User manual for the Carbon footprint calculator

31.12.2021

Euroopa Liit
Euroopa
Regionaalarengu Fond

Eesti
tuleviku heaks

About the tool

This tool calculates the carbon footprint of a building. It is not designed to compete with the commercial LCA (life cycle assessment) tools but rather to familiarize the users with the LCA approach and to demonstrate the Estonian carbon footprint calculation method for construction works. Therefore, the tool is designed to make the calculation as transparent as possible. To make testing easy, the tool asks for a minimum number of inputs to get started. It is possible to fill in the address of the building and the name of the assessor when before printing results. More project information will be asked step-by-step on other worksheets.

In LCA, the life of building consists of three stages (A–C), which are further divided in modules (A1, A2 etc.). D category reports the greenhouse gas impacts that cannot be allocated in the stages of life and are beyond the life-cycle of the project/building. The tool has one worksheet for each module (with the exception of A1-A3 which are on one worksheet). On the left hand side of each worksheet, there is a "+" button that opens a set of new rows that explain how each module is calculated. According to the Estonian method, the carbon footprint of building is the sum of the results from modules A1–A5, B4, B6, and C1–C4. The module D is reported separately and is not included in the carbon footprint.

The key inputs in this tool are:

- The quantities (m^3, m^2) of construction materials (bill of materials)
- The delivered energy by energy carrier.

Bill of materials is usually generated from the building information model in a design software. The list can be exported from the design software as an Excel spreadsheet. The cells including the names of the materials and the quantities are copied and pasted into this calculator on the "Import" worksheet.

Delivered energy is calculated as for the energy certificate. The delivered energy for heating of spaces and water as well as electricity needs to be simulated or estimated in another tool, because energy consumption cannot be calculated in this tool.

The Estonian method applies a scenario on the grid electricity that is expected to become less carbon-intensive in the near future. The tool applies the most relevant scenario available in 2021. The scenario covers the time period until the year 2070, after which the emission factor is assumed to constant. The current scenario on energy carriers is displayed on the worksheet "Energy".

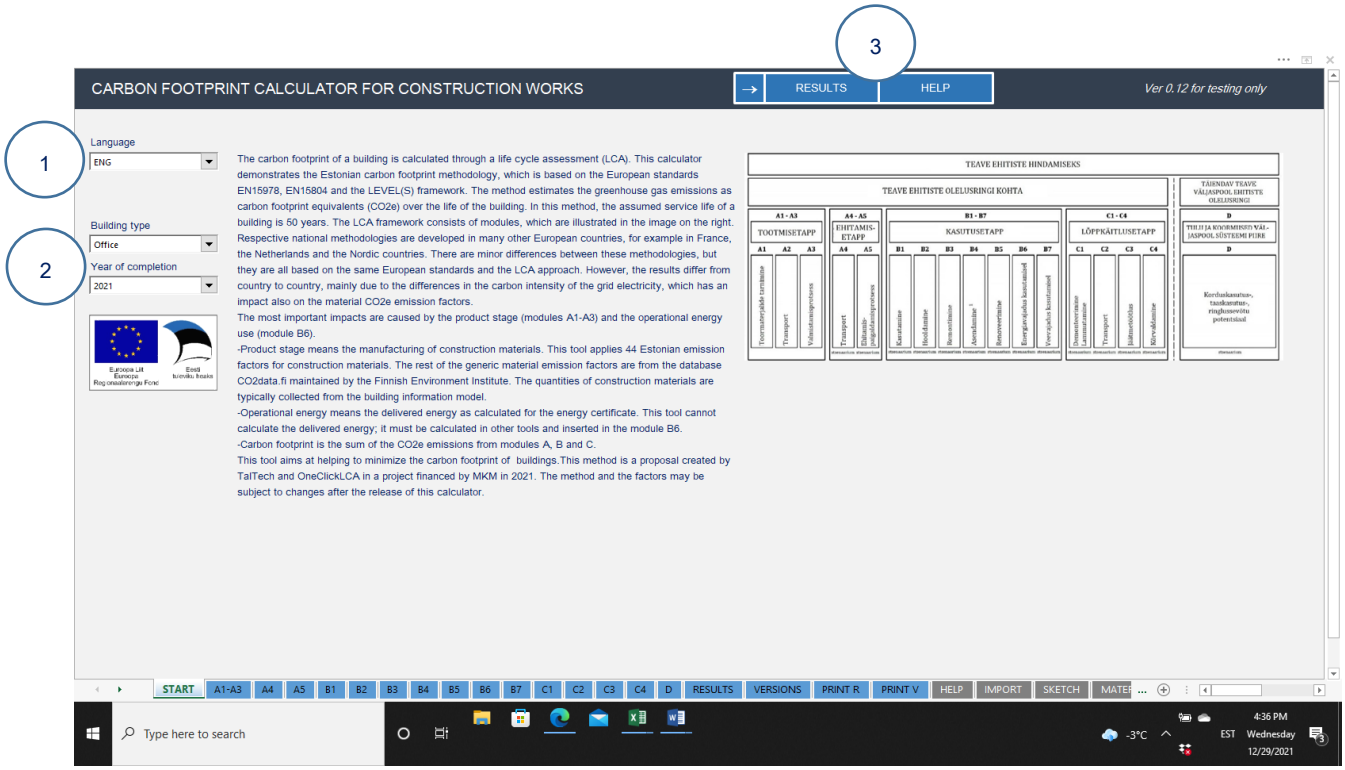
The calculation period is selected in module B6. The Estonian method applies the calculation period of 50 years. In the tool it is possible to test the impact of longer or shorter calculation period.

Please notice that there are specific worksheets with a white background for printing out results or comparisons on paper. The tool can save the data of four versions in addition to the current calculation. However, versions and inputs are saved only when the entire MS Excel file is saved.

The tool can be used in Estonian, English or Finnish. The language is selected on the first page and it can be changed any time without any impact on the actual calculation.

The tool applies the standard functionalities of MS Excel. The version control and the action buttons apply macros with simple VBA scripts.

The tool was developed by the researchers of TalTech in a project financed by MKM in 2021.

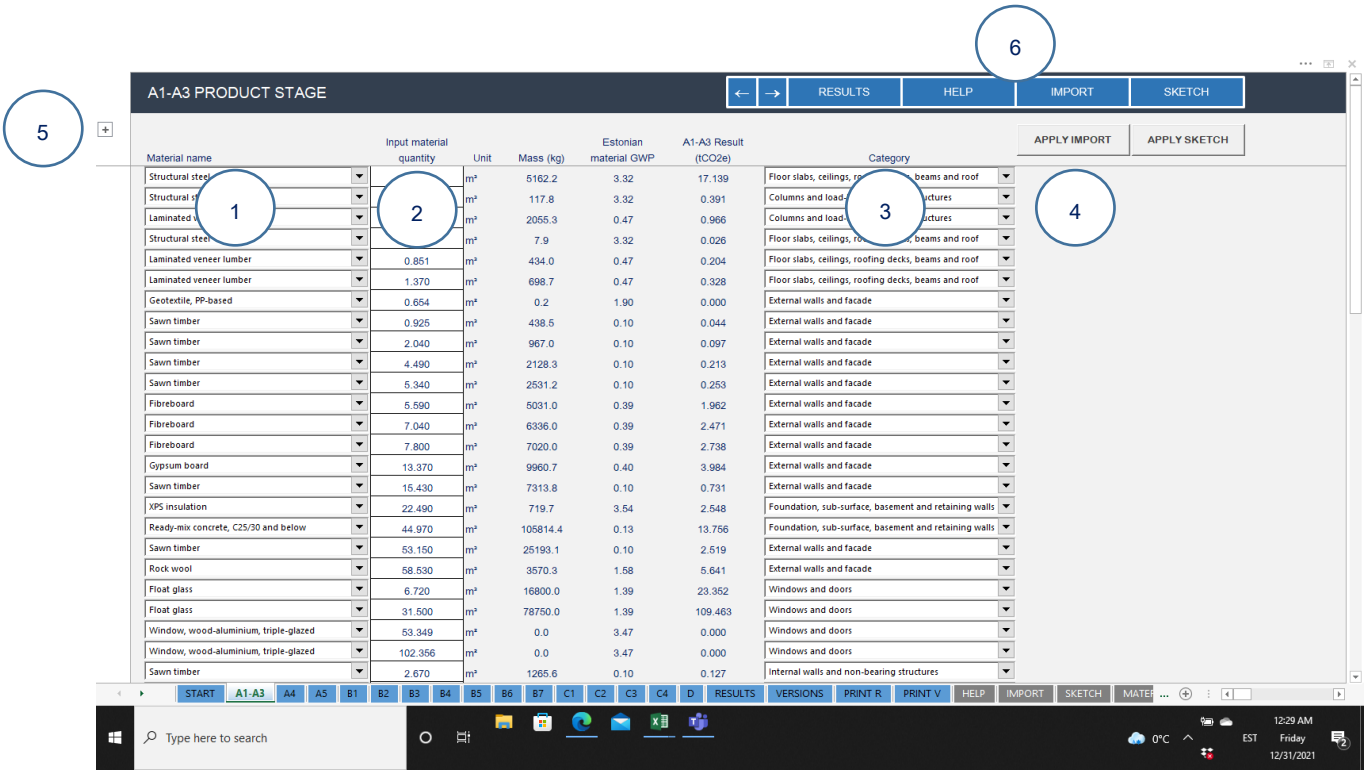


START

This MS Excel tool applies Macros, and therefore after opening the tool You need to click “Enable content”.

1	Language	Options: Estonian, English and Finnish. This option can be changed any time without any impact on the calculation.
2	Building type	Select the best choice from the menu options. Building type will have an impact on the CO_2e emissions from the building services (technical systems and the installations) in the modules A1–A3 and the demolition in the module C1, because the calculator applies default values that depend on the building type.
3	Year of completion	Select the first year when building is expected to be in use. For example: if You choose 2025, this will be the first year of the life span of the building, and the year to which the use stage emissions are allocated. CO_2e emissions from construction site will be allocated to 2024 and the CO_2e emissions from material production to 2023.
4	Navigation	Blue buttons are designed to help the navigation between the worksheets.
	Arrow (→)	takes You to the next worksheet (A1–A3)
	“RESULTS”	is a shortcut to calculation results
	“HELP”	takes You to the user guide worksheet.

In addition, all the standard Excel navigation buttons can be used for navigation.



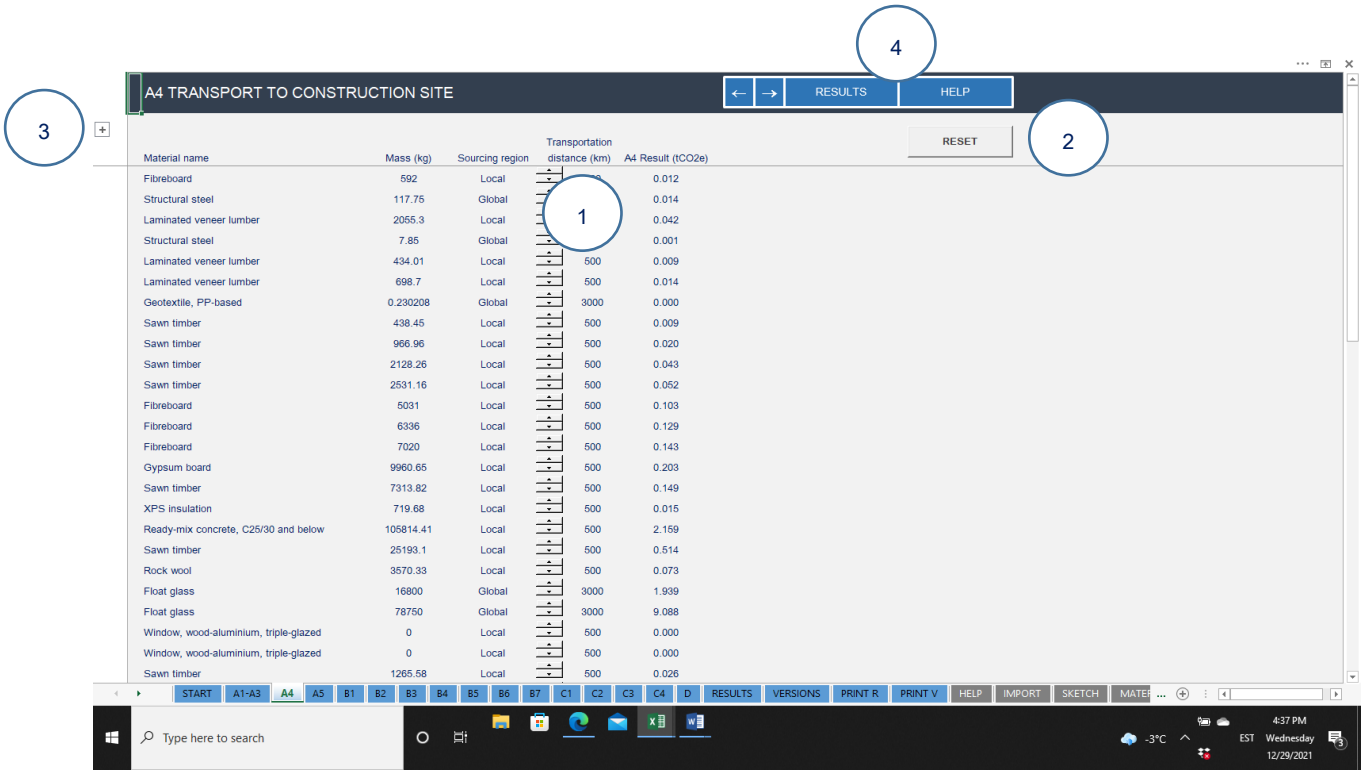
A1–A3

These modules calculate the greenhouse gas emissions from the production of materials. The bill of materials is inserted on this worksheet. There are three ways for inserting the construction materials:

- manually, by feeding in the materials row-by-row
- pasting the bill of materials on the “Import” worksheet (link available on the ribbon)
- creating a schematic building design on the “sketch” worksheet (link available on the ribbon).

Please scroll down the worksheet to describe all the construction materials of the building by three inputs.

1	Material name	Select material from the menu.
2	Material quantity	Insert material quantity in m³.
3	Category	Select the category in which the material belongs to.
4	“APPLY IMPORT”	Push to apply the bill of materials prepared on the “IMPORT” worksheet.
5	“+”	Opens an explanatory note (new rows that explain the calculation).
	“-“	Closes the explanatory note (visible when the additional rows are open).
6	Navigation	Blue buttons are designed to help the navigation between the worksheets.
	Arrows (← →)	take You to the previous or the following worksheet
	“RESULTS”	is a shortcut to the calculation results
	“HELP”	takes You to the user guide worksheet.
	“IMPORT”	takes You to a worksheet where the bill of materials can be pasted
	“SKETCH”	takes You to a worksheet where a sketch design can be created



A4

The module A4 estimates the greenhouse gas emissions caused by the transportation of construction materials from factory to the construction site.

1 Transportation distance The tool proposes default values as follows:

3000 km for globally sourced materials

500 km for locally sourced materials.

If You know where the material is transported from, transportation distance can be adjusted with the control buttons. You can measure the distance for example on Google maps. The distance is multiplied by 1.4 to include the return trips without load.

2 “RESET” Returns the default values in the transportation distance column.

3 “+” Opens an explanatory note (new rows that explain how the module calculates).

“-“ Closes the explanatory note (visible when the additional rows are open).

4 Navigation Blue buttons are designed to help the navigation between the worksheets.

Arrows (← →) take You to the previous or the following worksheet

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“HELP” takes You to the user guide worksheet.

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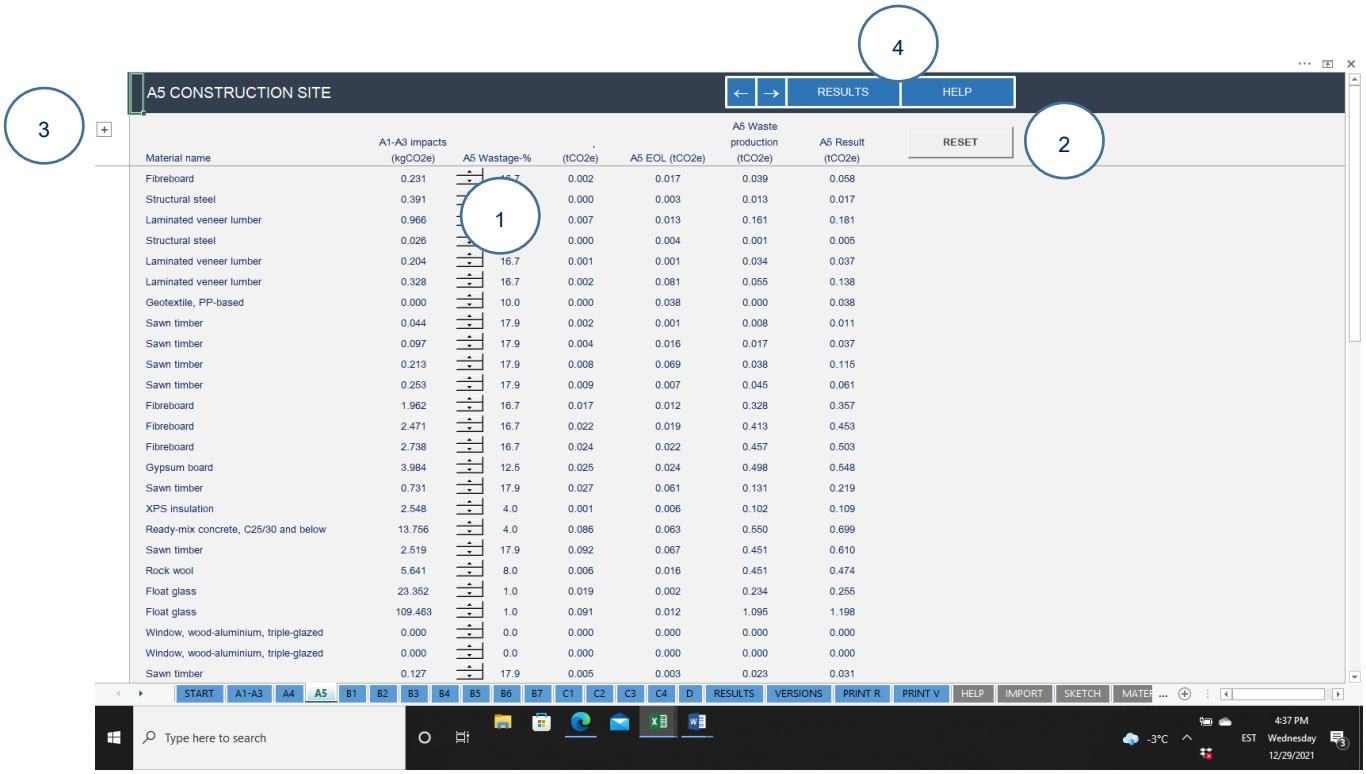

A5

The module A5 estimates the greenhouse gas emissions caused by the construction site activities.

1	Wastage-%	The tool proposes a default value by material. The value can be adjusted with the control buttons next to the value.
2	“RESET”	Reset-button returns the default values in the wastage-% column.
3	“+”	Opens an explanatory note (new rows that explain how the module calculates).
	“-“	Closes the explanatory note (visible when the additional rows are open).
4	Navigation	Blue buttons are designed to help the navigation between the worksheets.
	Arrows (← →)	take You to the previous or the following worksheet
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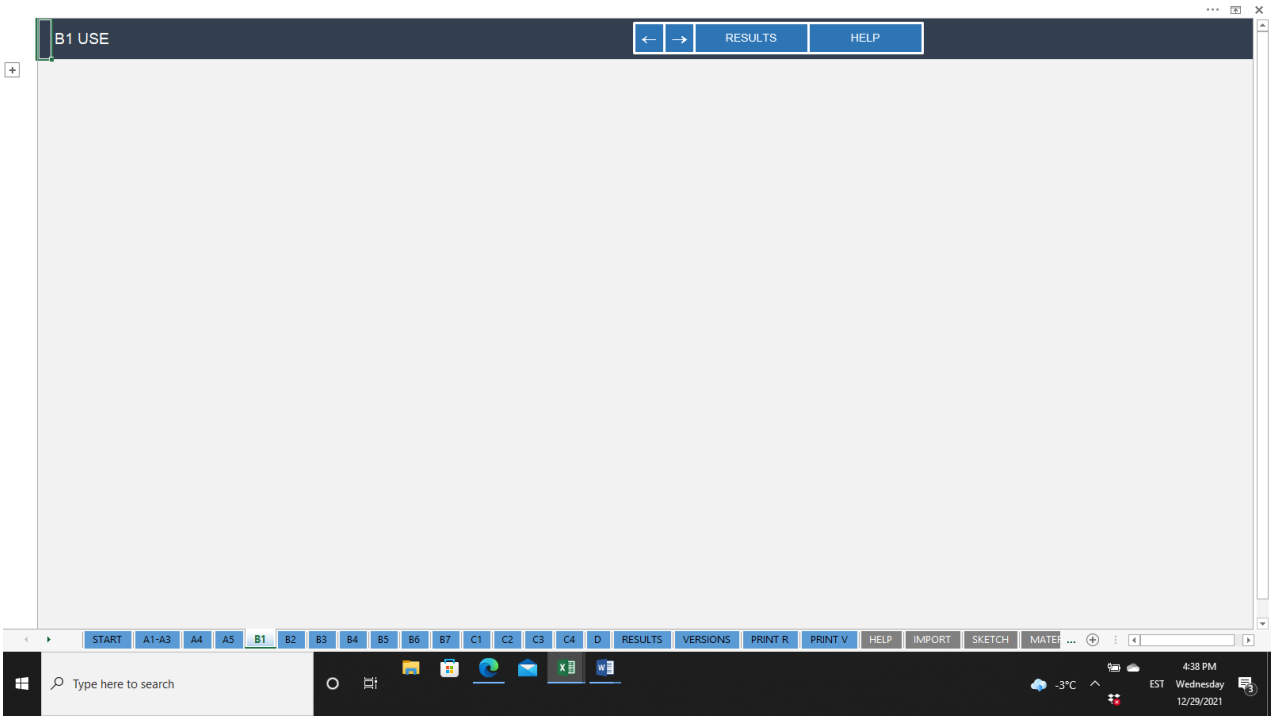
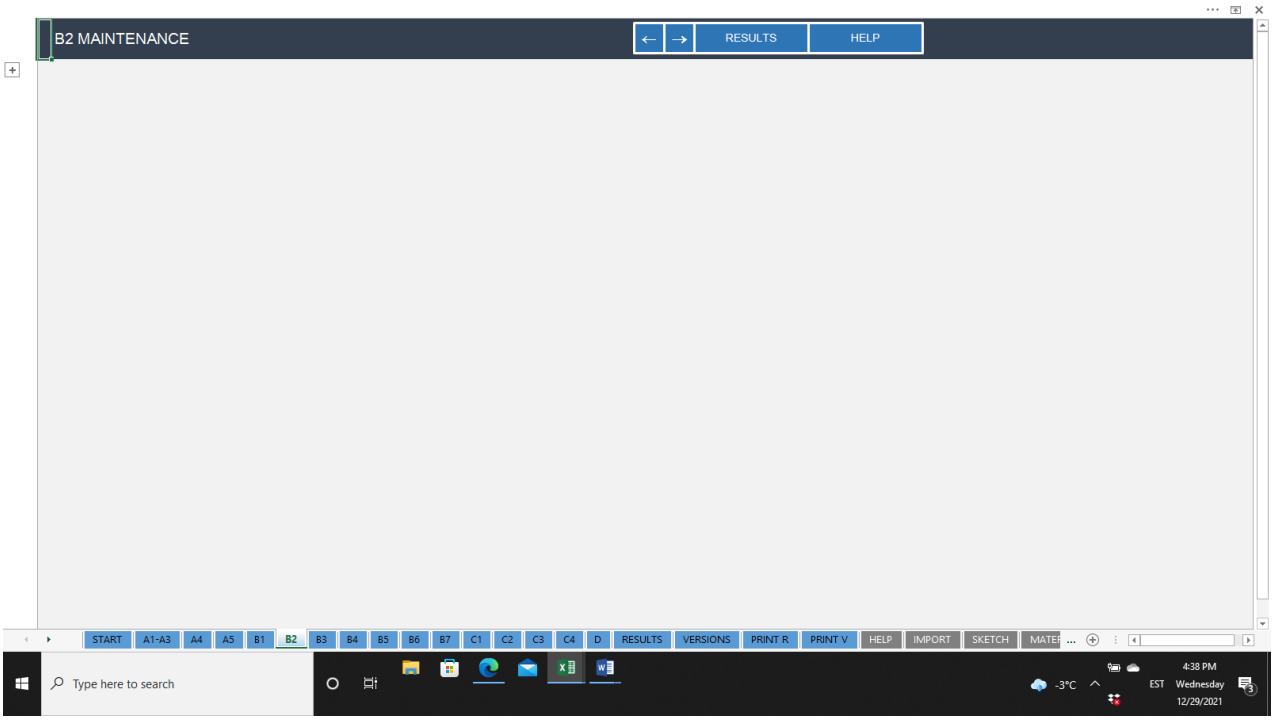


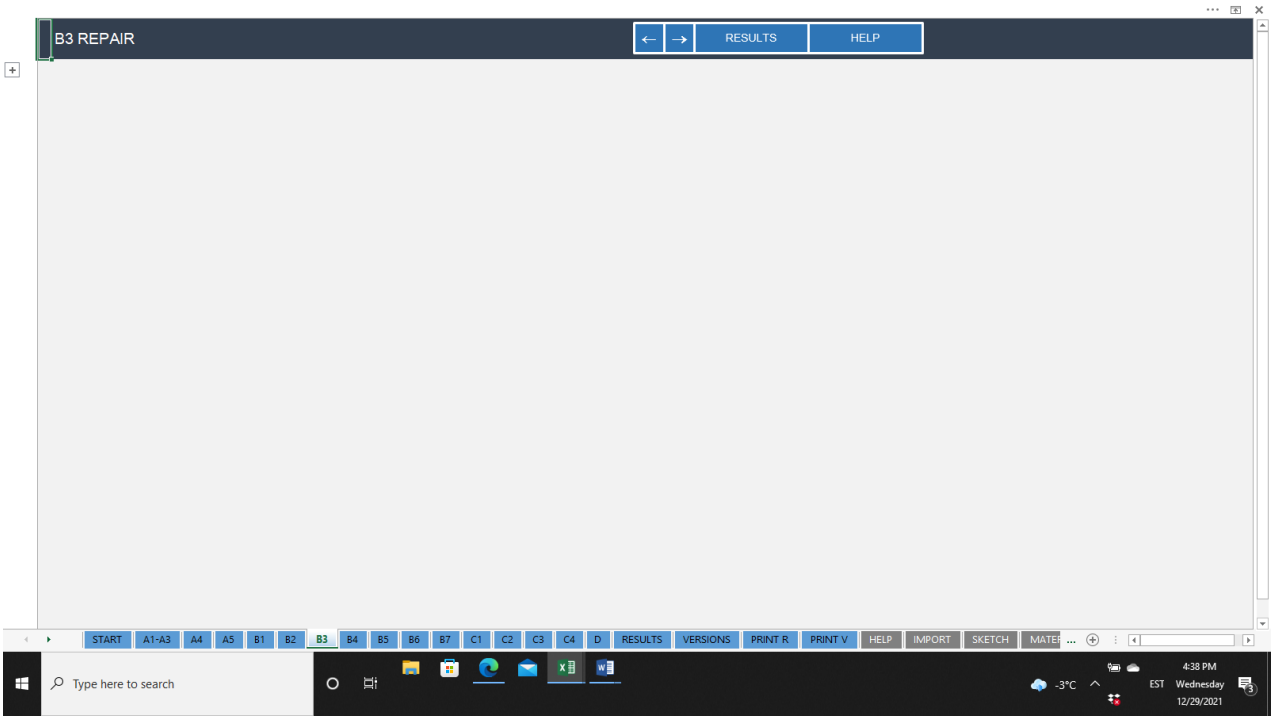
B1

The module B1 is not included in the Estonian carbon footprint calculation method.



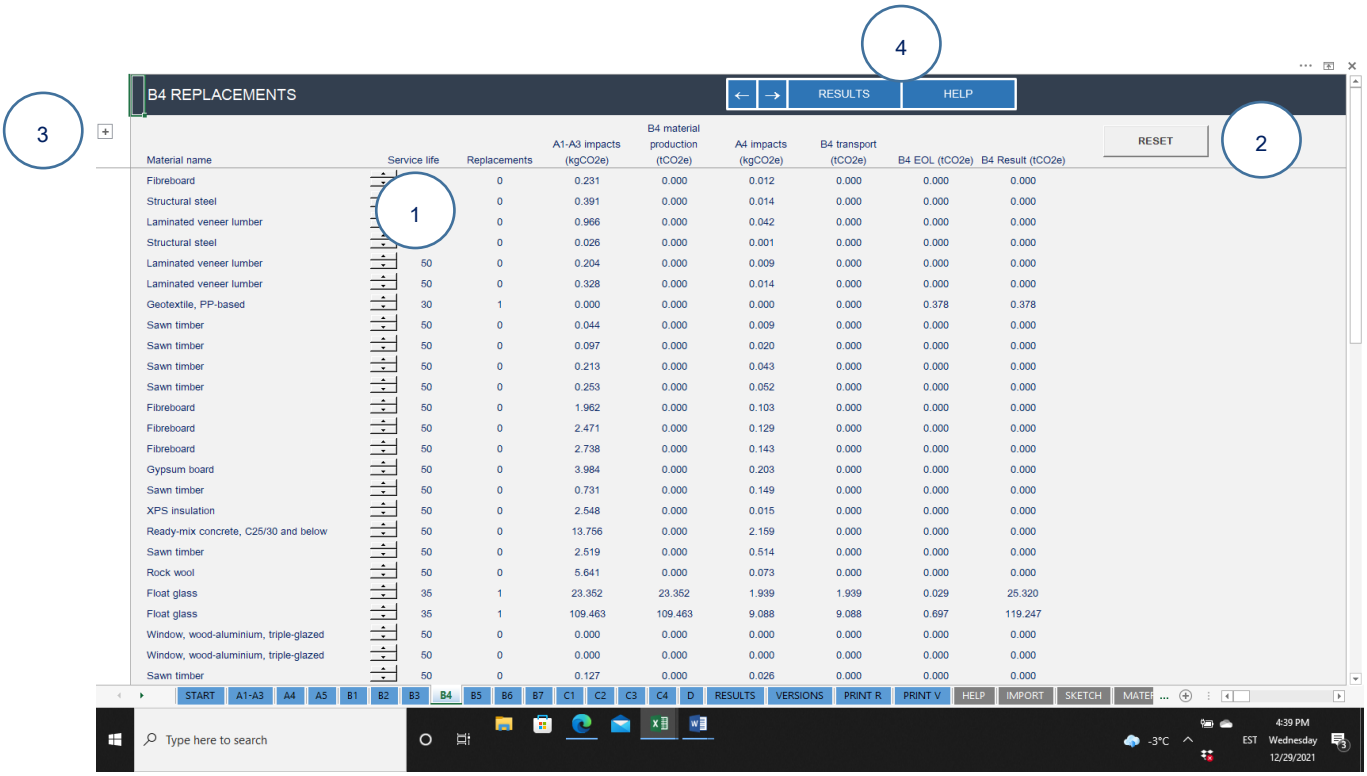
B2

The module B2 is not included in the Estonian carbon footprint calculation method.



B3

The module B3 is not included in the Estonian carbon footprint calculation method.



Material name	Service life	Replacements	A1-A3 impacts (kgCO2e)	B4 material production (tCO2e)	A4 impacts (kgCO2e)	B4 transport (tCO2e)	B4 EOL (tCO2e)	B4 Result (tCO2e)
Fibreboard		0	0.231	0.000	0.012	0.000	0.000	0.000
Structural steel		0	0.391	0.000	0.014	0.000	0.000	0.000
Laminated veneer lumber		0	0.966	0.000	0.042	0.000	0.000	0.000
Structural steel		0	0.026	0.000	0.001	0.000	0.000	0.000
Laminated veneer lumber	50	0	0.204	0.000	0.009	0.000	0.000	0.000
Laminated veneer lumber	50	0	0.328	0.000	0.014	0.000	0.000	0.000
Geotextile, PP-based	30	1	0.000	0.000	0.000	0.000	0.378	0.378
Sawn timber	50	0	0.044	0.000	0.009	0.000	0.000	0.000
Sawn timber	50	0	0.097	0.000	0.020	0.000	0.000	0.000
Sawn timber	50	0	0.213	0.000	0.043	0.000	0.000	0.000
Sawn timber	50	0	0.253	0.000	0.052	0.000	0.000	0.000
Fibreboard	50	0	1.962	0.000	0.103	0.000	0.000	0.000
Fibreboard	50	0	2.471	0.000	0.129	0.000	0.000	0.000
Fibreboard	50	0	2.738	0.000	0.143	0.000	0.000	0.000
Gypsum board	50	0	3.984	0.000	0.203	0.000	0.000	0.000
Sawn timber	50	0	0.731	0.000	0.149	0.000	0.000	0.000
XPS insulation	50	0	2.548	0.000	0.015	0.000	0.000	0.000
Ready-mix concrete, C25/30 and below	50	0	13.756	0.000	2.159	0.000	0.000	0.000
Sawn timber	50	0	2.519	0.000	0.514	0.000	0.000	0.000
Rock wool	50	0	5.641	0.000	0.073	0.000	0.000	0.000
Float glass	35	1	23.352	23.352	1.939	1.939	0.029	25.320
Float glass	35	1	109.463	109.463	9.088	9.088	0.697	119.247
Window, wood-aluminium, triple-glazed	50	0	0.000	0.000	0.000	0.000	0.000	0.000
Window, wood-aluminium, triple-glazed	50	0	0.000	0.000	0.000	0.000	0.000	0.000
Sawn timber	50	0	0.127	0.000	0.026	0.000	0.000	0.000

B4

The module B4 calculates the impact of materials replacement during the life of the building. This includes all materials with a service life that is shorter than the assessment period.

1	Service life	The tool proposes a default value for each material. Service life can be adjusted with the arrow buttons next to the value.
2	“RESET”	Reset-button returns the default values in the service life column.
3	“+”	Opens an explanatory note (new rows that explain how the module calculates).
	“-“	Closes the explanatory note (visible when the additional rows are open).
4	Navigation	Blue buttons are designed to help the navigation between the worksheets.
	Arrows (← →)	take You to the previous or the following worksheet
	“RESULTS”	is a shortcut to calculation results
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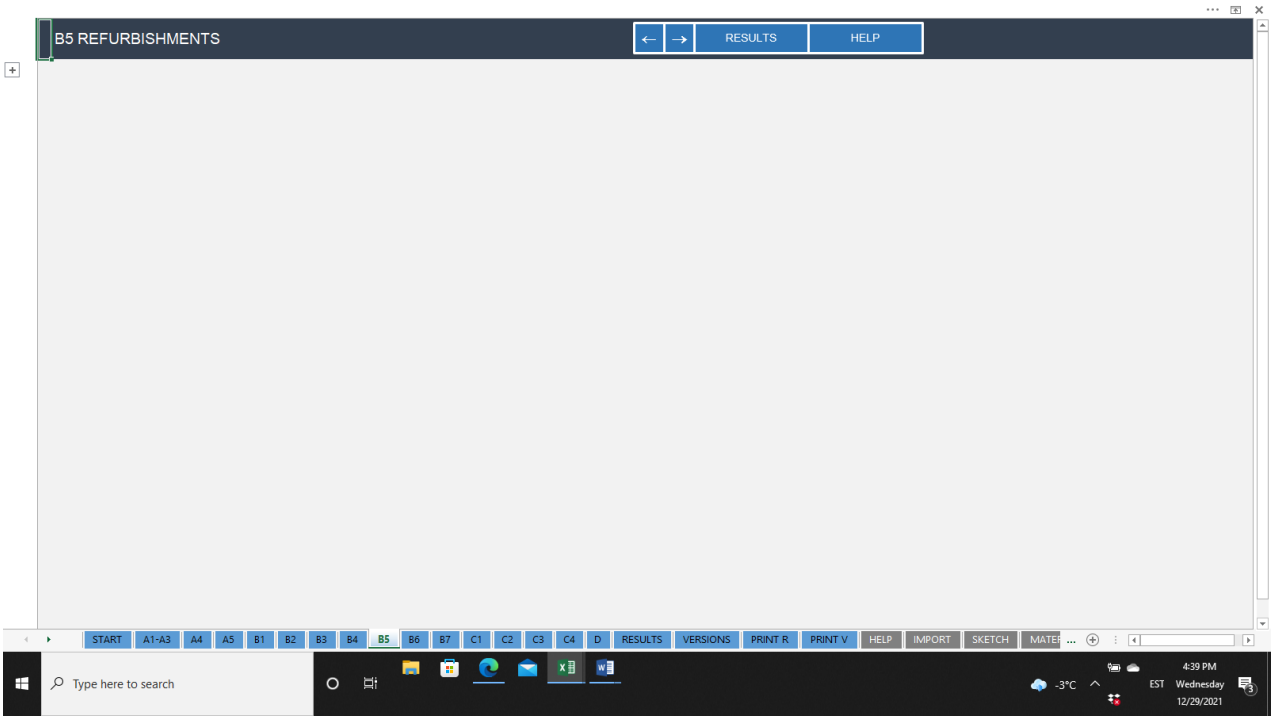
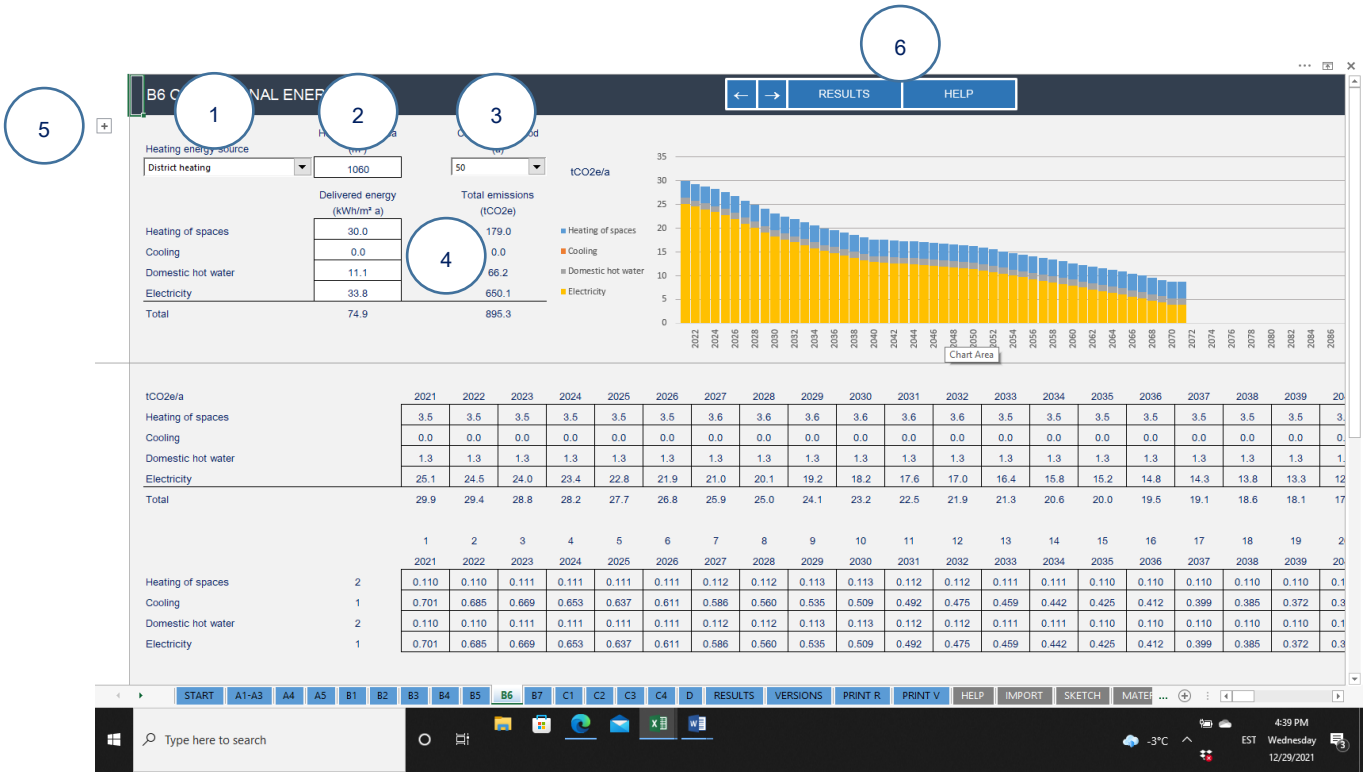
In addition, all the standard Excel navigation buttons can be used for navigation.



B5

The module B5 is not included in the Estonian carbon footprint calculation method.



B6

The module B6 calculates the greenhouse gas emissions caused by the energy use over the life of the building.

1	Heating energy source	Select the main heating energy source from menu.
2	Heated net floor area	Insert the heated net floor area (as in the energy certificate)
3	Assessment period	Select the assessment period from menu. The Estonian method applies 50 years.
4	Delivered energy	Insert the delivered energy (kWh/m²a) for heating of space, cooling, heating of water and electricity (as in the energy certificate).
5	"+"	Opens an explanatory note (new rows that explain how the module calculates).
	"-"	Closes the explanatory note (visible when the additional rows are open).
6	Navigation	Blue buttons are designed to help the navigation between the worksheets.
	Arrows (← →)	take You to the previous or the following worksheet
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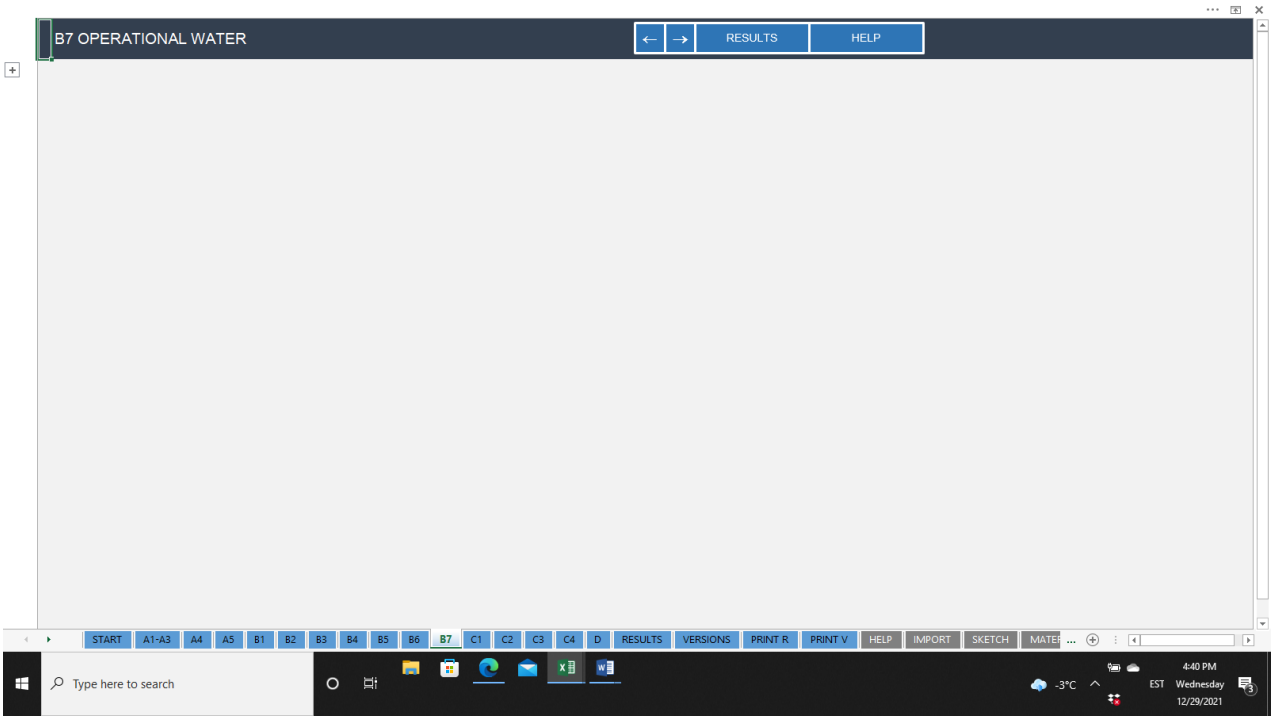
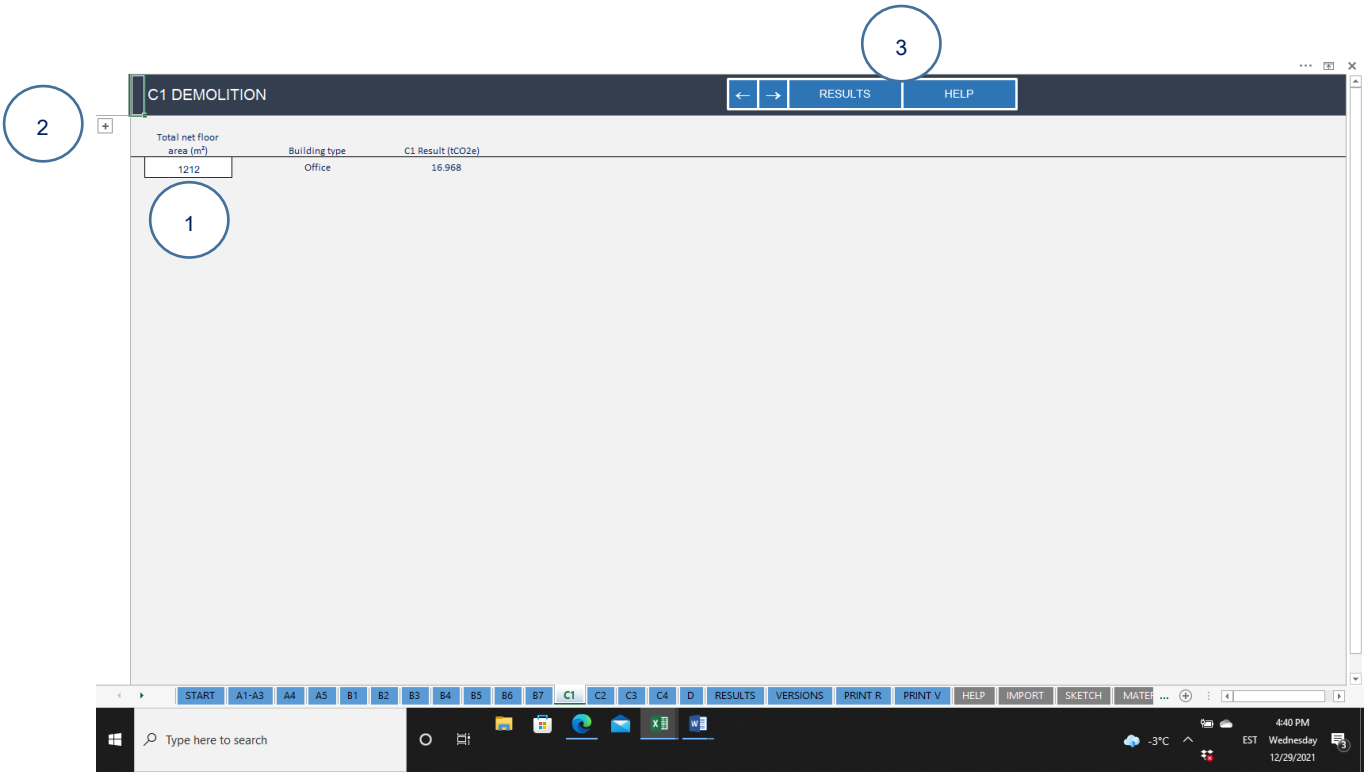


B7

The module B7 is not included in the Estonian carbon footprint calculation method



C1

The module C1 calculates the greenhouse gas emissions caused by the demolition of the building. The estimate is based on the building type selection on the START page.

1	Total net floor area	Insert the total floor area (the sum of heated and non-heated spaces).
2	"+"	Opens an explanatory note (new rows that explain how the module calculates).
	"-"	Closes the explanatory note (visible when the additional rows are open).
3	Navigation	Blue buttons are designed to help the navigation between the worksheets.
	Arrows (← →)	take You to the previous or the following worksheet
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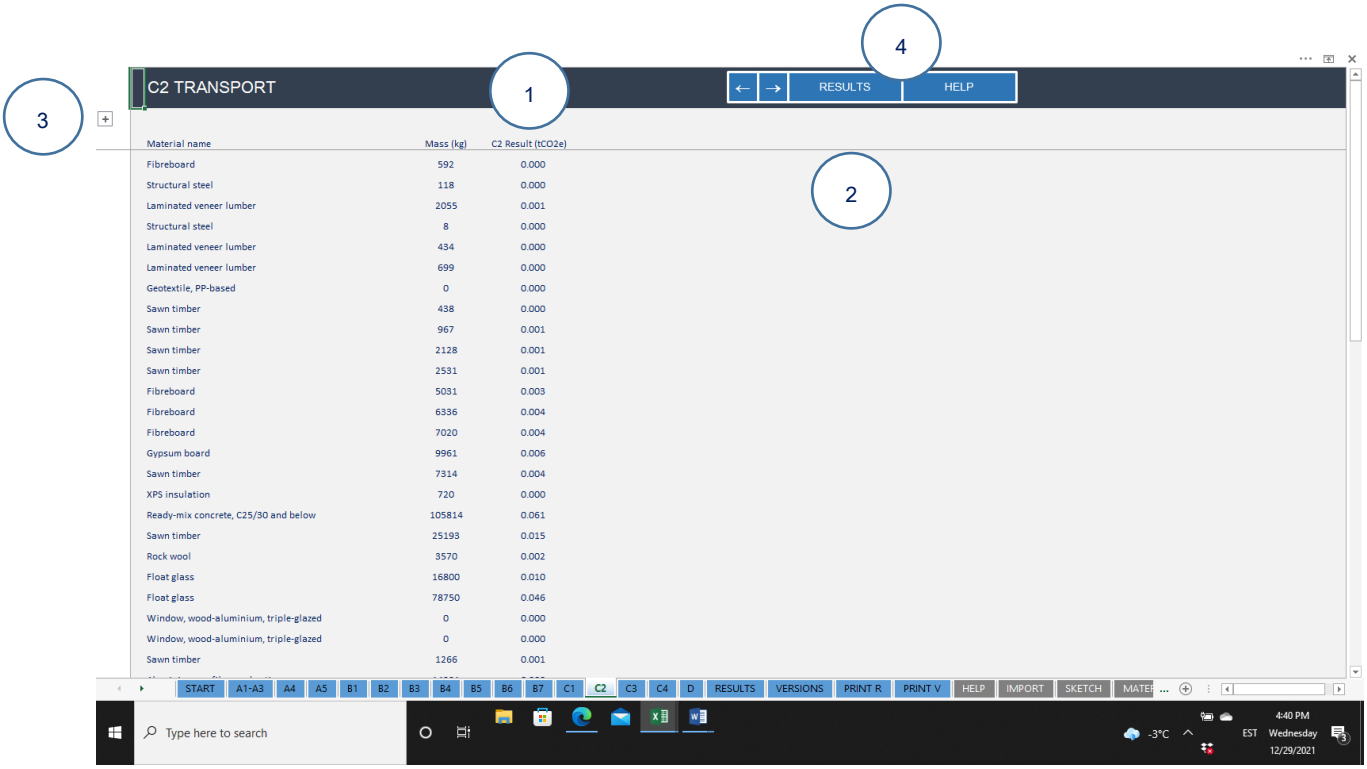

C2

The module C2 calculates the greenhouse gas emissions caused by the transportation in the end-of-life stage. By default, this module applies a transportation distance of 50 km and a road trnasportation emission factor of 0.0116 $kgCO_2/tkm$.

1	Transportation distance	Transportation distance (default) can be adjusted with the control buttons next to the value.
2	“RESET”	Returns the default values in the transportation distance column.
3	“+”	Opens an explanatory note (new rows that explain how the module calculates).
	“-“	Closes the explanatory note (visible when the additional rows are open).
4	Navigation	Blue buttons are designed to help the navigation between the worksheets.
	Arrows (← →)	take You to the previous or the following worksheet
	“RESULTS”	is a shortcut to calculation results
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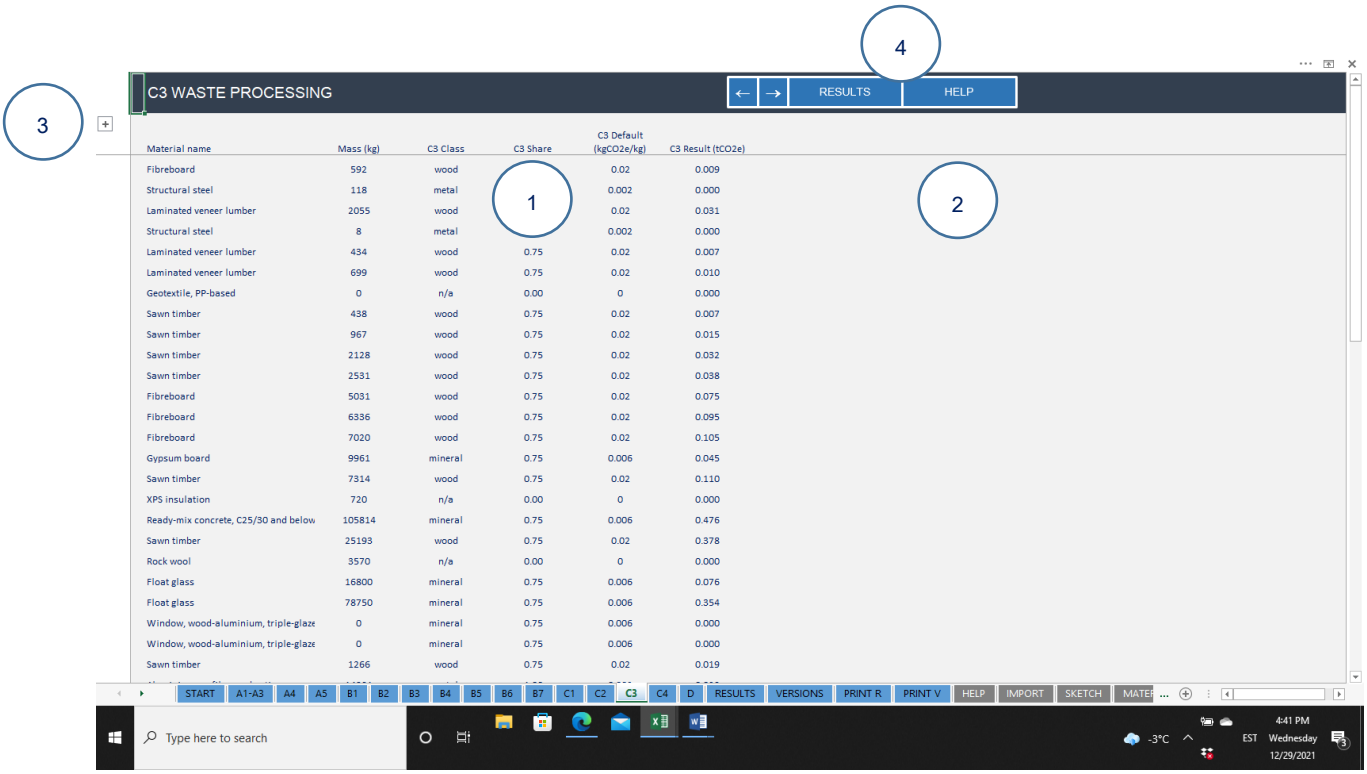

Material name	Mass (kg)	C3 Class	C3 Share	C3 Default (kgCO2e/kg)	C3 Result (tCO2e)
Fibreboard	592	wood		0.02	0.009
Structural steel	118	metal		0.002	0.000
Laminated veneer lumber	2055	wood		0.02	0.031
Structural steel	8	metal		0.002	0.000
Laminated veneer lumber	434	wood	0.75	0.02	0.007
Laminated veneer lumber	699	wood	0.75	0.02	0.010
Geotextile, PP-based	0	n/a	0.00	0	0.000
Sawn timber	438	wood	0.75	0.02	0.007
Sawn timber	967	wood	0.75	0.02	0.015
Sawn timber	2128	wood	0.75	0.02	0.032
Sawn timber	2531	wood	0.75	0.02	0.038
Fibreboard	5031	wood	0.75	0.02	0.075
Fibreboard	6336	wood	0.75	0.02	0.095
Fibreboard	7020	wood	0.75	0.02	0.105
Gypsum board	9961	mineral	0.75	0.006	0.045
Sawn timber	7314	wood	0.75	0.02	0.110
XPS insulation	720	n/a	0.00	0	0.000
Ready-mix concrete, C25/30 and below	105814	mineral	0.75	0.006	0.476
Sawn timber	25193	wood	0.75	0.02	0.378
Rock wool	3570	n/a	0.00	0	0.000
Float glass	16800	mineral	0.75	0.006	0.076
Float glass	78750	mineral	0.75	0.006	0.354
Window, wood-aluminium, triple-glaze	0	mineral	0.75	0.006	0.000
Window, wood-aluminium, triple-glaze	0	mineral	0.75	0.006	0.000
Sawn timber	1266	wood	0.75	0.02	0.019

C3

The module C3 estimates the greenhouse gas emissions from waste processing. This is based on the bill of materials and their classification in the Estonian material database (mineral/metal/wood). The C3 share shows a percentage of materials that are accounted in this module.

1	C3 share	The tool proposes a default value by material. The value can be adjusted with the control buttons next to the value.
2	“RESET”	Returns the default values in the transportation distance column.
3	“+”	Opens an explanatory note (new rows that explain how the module calculates).
	“-“	Closes the explanatory note (visible when the additional rows are open).
4	Navigation	Blue buttons are designed to help the navigation between the worksheets.
	Arrows (← →)	take You to the previous or the following worksheet
	“RESULTS”	is a shortcut to calculation results
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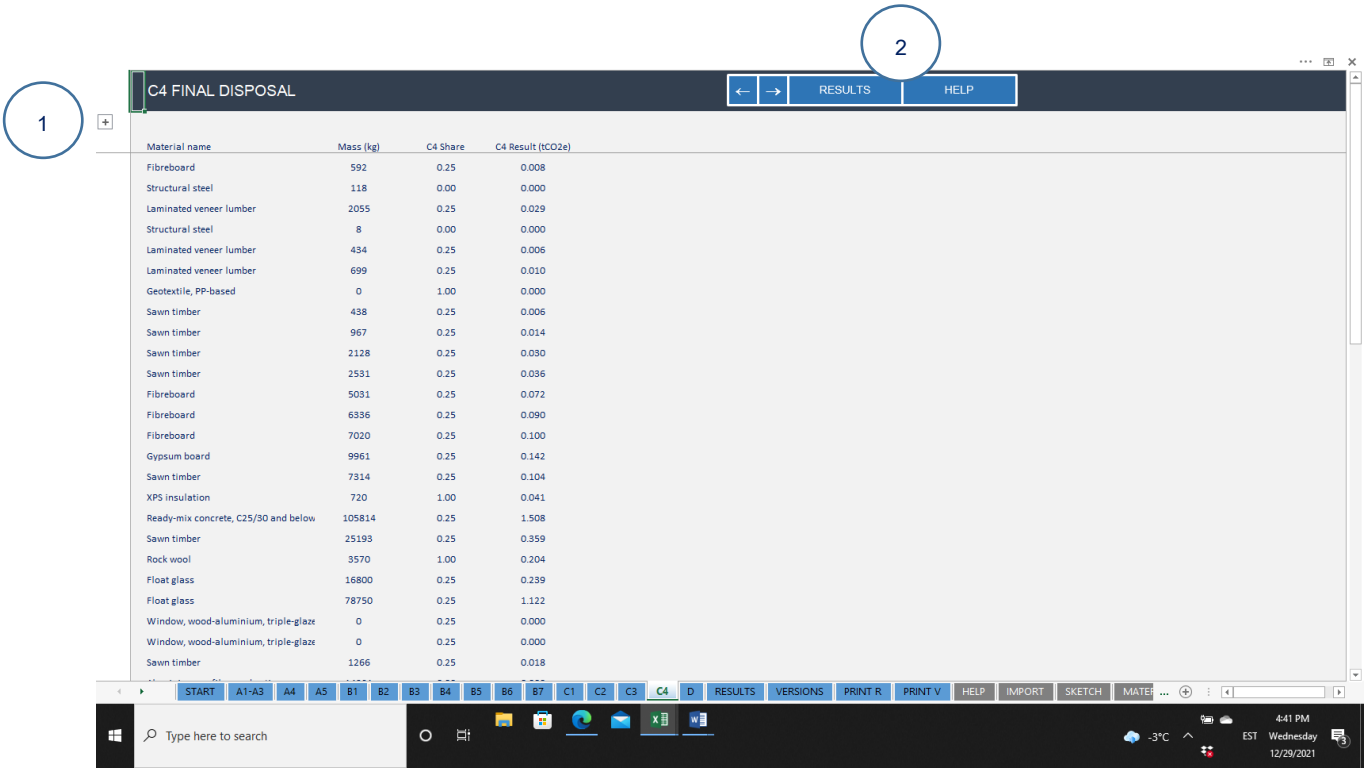
In addition, all the standard Excel navigation buttons can be used for navigation.



C4

The module C4 calculates the greenhouse gas emissions from final disposal. The material share that was not included in C3 is included in here. There are no inputs for this module.

1	"+"	Opens an explanatory note (new rows that explain how the module calculates).
	"-"	Closes the explanatory note (visible when the additional rows are open).
2	Navigation	Blue buttons are designed to help the navigation between the worksheets.
	Arrows (← →)	take You to the previous or the following worksheet
	"RESULTS"	is a shortcut to calculation results
	"HELP"	takes You to the user guide worksheet.

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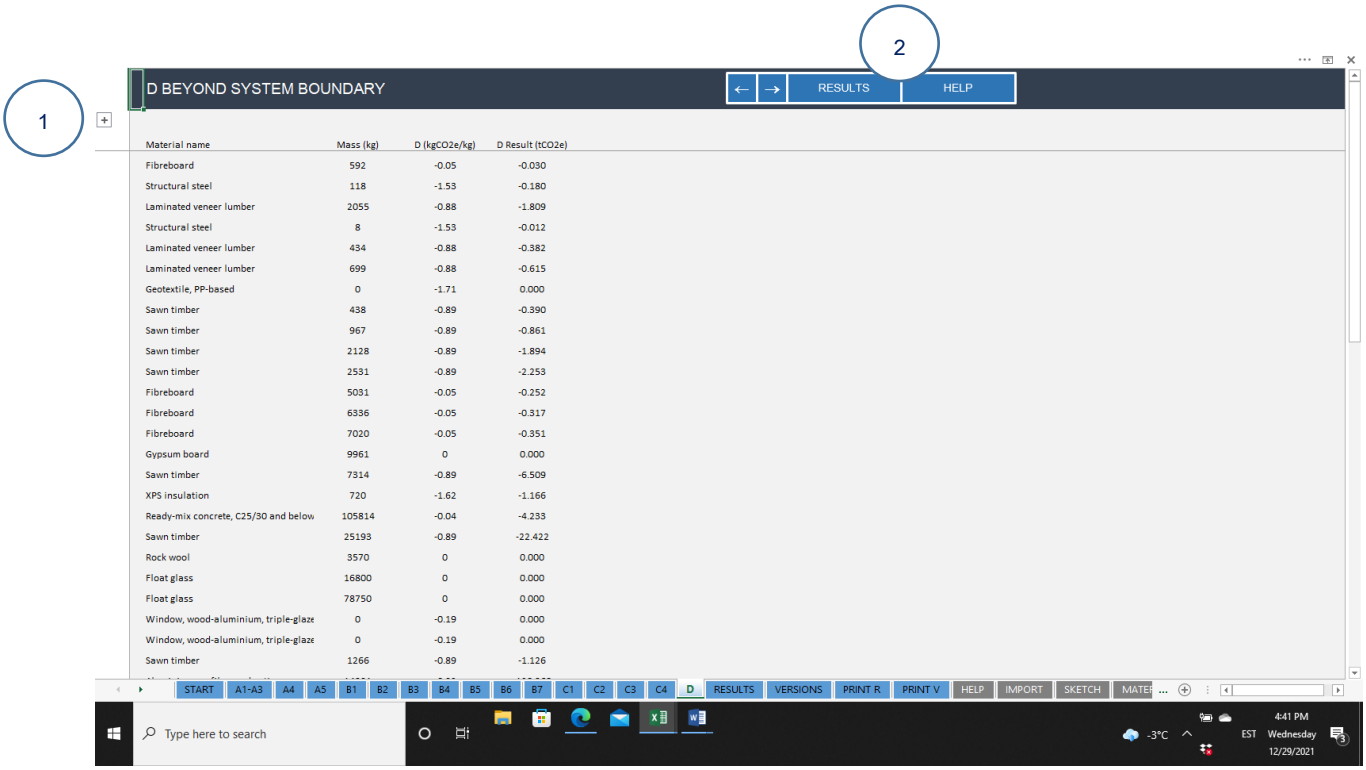

D

The category D entails the benefits and loads beyond the system boundary that would not occur without the construction project. The results is not included in the carbon footprint but is reported as a separate figure. The calculation is based on the default value in the material database. There are no inputs in this module.

1	"+"	Opens an explanatory note (new rows that explain how the module calculates).
	"-"	Closes the explanatory note (visible when the additional rows are open).
2	Navigation	Blue buttons are designed to help the navigation between the worksheets.
	Arrows (← →)	take You to the previous or the following worksheet
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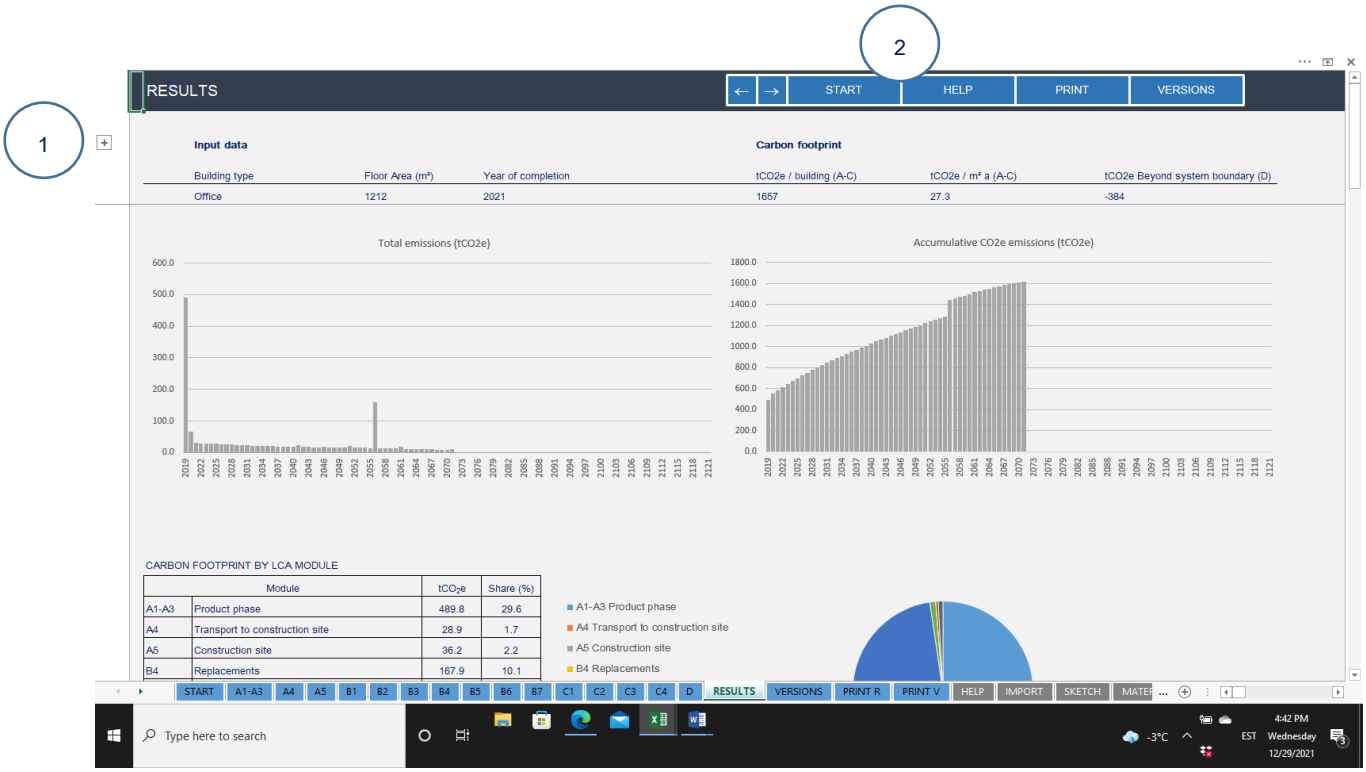
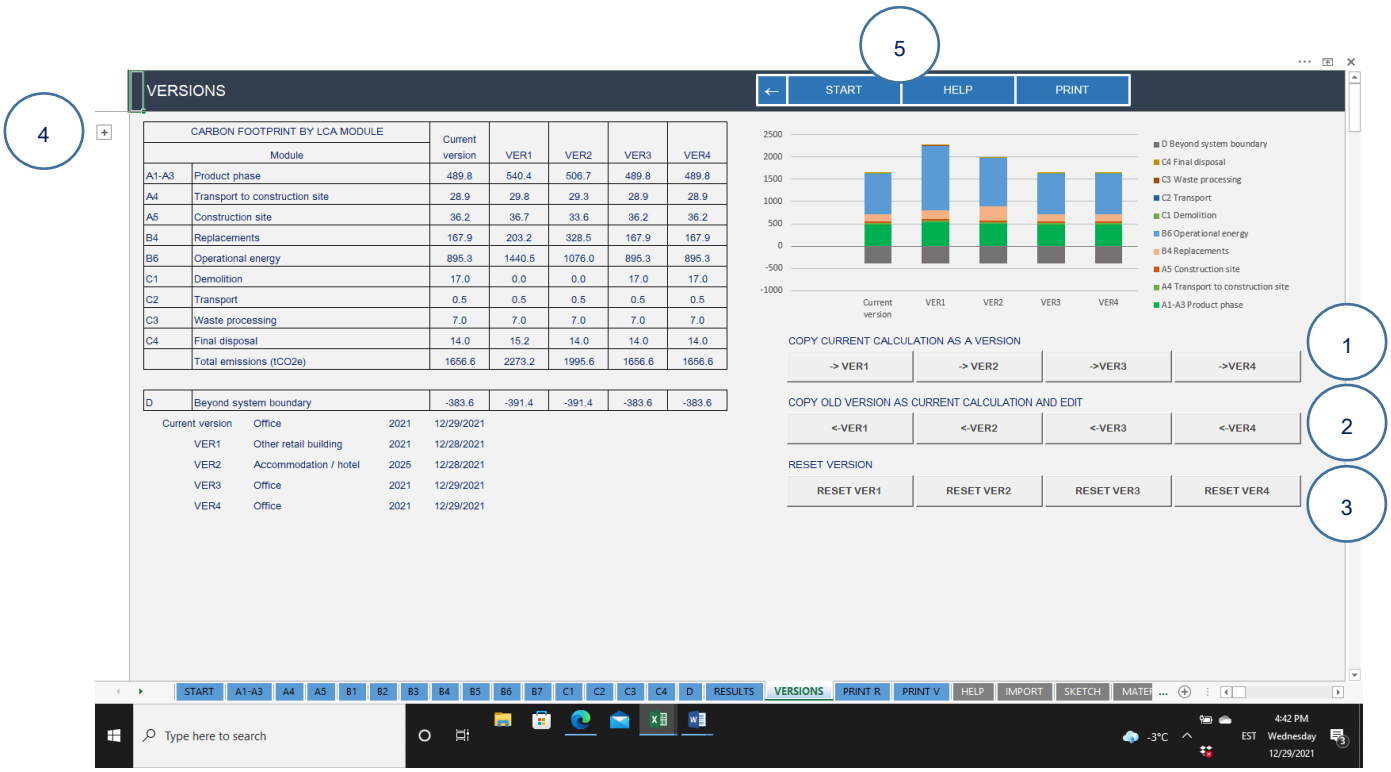


RESULTS

This worksheet displays the results of the calculation.

1	"+"	Opens an explanatory note (new rows that explain how the module calculates).
	"-"	Closes the explanatory note (visible when the additional rows are open).
2	Navigation	Blue buttons are designed to help the navigation between the worksheets.
	Arrows (← →)	take You to the previous or the following worksheet
	"START"	is a shortcut back to the very first page
	"HELP"	takes You to the user guide worksheet.
	"PRINT"	opens the content on a lay-out that is designed for printing on paper
	"VERSIONS"	opens the next worksheet that enables comparison of versions

In addition, all the standard Excel navigation buttons can be used for navigation.

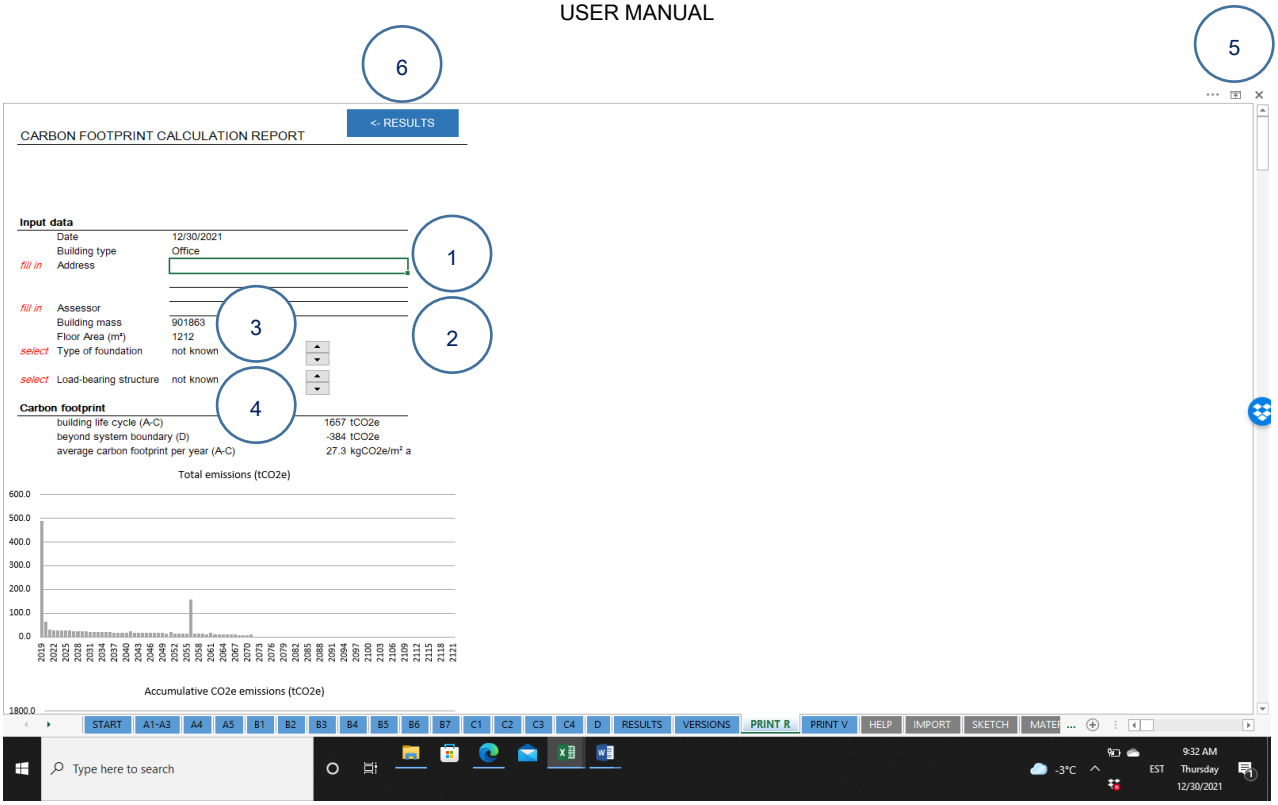


VERSIONS

This worksheet enables the comparison of versions. The version control is done with the action buttons in three rows on the right.

1	"→ VER"	The action button copies the current calculation as a version (1-4). You can continue editing the current calculation and return to the version later.
2	"← VER"	The action button copies an old version (1-4) as the current calculation. Please notice that all the values of current calculation will be written over.
3	"RESET VER"	The action button resets a version (1-4). The previous values cannot be recalled after reseting.
4	"+"	Opens an explanatory note (new rows that explain how the module calculates).
	"-"	Closes the explanatory note (visible when the additional rows are open).
5	Navigation	Blue buttons are designed to help the navigation between the worksheets.
	Arrow (←)	takes You back to the previous worksheet
	"START"	is a shortcut back to the very first page
	"HELP"	takes You to the user guide worksheet.
	"PRINT"	opens the content on a lay-out that is designed for printing on paper

In addition, all the standard Excel navigation buttons can be used for navigation.

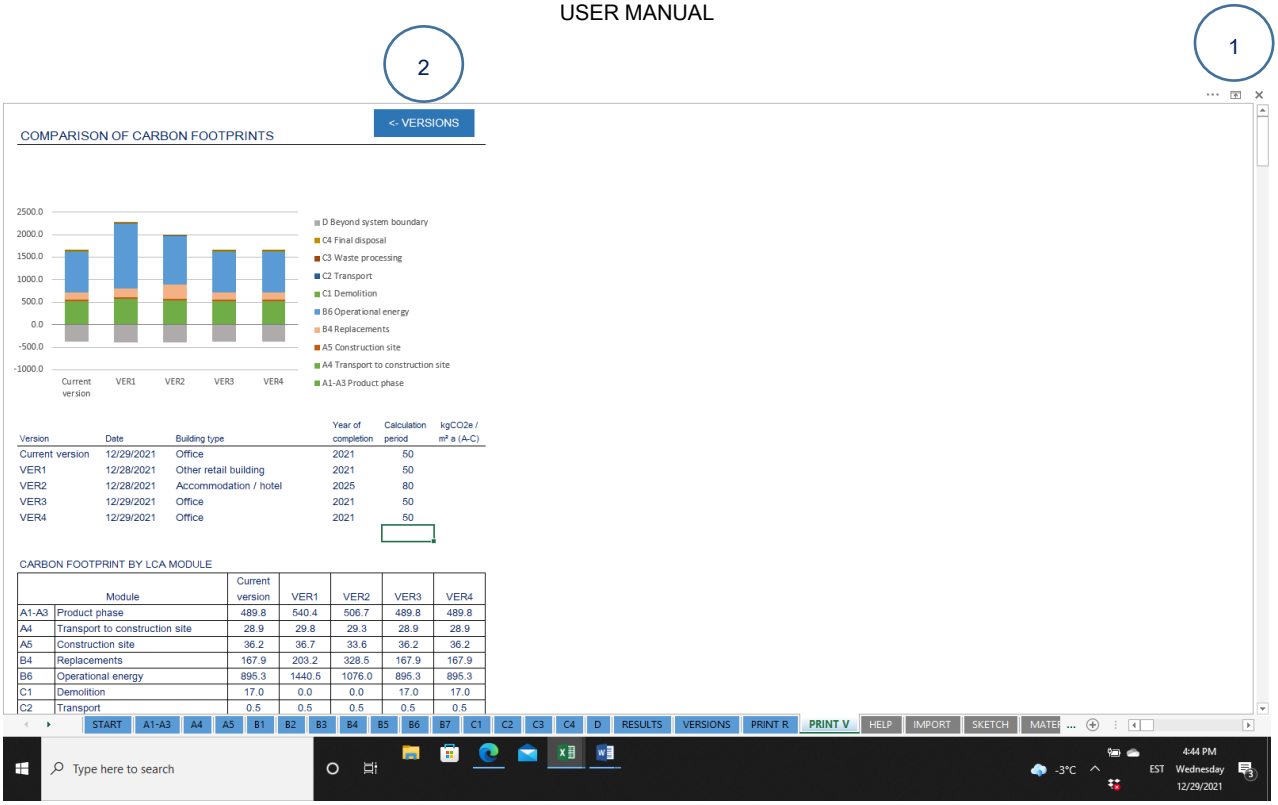


PRINT RESULTS

This worksheet is designed for printing the calculation results on paper.

1	Address	Please insert the address of the building.
2	Assessor	Please insert Your name.
3	Type of foundation	Please select the best option from the menu.
4	Load-bearing structure	Please select the best option from the menu.
5	Icon for printing	Click the small icon with an arrow (↑) to display a menu with three options. Click “Show tabs and commands”. Click “file” → “print” → choose the printer → “print”. Click “Auto-hide ribbon” and continue.
6	Navigation	These buttons are designed to help the navigation between the worksheets.
	“RESULTS”	takes You back to the Results worksheet

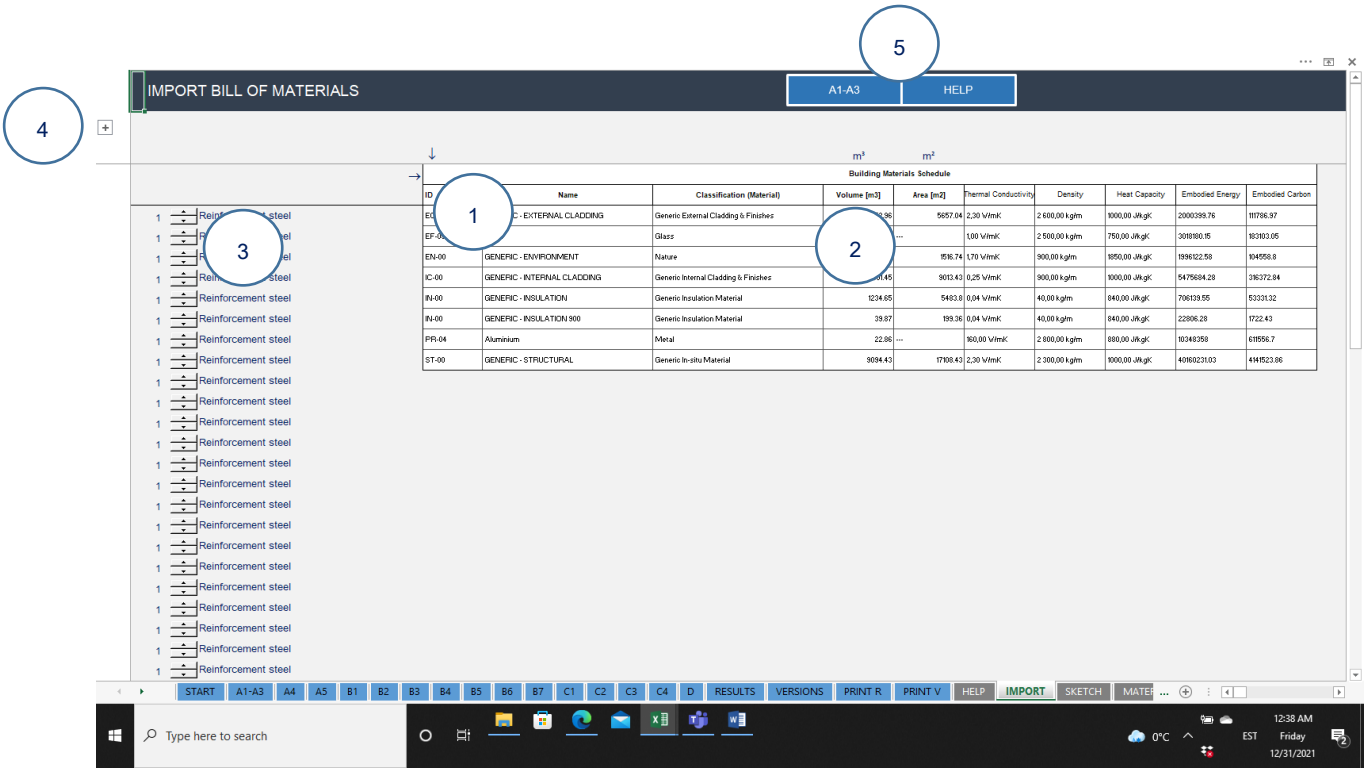
In addition, all the standard Excel navigation buttons can be used for navigation.



PRINT VERSIONS

This worksheet is designed for printing the comparison of versions on paper.

1	Icon for printing	Click the small icon with an arrow to display a menu with three options. Click “Show tabs and commands”. Click “file” → “print” → choose the printer → “print”. Click “Auto-hide ribbon” and continue.
2	Navigation worksheets. “VERSIONS”	These buttons are designed to help the navigation between the takes You back to the Versions worksheet.

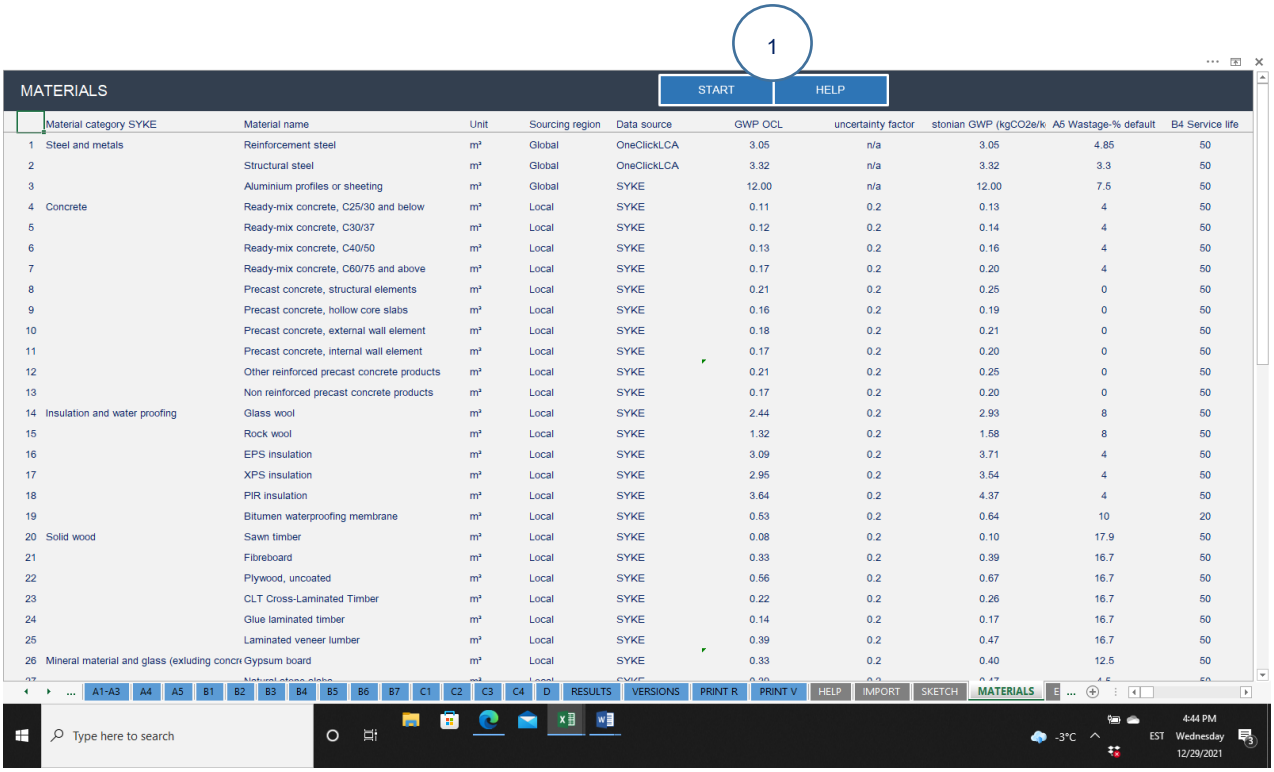


IMPORT

On this worksheet You can paste a table which includes a bill of materials. First export “Building materials schedule” from ArchiCAD as a new Excel spreadsheet and copy the whole table. Move to the “Import” worksheet and place the cursor on the cell indicated with two arrows. Paste the table here.

On the left side of the table, use the control buttons to select the materials so that they are the best possible match with the materials listed on the same line in the building materials schedule. When Your list is ready, move back to “A1–A3” worksheet and click “Apply import” to copy the material quantities in the calculator.

1	Arrows	Arrows show the cell that must be active when the building materials schedule is pasted.
2	m³	Please make sure that the material quantities are copied in this column.
3	Material	Please use the control buttons to select a material that is the best match with the material on the building materials schedule.
4	“+”	Opens an explanatory note
5	“-“	Closes the explanatory note (visible when the additional rows are open).
6	Navigation	Blue buttons are designed to help the navigation between the worksheets.
	“A1–A3”	takes You back to the first module A1–A3 where You need to click “APPLY IMPORT” to import the building materials schedule.
	“HELP”	takes You to the user guide worksheet.

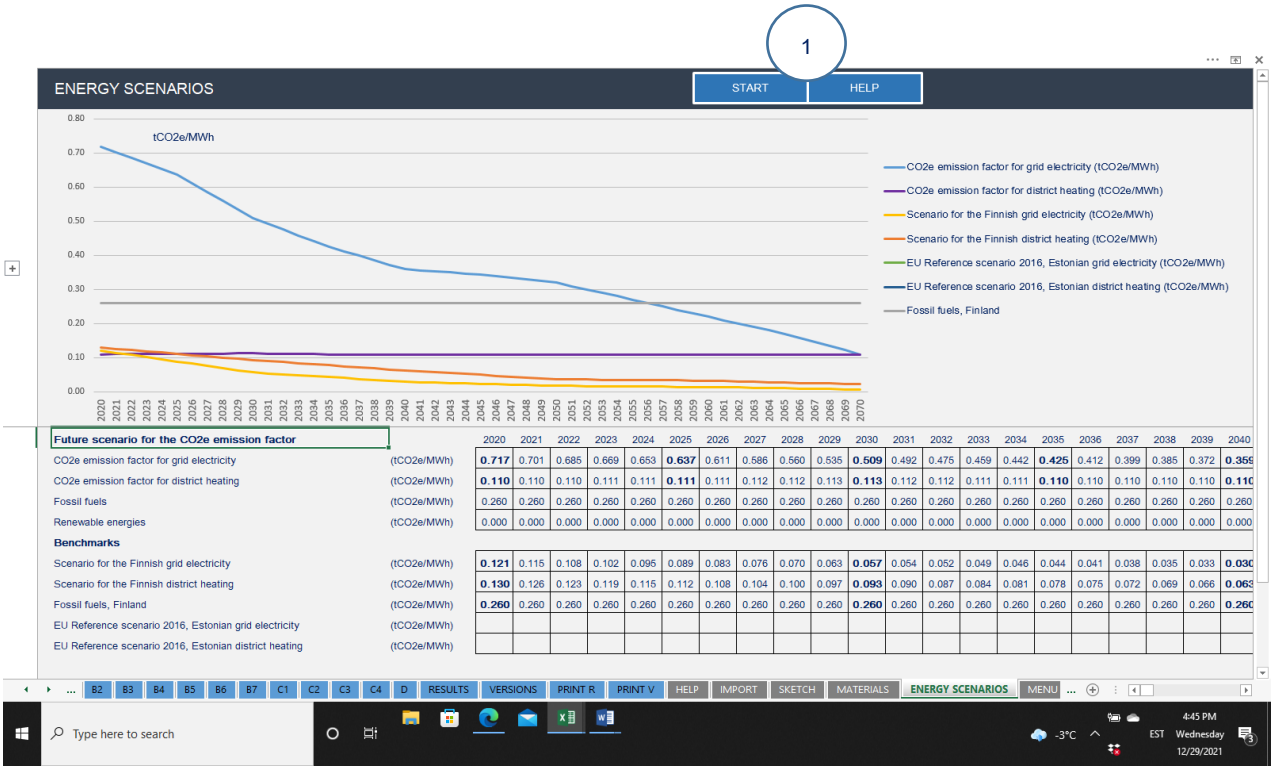


	Material category SYKE	Material name	Unit	Sourcing region	Data source	GWP OCL	uncertainty factor	stonian GWP (kgCO2e/k	A5 Wastage-% default	B4 Service life
1	Steel and metals	Reinforcement steel	m³	Global	OneClickLCA	3.05	n/a	3.05	4.85	50
2		Structural steel	m³	Global	OneClickLCA	3.32	n/a	3.32	3.3	50
3		Aluminium profiles or sheeting	m³	Global	SYKE	12.00	n/a	12.00	7.5	50
4	Concrete	Ready-mix concrete, C25/30 and below	m³	Local	SYKE	0.11	0.2	0.13	4	50
5		Ready-mix concrete, C30/37	m³	Local	SYKE	0.12	0.2	0.14	4	50
6		Ready-mix concrete, C40/50	m³	Local	SYKE	0.13	0.2	0.16	4	50
7		Ready-mix concrete, C60/75 and above	m³	Local	SYKE	0.17	0.2	0.20	4	50
8		Precast concrete, structural elements	m³	Local	SYKE	0.21	0.2	0.25	0	50
9		Precast concrete, hollow core slabs	m³	Local	SYKE	0.16	0.2	0.19	0	50
10		Precast concrete, external wall element	m³	Local	SYKE	0.18	0.2	0.21	0	50
11		Precast concrete, internal wall element	m³	Local	SYKE	0.17	0.2	0.20	0	50
12		Other reinforced precast concrete products	m³	Local	SYKE	0.21	0.2	0.25	0	50
13		Non reinforced precast concrete products	m³	Local	SYKE	0.17	0.2	0.20	0	50
14	Insulation and water proofing	Glass wool	m³	Local	SYKE	2.44	0.2	2.93	8	50
15		Rock wool	m³	Local	SYKE	1.32	0.2	1.58	8	50
16		EPS insulation	m³	Local	SYKE	3.09	0.2	3.71	4	50
17		XPS insulation	m³	Local	SYKE	2.95	0.2	3.54	4	50
18		PIR insulation	m³	Local	SYKE	3.64	0.2	4.37	4	50
19		Bitumen waterproofing membrane	m³	Local	SYKE	0.53	0.2	0.64	10	20
20	Solid wood	Sawn timber	m³	Local	SYKE	0.08	0.2	0.10	17.9	50
21		Fibreboard	m³	Local	SYKE	0.33	0.2	0.39	16.7	50
22		Plywood, uncoated	m³	Local	SYKE	0.56	0.2	0.67	16.7	50
23		CLT Cross-Laminated Timber	m³	Local	SYKE	0.22	0.2	0.26	16.7	50
24		Glue laminated timber	m³	Local	SYKE	0.14	0.2	0.17	16.7	50
25		Laminated veneer lumber	m³	Local	SYKE	0.39	0.2	0.47	16.7	50
26	Mineral material and glass (exluding concr	Gypsum board	m³	Local	SYKE	0.33	0.2	0.40	12.5	50

MATERIALS

This worksheet displays the construction materials database and the default values in it. There are no inputs on this worksheet.

1	Navigation	Blue buttons are designed to help the navigation between the worksheets.
	"VERSIONS"	takes You back to the Versions worksheet.



ENERGY SCENARIOS

This worksheet displays the current scenarios for the CO_2e emission factor for the energy carriers in Estonia. For comparison, the graph also displays the Finnish scenario for the grid electricity and district heating.

1	Navigation “VERSIONS”	Blue buttons are designed to help the navigation between the worksheets. takes You back to the Versions worksheet.