regarding the effect of harvesting levels. According to the report by The Finnish climate change panel (Seppälä et al. 2022), the emissions reduction due to the carbon stored in wood-based products and the substitution effects of wood-based products and fuels compared to fossil-based options are not enough to compensate for the loss of forest carbon sinks in at least 150 years' time if

² " Member States shall also address carbon removals associated to carbon storage in or on buildings" as sated in Article 7 in Proposal for a directive of the European Parliament and of the Council on the energy performance of buildings (recast).

³ [LCA database for building products, services, and systems – Description of the content and working methods \(helsinki.fi\)](#)

levels of harvesting are permanently increased to supply these products. However, wood-based building materials currently provide higher climate benefits than pulp-based products. If increased production of wood-based building materials can be achieved without increasing levels of harvesting, climate benefits can be gained even in the short term compared to the current situation.

Based on carbon storage calculation on multiple EPDs of timber products a common factor of -1.6 kg CO₂e/kg was selected to be used in the database.

7 Carbonation of concrete

Carbonation of concrete is a natural chemical reaction by which CO₂ in the ambient air penetrates the concrete and reacts with hydration products in the concrete. Thus, part of the carbon dioxide emitted during cement production is rebounded to the concrete during use and end of life stages. However, according to the proposed regulation (YM 2022b) the consideration of the carbonation is limited to the reaction that happens during a maximum of one hundred years period after the cement-based building material is removed from use (2 §). In addition, the evaluation of the potential benefit of carbonation must be based on the same types of cement that have been used in the evaluation of the carbon footprint. The standard says EN 5676 (2017) (Annex BB) that although pozzolanic binders and latent hydraulic binders could contain reactive CaO, the calculation of uptake of CO₂ should only consider the materials that have allocated emissions. The standard EN 16757 (2017) provides a method to assess the CO₂ absorbed through carbonation of concrete. Based on the general principles presented in the informative Annexes, significant carbon uptake could happen in C phase after crushing in favorable conditions due the influence of CO₂ in the ambient air. However, when used in new concrete products as aggregate materials, the phenomenon proceeds very slowly, and its share of the overall possible carbon uptake is small. The same is probably true when crushed concrete is utilized in landfilling (in land restoration). According to the standard, in Module D, carbonation may be considered up to the point of functional equivalence.

The typical value presented in the CO₂DATA database, is calculated assuming that the proportion of lime exposed to carbonation in the cement-based material (out of the total amount of lime) could be in maximum 50 percentage considering that a significant share of maximum carbonation has already taken place during B and C phases and considering the maximum period of 100 years in D phase. Also, by using the weight 2400 kg/m³ for concrete, a kind of maximum value 400 kg/m³ for cement content, assuming a 65% CaO content in cement, and using the mole ratio 44/56=0,786 for CO₂ and CaO, the following upper value was calculated:

$$0.786 \text{ kg CO}_2\text{e/kg} * 0.65 * (400 \text{ kg} / 2400 \text{ kg}) * 0,5 = 0.043 \text{ kg CO}_2\text{e/kg} \quad (\text{Eq. 3})$$

The lowest value could - on the other hand - be zero or almost zero in earth conditions, where the penetration of air would be almost negligible, and when cement content is low, and carbonation has already taken place during earlier phases.

A value in the middle of these two values was chosen as the typical value for the database for all concrete types.

The typical emission values for concrete products in the database do not consider carbonation although EN 16757 (2017) presents that when the CO₂ uptake due to the carbonation of concrete is considered, it shall be included in the respective modules in which it occurs. Thus, the emission values of concrete products may need to be modified if the same approach was also included in the later/final version of the climate declaration.

8 Summary of selected values

The following items and values were selected to database as representative for potential benefit because of recycling, renewable energy, carbon storage and carbonation:

Item	Carbon handprint (CO2e kg/kg)
<i>Carbon handprint, steel, recycling</i>	-1,300
<i>Carbon handprint, aluminium, recycling</i>	-3,500
<i>Carbon handprint, copper, recycling</i>	-3,000
<i>Carbon handprint, bitumen membrane, recycling</i>	-0,100
<i>Carbon handprint, organic material, carbon storage</i>	-1,6
<i>Carbon handprint, concrete, carbonation</i>	-0,022

Potential benefit of reuse is defined as product-specific value for any products with a typical reuse scenario. In the present case check chapter 5.