2023-2025

ADVANCE

ACCOMPANYING MEASURE FOR DISSEMINATION, VALORISATION AND COLLABORATIVE EXPLOITATION OF CIRCULARITY OF CONSTRUCTIONAL STEEL PRODUCTS

Research Fund for Coal and Steel
Grant agreement No: 101112269

Funded by the European Union

LCA online tool

August 2025

Deliverable: D 4.3 Web tool

Confidentiality: Public

Authors: **Helena Gervasio, Luis Simões da Silva**
University of Coimbra, UC

Petr Hradil, Tiina Vainio-Kaila, Jana Geyer
VTT Technical Research Centre of Finland, VTT

Daniel-Viorel Ungureanu
University of Timisoara, UPT

ADVANCE project is funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them

Executive summary

This document provides a description of the Deliverable D4.3, the 'Buildings LCA' tool developed in the scope of the RFCS project SB STEEL, upgraded in the scope of ADVANCE project, and converted into the web application available at: https://buildingslca.onesource.pt.

The updated dashboard of the tool is illustrated in Figure 1. The original tool was developed to provide a simplified and quick evaluation of the sustainability of steel-framed buildings in the early stages of design, taking into account the life cycle environmental performance of the building. The adopted approach was based on a macro-component approach to cope with the lack of data in the early stages of building design [1].

Figure 1. Main dashboard of the updated tool.

The original mobile tool was freely available for smartphones and tablets and could be downloaded from the App Store or the Google Store. The updated version is also freely available for smartphones and tablets as Deliverable D4.2 of ADVANCE project, and a new version is also available online.

The main upgrades of the current tool are:

- Implementation of the LCA approach for the reuse of steel products (as described in Deliverable D4.1)
- Additional macro-components for industrial buildings described in Deliverable D4.2.
- Development of the online tool, which additionally allows for the creation of BIM objects of the macro-components, including the environmental LCA data presented in this document.

Use of the tool

The tool is very user-friendly and the LCA calculation is made according to the flowchart represented in Figure 2:

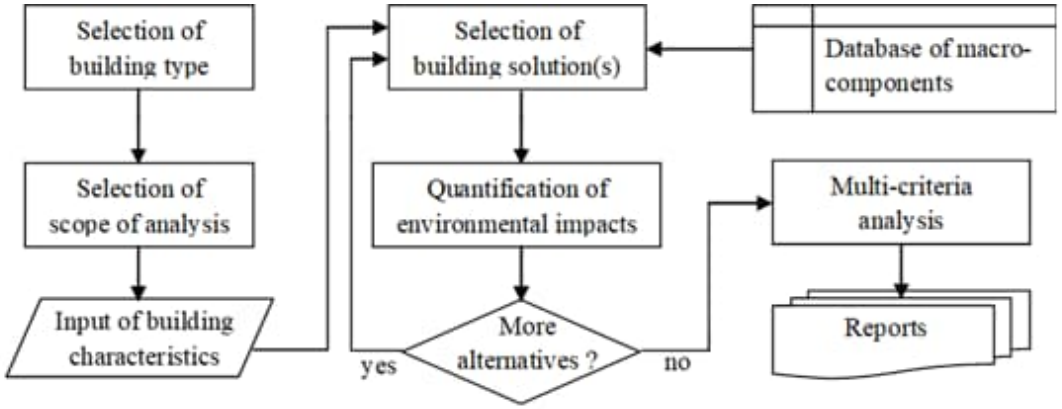

Figure 2. Flowchart of the LCA calculation.

As previously referred, this tool aims to provide a quick evaluation, in the early stages of design, of the sustainability of steel-framed buildings, taking into account the life cycle environmental performance of the building.

In the early stages of design, a building designer often faces different challenges in relation to the selection of the best environmental construction solutions when building data is often scarce (e.g.: which structural system to adopt, solutions for the building envelope, etc.).

Naturally, this is a challenging procedure as each question has a wide range of different alternatives that globally will lead to an even wider range of different solutions. In addition, from the point of view of the environmental assessment, the problem is more complex as one constructional solution may be beneficial in some environmental categories and simultaneously be very harmful in others.

To cope with the above problem, macro-components were developed, which consist of predefined solutions for each building component. Each macro-component is composed of different materials and includes the LCA of each solution. Therefore, the LCA of the building may be carried out based on the selection of a macro-component for each building component.

The details of the LCA calculation at the product (see Figure 3) and building (see Figure 4) levels are described in Deliverable D4.2.

Figure 3. LCA calculation at the product level.

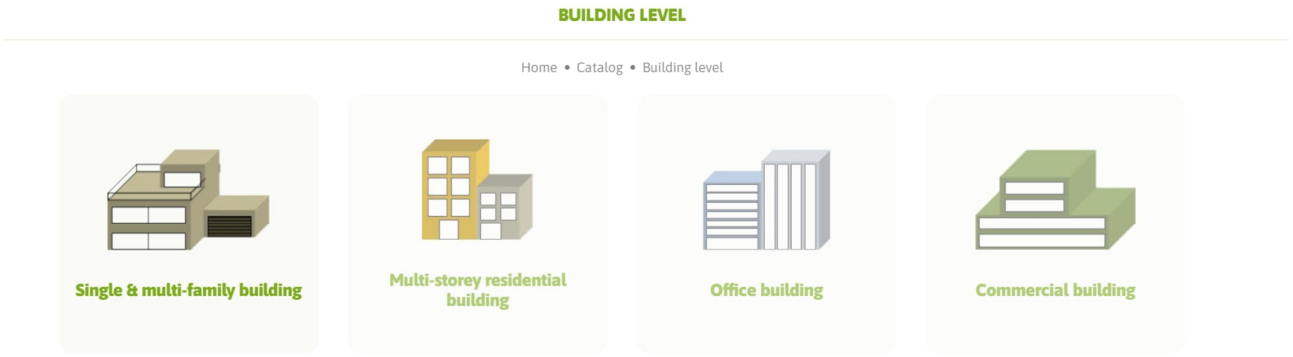

Figure 4. LCA calculation at the building level.

As illustrated in Figure 5, the online tool allows the user to create to log in and manage (save or edit) the files of each LCA calculation. In addition, it is possible to select the indicators adopted for the LCA, which are the ones provided in CEN/TC 350 standards [2][3], as indicated in Figure 6.

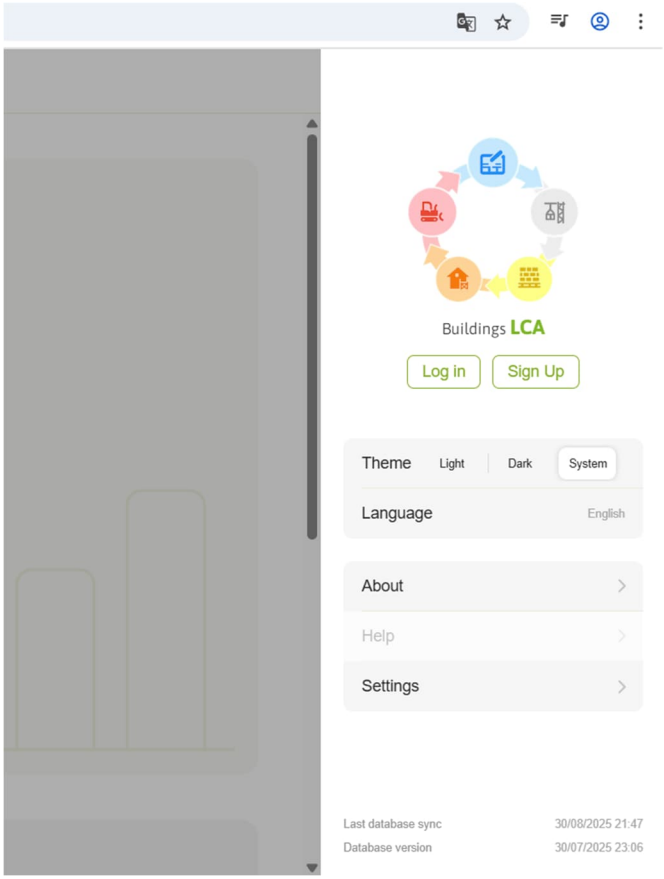

Figure 5. Log in to the online tool.

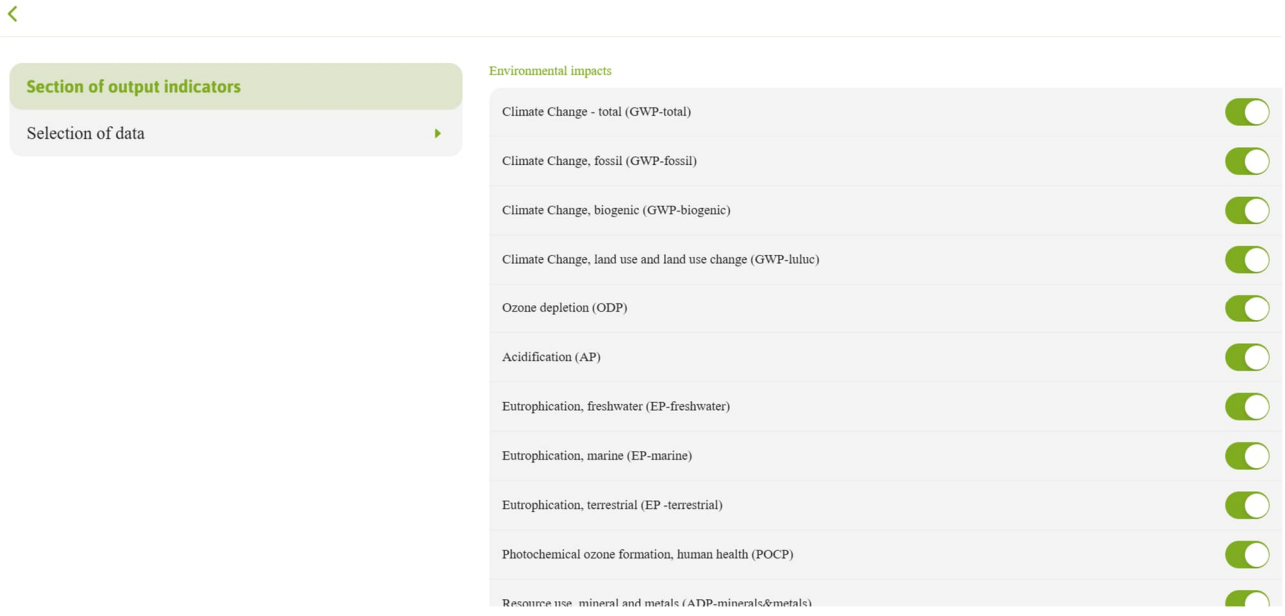

Figure 6. Selection of environmental indicators.

Each LCA calculation is detailed in a report, in the PDF format (see Figure 7), which may be downloaded and printed.

LCA Results

LCA of 1m² of a weight steel slabs macro-component

Indicators describing environmental impacts

Indicator	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D1.1	D1.2	D1	TOTAL
GWP-total	[kg CO2 eq.]	3.34e+1	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	-1.38e+1	0.00e+0	-1.38e+1	1.96e+1
GWP-fossil	[kg CO2 eq.]	3.34e+1	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	-1.38e+1	0.00e+0	-1.38e+1	1.96e+1
GWP-biogenic	[kg CO2 eq.]	-6.14e-2	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	8.20e-2	0.00e+0	8.20e-2	2.06e-2
GWP-luluc	[kg CO2 eq.]	5.27e-3	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	-1.84e-3	0.00e+0	-1.84e-3	3.42e-3
ODP	[kg CFC-11 eq.]	-6.21e-13	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	1.87e-11	0.00e+0	1.87e-11	1.81e-11
AP	[Mole of H+ eq.]	7.89e-2	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	-3.40e-2	0.00e+0	-3.40e-2	4.49e-2
EP-freshwater	[kg P eq.]	1.35e-5	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	-3.23e-6	0.00e+0	-3.23e-6	1.03e-5
EP-marine	[kg N eq.]	1.69e-2	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	-5.45e-3	0.00e+0	-5.45e-3	1.14e-2
EP-terrestrial	[Mole of N eq.]	1.82e-1	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	-4.88e-2	0.00e+0	-4.88e-2	1.33e-1
POCP	[kg NMVOC eq.]	6.64e-2	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	-2.22e-2	0.00e+0	-2.22e-2	4.43e-2
ADP-minerals&metals	[kg Sb eq.]	8.48e-6	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	-7.88e-5	0.00e+0	-7.88e-5	-7.03e-5
ADP-fossil	[MJ]	3.82e+2	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	-1.38e+2	0.00e+0	-1.38e+2	2.43e+2
WDP	[m³ world equiv.]	-1.01e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	0.00e+0	-9.29e-1	0.00e+0	-9.29e-1	-1.94e+0

Figure 7. Pdf report of the LCA calculation.

Creation of BIM objects

The online tool additionally allows the creation of parametric BIM objects of each macro-component.

BIM objects include geometric and functional information of the product. To allow the use of the BIM objects in the modelling of full buildings, layered objects were created that do not have a fixed shape or size (e.g.: walls, flooring, roof tiles). When using BIM object by inserting it into the BIM application, the object is inserted with all its parameters and its different types.

The level of development (or detail) selected for the BIM objects was LOD 300: *Detailed design, specific elements with accurate size and shape*. With BIM LOD 300, it is possible to create a model detailed enough for design coordination and the production of construction documents, including specific sizes, shapes, and quantities of elements, and basic assemblies and connections. This level supports clash detection between disciplines, enables accurate cost estimation, and allows for spatial validation of the design by providing precise geometric information and non-geometric data like material types. In addition, since the BIM objects include all LCA data, the addition of the BIM objects to the building model allows to perform the LCA of the building, as illustrated in Figure 8.

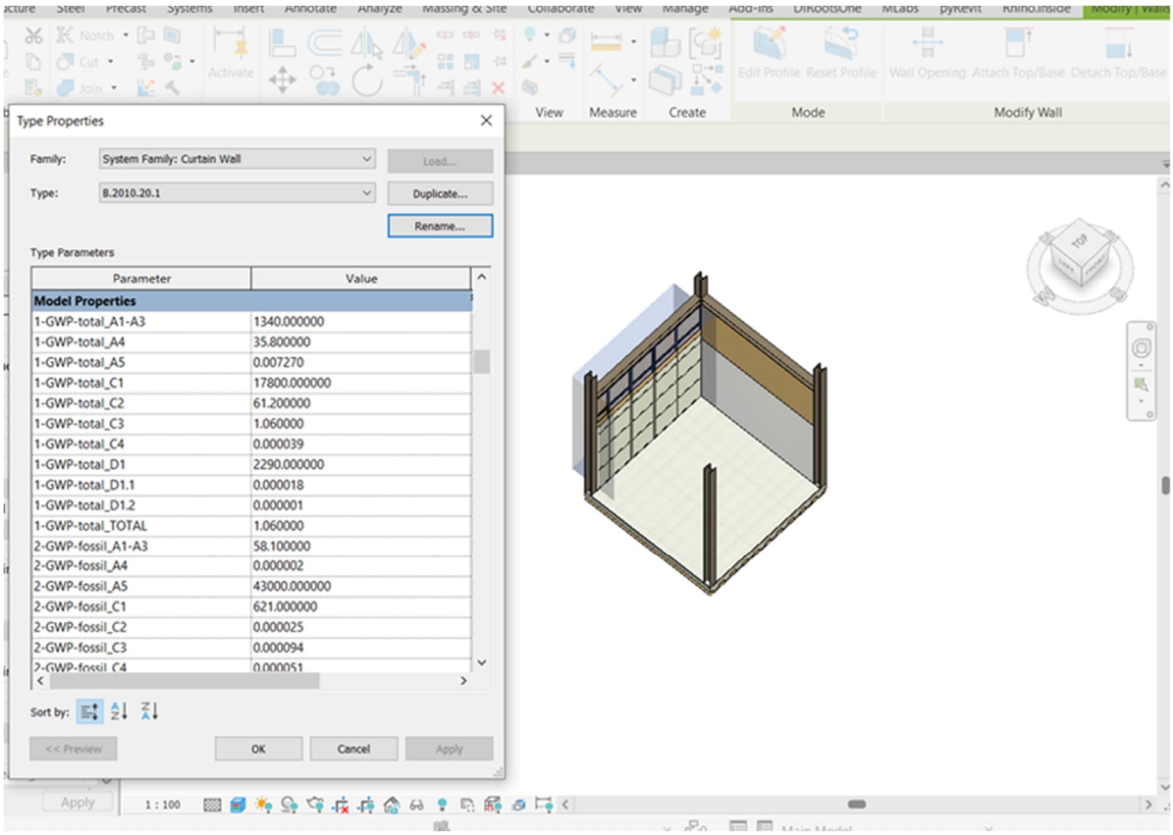

Figure 8. BIM model with objects containing LCA data.

Hence, with the online tool, building designers are able not only to optimize a building's LCA, but also to construct the BIM model with the exported BIM objects, ensuring that the model's LCA is directly integrated into the BIM environment.

References

[1] Gervásio, H., Martins, R., Santos, P., Simões da Silva, L. (2014). A macro-component approach for the assessment of building sustainability in early stages of design, *Building and Environment* 73, pp. 256-270 (2014), http://dx.doi.org/10.1016/j.buildenv.2013.12.015.

[2] CEN (2019). EN 15804:2012 + A1:2019, *Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products*. European Committee for Standardization, Brussels, Belgium.

[3] CEN (2011). EN 15978. 2011. *Sustainability of Construction Works — Assessment of environmental performance of buildings — Calculation method*. European Committee for Standardization, Brussels, Belgium.