**CO2 transport calculator for Dutch demolition and construction sites**

**CDW**



### Description:

In a circular economy, we will keep materials in the loop to minimize waste and reduce the extraction of virgin materials. When this concept is applied in the construction industry, the input consists of construction materials that have already been accumulated in the built environment. In the hierarchy of circularity direct re-use of components and products is favoured above demolition. However, even after demolition materials are set free in form of Construction and Demolition Waste (CDW) ready to be reused and recycled. When it comes to soil, sand, and concrete products, this CDW can be used as a resource for new civil construction projects. A tool was developed to reflect on CO2 emissions when transporting these resources common to civil construction projects. In developing this tool, we operated in the field of embodied carbon where the production, transport, and handling contribute to a carbon “price” of new products. If CDW is used as a resource, embodied carbon stays captured in these materials, and emissions of producing new products can be avoided. As Kellermann states “This means that the carbon saving potential in a circular economy is not isolated to the production process itself. There is also a carbon saving potential in the construction and end of life stages” (Kellermann, 2021a).

Therefore, Kellermann (2021b) developed a tool to compute the lifecycle CO2 impact of concrete, soil, or mixed CDW. This tool makes use of generic European information on Global Warming Potential (GWP) and machinery characteristics. However, each country in Europe has its characteristics that influence CO2 emissions, e.g. road typologies and equipment. Therefore, a Dutch CO2 transport calculator was developed by Saxion UAS. Instead of European or Danish values, this Dutch calculator makes use of local transport emissions and requires a slightly more detailed input to come to results that better fit the Dutch situation.

Input to the calculator:

The inputs required for the Dutch CO2 transport calculator per material (concrete bricks, concrete tiles, asphalt, and soil) are presented in Table 1.

Table 1. Instrument's input parameters (Hagen and Entrop, forthcoming).

|  |  |
| --- | --- |
| Input parameter | Unit |
| Loading capacity of the lorry | tons |
| Unloaded weight of the lorry | tons |
| Total distance from the site to waste depot or landfill | km |
| Highway distance from the site to waste depot or landfill | km |
| Total distance from the site to collection point or storage site | km |
| Highway distance from the site to collection point or storage site | km |
| Amount of materials | tons, m2, or m3 |
| Reuse percentage | % |

Output from the calculator:

The Dutch CO2 transport calculator computes the CO2 emission per transported materials for three scenarios:

* 100% reuse (all material is transported to a collection point or storage site);
* 0% reuse (none of the material is transported to a collection point or storage site);
* X% reuse (the percentage of reused material that is entered as input, is transported to a collection point or storage site).

In this way, the tool provides insight into the CO2 emission of different designs (different reuse percentages) and the CO2 emission for different locations and routes which helps in the decision-making process.

Keywords:

* Construction Demolition Waste
* CO2 emission
* Transport
* Decision making

Complementary tools:

* Pre-demolition screening procedure
* Selective demolition procedure
* CDW quality assessment

Target user:

* Local governments - (e.g. departments of buildings & infrastructure, environment, urban development, procurement)
* Contractors in the field of civil engineering

Format:

* Excel sheet with instructions distinguishing input, throughput, and output (available in English)

### Development

The Dutch CO2 transport calculator is based on the tool developed by Kellermann (2021b). The first version of the Dutch tool is set up by Willoughby as part of a minor project from Saxion University of Applied Sciences in 2020 (Poutiainen, Willoughby, and Otten, 2020). This version is checked and optimized by Lisanne Hagen and Bram Entrop, which resulted in the Dutch CO2 calculator as presented in this tool factsheet. This tool is tested in practice at the casus of Griffiersveld in the municipality of Apeldoorn, the Netherlands in 2022.

**Barriers**:

CDW can be handled and transported by different types of equipment. Furthermore, in dense cities, many different routes can be followed to cover the distance between donor location A and a depot or facility at location B. Therefore, it is not an easy task to retrieve reliable data and to ensure the data used is representative of other civil construction projects or even road renovation projects.

### Deployment

Within H2020 Cityloops, soil, mixed CDW, and concrete CO2 calculator tools have already been used in multiple tender processes. This particular Dutch CO2 transport emission calculator will be tested in a road renovation project. The project takes place in the municipality of Apeldoorn in a residential area called Griffiersveld. The contractor will provide data on which equipment and routes will be used in handling soil and concrete products.

### Replication

Just like the other calculators, also this tool can be made available to anyone interested in using it. The excel sheets for calculating CO2 transport emissions savings of concrete tiles, concrete bricks, asphalt, and soil are accompanied by instructions in English, as well as the methodology, source of data, and how to use them.

### References

Poutiainen, S., Willoughby, N., and Otten, B. (2020). *Designing a material to facilitate circular industry.* Saxion, Enschede.

Kellermann, K. (2021a). *Lifecycle CO2e Calculator for Demolition and Renovation Sites* [Tool Factsheet]. CityLoops.

Kellermann, K. (2021b). *CO2 calculator for demolition and renovation sites* [Excel tool]. CityLoops

Hagen, L., and Entrop, A. G. (forthcoming). *CO2 transport calculator for demolition and construction sites: the case of a Dutch road renovation project.*

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