Annex 9

Study for the application of assessment principles for the carbon footprint of construction works in Estonia

CASE STUDY REPORT

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1. INTRODUCTION

This report summarizes the results of the five case studies in the project „Study for the application of assessment principles for the carbon footprint of construction works in Estonia“ („Uuring ehituse süsinikujalajälje hindamisprintsiipide rakendamiseks Eestis“) in 2021. The project was commissioned by the Estonian Ministry of Economic Affairs and Communications and co-financed by the RITA programme. The project was carried out by the researchers of TalTech and the experts of the Finnish concultancy One Click LCA.

The purpose of the case study analysis is to use and test the new Estonian carbon footprint assessment method on real projects. Furthermore, it was carried out to compare the results with validated tool results and to collect quantified data for different building types. Carbon footprint was calculated for the case studies using the Estonian method, as well as the Level(s) method and the method by the Finnish ministry of environment in the One Click LCA tool. The results are then compared for each calculation module (based on EN 15978) to validate the method and the underlying database.

2. CASE STUDIES

The project conducted carbon footprint analyses of five Estonian case studies (Table 1).

Table 1. Overview of the five case study buildings.

Case-study	Building type	new or renovation	size m²		load-bearing structure
			total area	heated area	
Maardu	day-care centre	new, 2018	1320	1060	timber
Sõpruse	apartment building	new, 2017	6800	6373	concrete, steel
Mäemaja	educational building	renovation 2021 built 1986	4068	3406	timber
Kuuma	apartment building	renovation 2021 built 1986	3260	1887	large panel
Pärnu	public building	new, 2021	12224	11761	concrete, steel

2.1 Maardu Day care center

Figure 1. Maardu day care center, Ploompuu Pst 52.

Basic information

Table 2. Basic information on Maardu day care center.

Address	Harju county, town of Maardu, Ploomipuu pst 52
Type	Pre school / daycare
Architect	Arhitektuuribüroo Pluss ÕÜ
Year of completion	2018
Building footprint (m²)	1475
No of storeys (above ground)	1
No of storeys (under ground)	-
Height (m)	6.4
Lenght (m)	55.8
Width (m)	28
Depth (m)	
Net enclosed area (m²)	1111.7
Heated area (m²)	1064
Volume (m²)	4400

Maardu case study is a one-storey day care building constructed of prefabricated timber elements. Load-bearing structure is sawn timber (195 mm). The floor plan is rectangular. The floor structure has a reinforced concrete slab on the ground. The roof is a flat roof with nail-plate truss construction. The walls have a light timber frame and a horizontal wooden cladding. The U-values are as follows:

wall	0.18 W/m²K
roof	0.09 W/m²K
floor	0.19 W/m²K.

Maardu day care center has a mechanical ventilation system with effective heat recovery. The heating system is ground source heat pump. The heat is delivered by floor heating. Delivered energy was calculated with the IDA Indoor Climate and Energy simulation software. The energy class of the building is class B. The building has a photovoltaic system on the roof.

The solutions can be considered rather typical for new construction with a prefabricated light timber frame.

Data acquisition

Maardu day care center had sub-models from architecture and construction. For carbon footprint calculations architecture and construction models were analyzed together. At the same time keeping in mind that material quantities are calculated only once. As this project did not have any interior architecture model, then all the floor, wall and partly ceiling quantities were calculated manually, by using floor plans. For more precise results it would be necessary that finish layers are modeled separately in detail.

Results

Table 3. Maardu: carbon footprint of building materials and products in the life cycle stage A1–A3.

Construction work	Carbon footprint *C*, tCO_2e /building	Specific carbon footprint *c*, $kgCO_2e/(m^2a)$
Foundation, sub-surface, basement and retaining walls	93.87	1.69
Columns and load-bearing vertical structures	1.36	0.02
Floor slabs, ceilings, roofing decks, beams and roof	61.3	1.1
External walls and facade	21	0.38
Windows and doors	31.89	0.57
Internal walls and non-bearing structures	57.33	1.03
Other structures and materials	4.32	0.08
Finishes and coverings	19.49	0.35
Building systems and installations	67.77	1.22
Total emissions	358.32	6.45

Table 4. Maardu: the life cycle GHG emissions.

Life cycle stage	C, tCO_2e/building	c, $kgCO_2e/(m^2a)$
A1–A3 Construction Materials	358	6.5
A4 Transport	19	0.3
A5 Construction Site	26	0.5
B4 Replacement	134	2.4
B6 Operating Energy	904	16.3
C1–C4 End-of-life	31	0.6
Building total (A–C)	**1472**	**26.5**
D Beyond system boundary	-43	-0.8

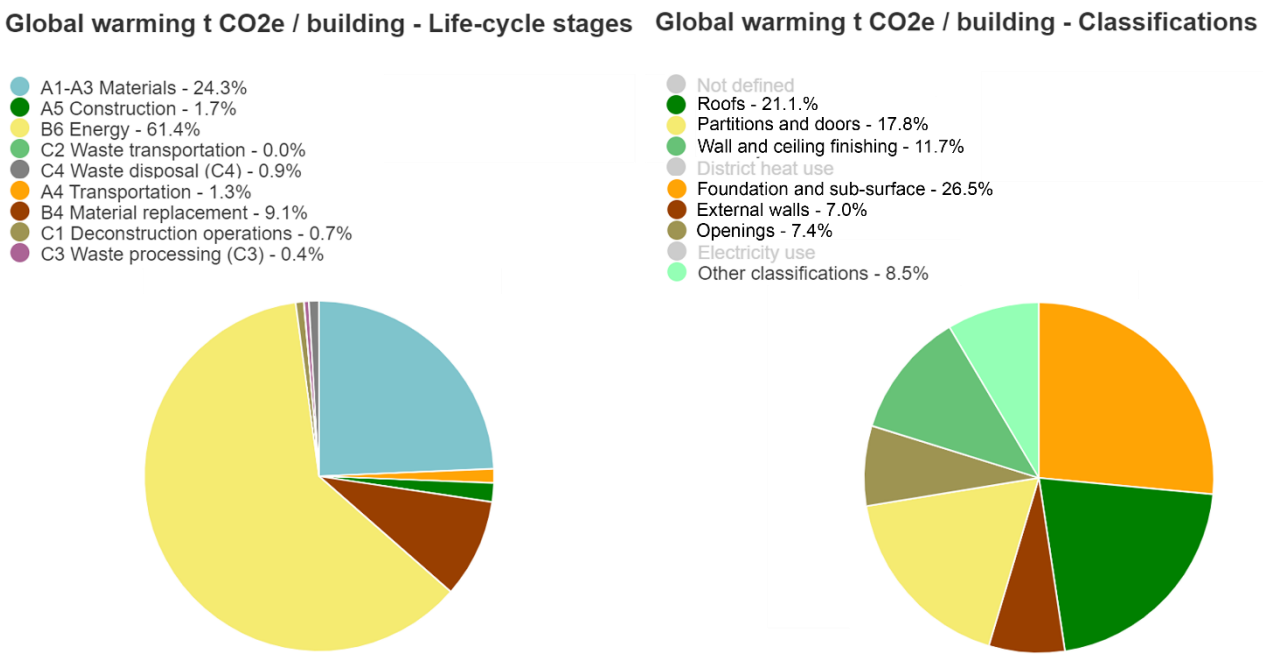

Figure 2. Maardu building life cycle carbon footprint share per assessment module (left); Maardu building embodied carbon impacts per building element (right).

2.2 Sõpruse - apartment building

Figure 3. Tallinn, Sõpruse pst 33.

Basic information

Table 5. Basic information on Sõpruse apartment building.

Address	Harju county, Tallinn, Kristiine district, Sõpruse pst 33
Type	Residential multi-storey building
Architect	Velle Kadalipp
Year of completion	2016
Building footprint (m²)	1618
No of storeys (above ground)	5
No of storeys (under ground)	1
Height (m)	17.8
Lenght (m)	54.3
Width (m)	35.7
Depth (m)	3.2
Heated area (m²)	6373
Volume (m²)	25900

The case study Sõpruse pst 33 is a five-storey apartment building. It is a U-shaped building has 51 apartments. Sõpruse pst 33 is constructed on pile foundation and concrete frame. The first floor frame is cast on site. The rest of of the building is constructed of prefabricated concrete elements. The outer walls are made of three-layer elements and the load-bearing inner walls are made of single-layer prefabricated

reinforced concrete panels. The walls between the apartments are made of reinforced concrete to prevent noise. The wet rooms are made of lightweight blocks and have plastered partitions on steel profiles. Apartments have wooden windows with triple glazing.Common areas have glass facades with aluminum profiles. The exterior of the building is made of weatherproof wood veneer tiles, concrete surfaces with different textures and glass. The building has an underground parking facility for 35 cars with a reinforced concrete structure. The building has commercial facilities on the ground floor.

The energy class of the building is class B.

Data acquisition

Sõpruse apartment building had only one BIM model – construction. Building elevations, plans and sections were used to calculate quantities of materials. Door and window specifications were used to calculate openings.

Results

Table 6. Sõpruse: carbon footprint of building materials and products in the life cycle stage A1–A3.

Construction work	Carbon footprint *C*, tCO_2e	Specific carbon footprint *c*, $kgCO_2e/(m^2a)$
Foundation, sub-surface, basement and retaining walls	413.54	1.22
Columns and load-bearing vertical structures	41.49	0.12
Floor slabs, ceilings, roofing decks, beams and roof	587.54	1.73
External walls and facade	846.2	2.49
Windows and doors	228.94	0.67
Internal walls and non-bearing structures	327.63	0.96
Other structures and materials	27.25	0.08
Finishes and coverings	90.49	0.27
Building systems and installations	372.13	1.09
Total emissions	2899.71	8.53

Table 7. Sõpruse: the life cycle GHG emissions.

Life cycle stage	C, tCO_2e/building	c, $kgCO_2e/(m^2a)$
A1–A3 Construction Materials	2900	8.5
A4 Transport	199	0.6
A5 Construction Site	115	0.3
B4 Replacement	616	1.8
B6 Operating Energy	5564	16.4
C1–C4 End-of-life	199	0.6
Building total (A–C)	**9593**	**28.2**
D Beyond system boundary	-537	-1.6

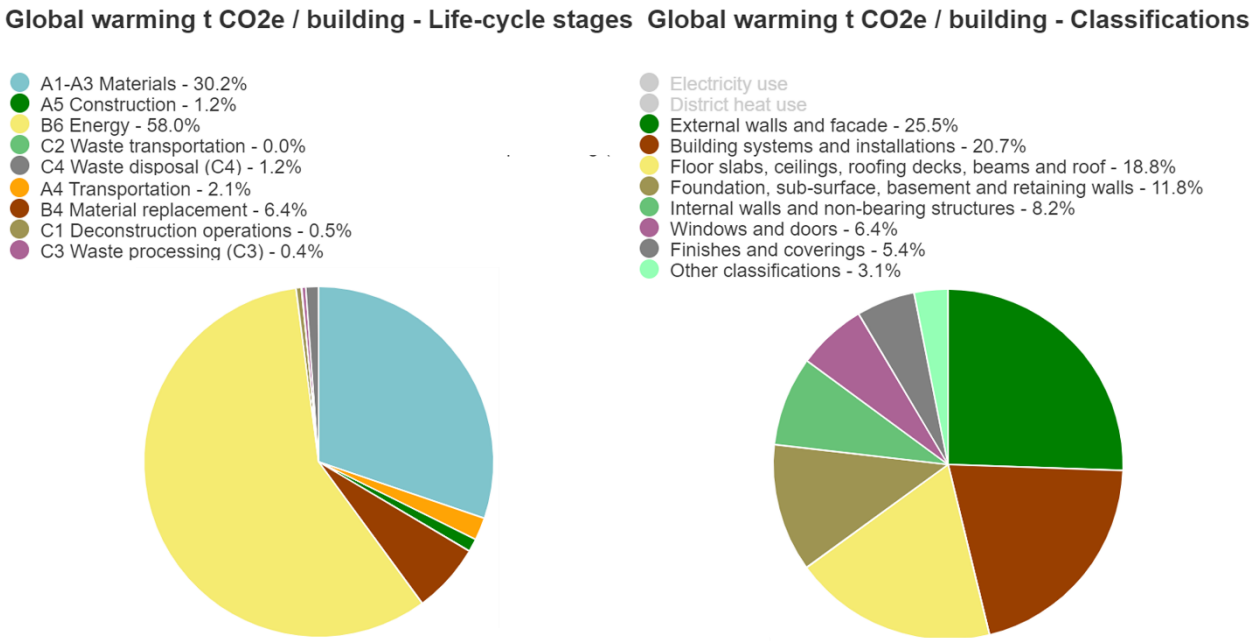

Figure 4. Sõpruse building life cycle carbon footprint share per assessment module (left); Sõpruse building embodied carbon impacts per building element (right).

2.3 Mäemaja educational building

Figure 5. Tallinn, Mäepealse 3.

Basic information

Table 8. Basic information on Mäemaja educational building.

Address	Harju county, Tallinn, Mustamäe district, Mäepealse tn 3
Type	Educational building
Architect	Tõnu Laigu
Year of completion	2021
Building footprint (m²)	1491
No of storeys (above ground)	3
No of storeys (under ground)	-1
Height (m)	17.8
Lenght (m)	50.1
Width (m)	43.1
Depth (m)	3.2
Heated area (m²)	3411.1
Volume (m²)	20328

Mäemaja (hilltop building) is a flagship reconstruction project of Tallinn University of Technology where structural and road engineering, HVAC and building physics laboratories and some auditoriums are located. In this case study a three-story part of the building is analysed which is totally new, starting from new foundations, and therefore corresponds to new educational building. Another part of the building, the construction testing hall, that was deeply renovated but maintained the loadbearing structure, is not included in this calculation. New part of Mäemaja has a basement with common concrete structures but other three

floors are from CLT, including columns, beams and slabs. On the CLT slab, however a concrete layer is used, and the staircases are also from concrete. External walls are lightweight with timber frame, in some places however loadbearing CLT is used and exposed to interior. Most of the facades are covered with metal sheet panels but the main entrance side of the building with wooden boards. Windows and glass facades are from aluminium profiles. The building is highly insulated and there are modern HVAC systems. Mechanical supply and exhaust heat recovery ventilation is in most of rooms demand controlled, and room conditioning is implemented with water radiators and active chilled beams. The building is connected to district heat. LED lighting uses occupancy sensors in many rooms. The maximum amount of photovoltaic panels for renewable electricity generation are installed to the roof, so that all free surface was covered with PV. The building reached as a whole, with new and renovated part, Estonian new building NZEB requirement 100 kWh/(m²a) primary energy including electricity of appliances (small power plug loads) that are included on the top of minimum energy uses in Estonian calculation.

Data acquisition

Mäemaja educational building had detailed BIM model and sub-models, for LCA calculations combined constrcution and architecture model was used.

Results

Table 9. Mäemaja: carbon footprint of building materials and products in the life cycle stage A1–A3.

Construction work	Carbon footprint *C*, tCO_2e	Specific carbon footprint *c*, $kgCO_2e/(m^2a)$
Foundation, sub-surface, basement and retaining walls	176.03	0.87
Columns and load-bearing vertical structures	13.73	0.07
Floor slabs, ceilings, roofing decks, beams and roof	313.98	1.54
External walls and facade	126.06	0.62
Windows and doors	83.39	0.41
Internal walls and non-bearing structures	141.53	0.7
Other structures and materials	31.69	0.16
Finishes and coverings	54.24	0.27
Building systems and installations	251.46	1.24
Total emissions	1192.11	5.86

Table 10. Mäemaja: the life cycle GHG emissions.

Life cycle stage	C, tCO_2e/building	c, $kgCO_2e/(m^2a)$
A1-A3 Construction Materials	1192	5.9
A4 Transport	69	0.3
A5 Construction Site	68	0.3
B4 Replacement	393	1.9
B6 Operating Energy	2841	14.0
C1-C4 End-of-life	118	0.6
Building total (A-C)	**4681**	**23.0**
D Beyond system boundary	-2	-0.0

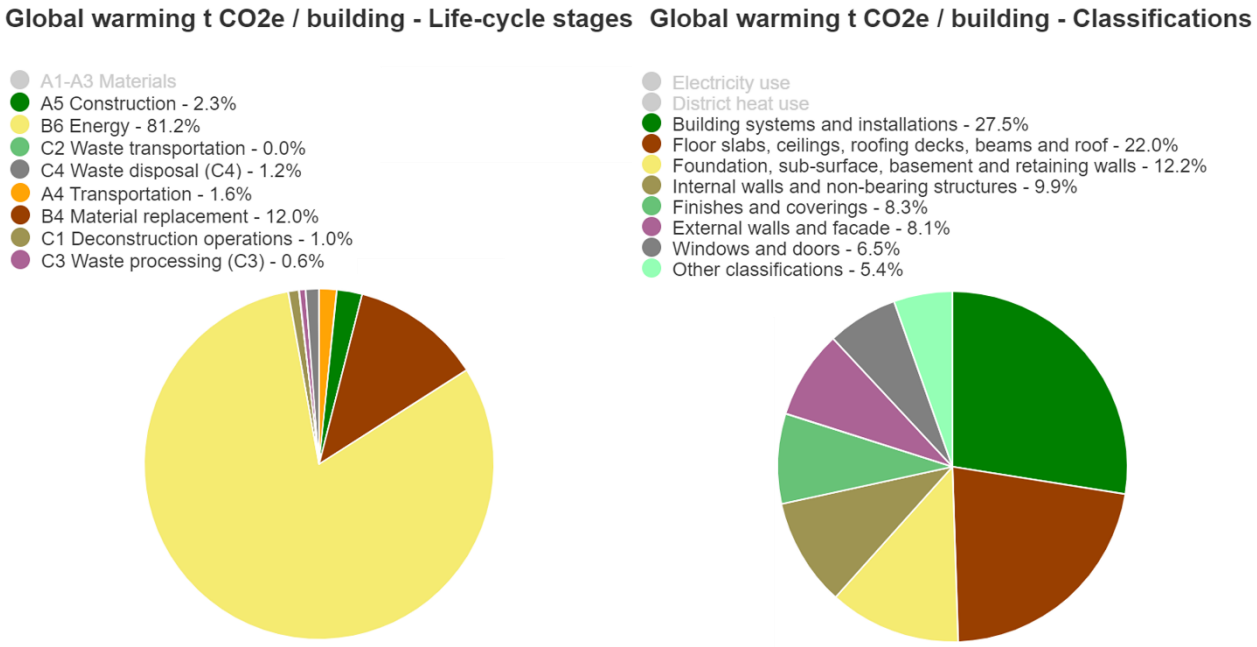

Figure 6. Mäemaja building life cycle carbon footprint share per assessment module (left); Mäemaja building embodied carbon impacts per building element (right).

2.4 Kuuma apartment building renovation

Figure 7. Saue, Kuuma 4.

Basic information

Table 11. Basic information on Kuuma apartment building renovation.

Address	Kuuma 4
Type	Apartment building
Architect	Kristina Sepp
Year of completion	2021
Building footprint (m²)	762
No of storeys (above ground)	3
No of storeys (under ground)	-1
Net enclosed area (m²)	2415
Heated area (m²)	1887
Volume (m²)	20328
No of apartments	24

Data acquisition

Kuuma apartment building renovation had a model, but all the elements in there were under “generic model” therefore it was not possible to use this model and all quantity calculations were made manually. As it was an apartment building renovation, there were not a lot of rows to calculate.

Results

Table 12. Kuuma: carbon footprint of building materials and products in the life cycle stage A1–A3.

Construction work	Carbon footprint *C*, tCO_2e	Specific carbon footprint *c*, $kgCO_2e/(m^2a)$
Foundation, sub-surface, basement and retaining walls	8.29	0.05
Columns and load-bearing vertical structures	-	-
Floor slabs, ceilings, roofing decks, beams and roof	73.88	0.45
External walls and facade	54.78	0.34
Windows and doors	45.65	0.28
Internal walls and non-bearing structures	-	-
Other structures and materials	18.1	0.11
Finishes and coverings	-	-
Building systems and installations	214.19	1.31
Total emissions	414.89	2.55

Table 13. Kuuma: the life cycle GHG emissions.

Life cycle stage	C, tCO_2e/building	c, $kgCO_2e/(m^2a)$
A1–A3 Construction Materials	4145	2.6
A4 Transport	4	0.0
A5 Construction Site	13	0.1
B4 Replacement	304	1.9
B6 Operating Energy	2062	12.7
C1–C4 End-of-life	28	0.2
Building total (A–C)	**2826**	**17.3**
D Beyond system boundary	-24	-0.2

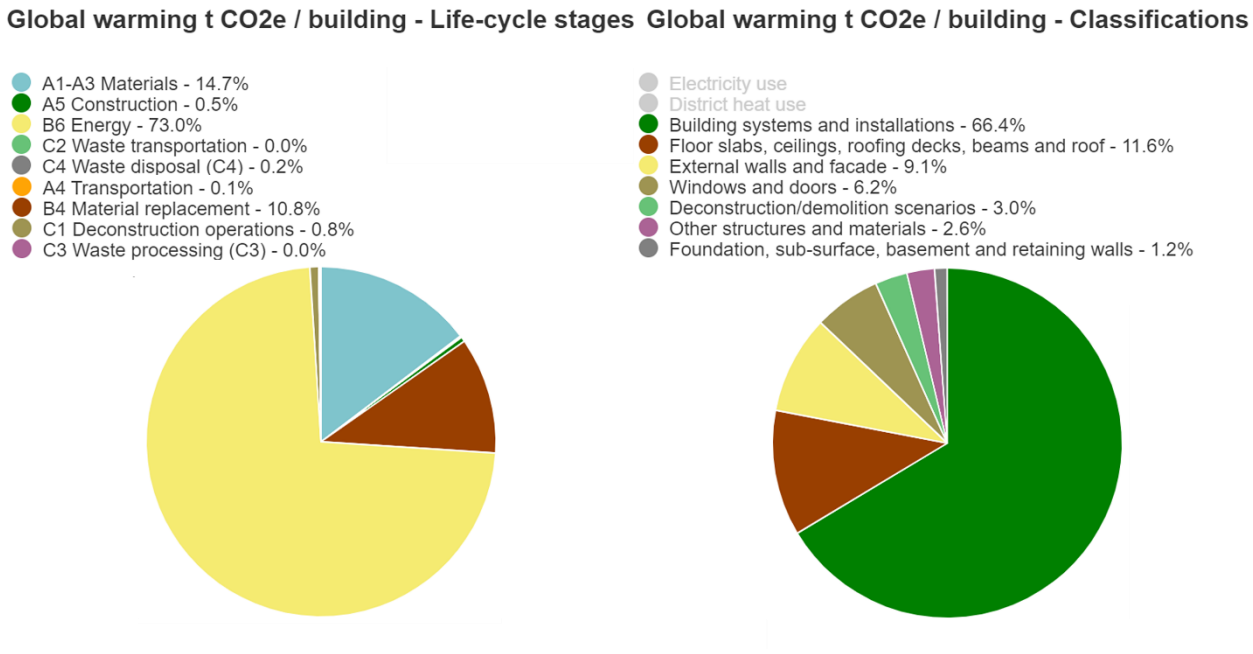

Figure 8. Kuuma building life cycle carbon footprint share per assessment module (left); Kuuma building embodied carbon impacts per building element (right).

2.5 Pärnu office building

Figure 9. Pärnu Ühishoone.

Basic information

Table 14. Basic information on the Pärnu office building.

Address	Pärnu county, town of Pärnu, Tammsaare pst 61, Tammsaare pst 70
Type	Public building
Architect	Novarc Group AS
Year of completion	2021
Building footprint (m²)	4575.7
No of storeys (above ground)	4
No of storeys (under ground)	0
Net enclosed area (m²)	12789
Heated area (m²)	11761.2
Volume (m²)	53311

The joint building complex is designed for the administrative institutions of the Ministry of the Interior. The official premises and workrooms of the Police and Border Guard Board, Estonian Rescue Board, Alarm Centre, IT and Development Centre at the Estonian Ministry of the Interior (SMIT), and Victim Support Department of the Social Insurance Board will be located in the new buildings of the complex on the Tammsaare pst 61 and Tammsaare pst 70 registered immovables.

Data acquisition

Pärnu public building had detailed BIM model and sub-models. For carbon footprint calculation, architectural and construction models were used.

Results

Table 15. Pärnu: carbon footprint of building materials and products in the life cycle stage A1–A3.

Construction work	Carbon footprint *C*, tCO_2e/building	Specific carbon footprint *c*, $kgCO_2e/(m^2a)$
Foundation, sub-surface, basement and retaining walls	743.08	1.22
Columns and load-bearing vertical structures	80.2	0.13
Floor slabs, ceilings, roofing decks, beams and roof	904.84	1.48
External walls and facade	1044.68	1.71
Windows and doors	513.79	0.84
Internal walls and non-bearing structures	1003.65	1.64
Other structures and materials	15.12	0.02
Finishes and coverings	356.09	0.58
Building systems and installations	989.45	1.62
Total emissions	5650.92	9.25

Table 16. Pärnu: the life cycle GHG emissions.

Life cycle stage	C, tCO_2e/building	c, $kgCO_2e/(m^2a)$
A1–A3 Construction Materials	5651	9.3
A4 Transport	346	0.6
A5 Construction Site	253	0.4
B4 Replacement	2651	4.3
B6 Operating Energy	10012	16.4
C1–C4 End-of-life	4623	0.8
Building total (A–C)	**19505**	**31.9**
D Beyond system boundary	-358	-0.6

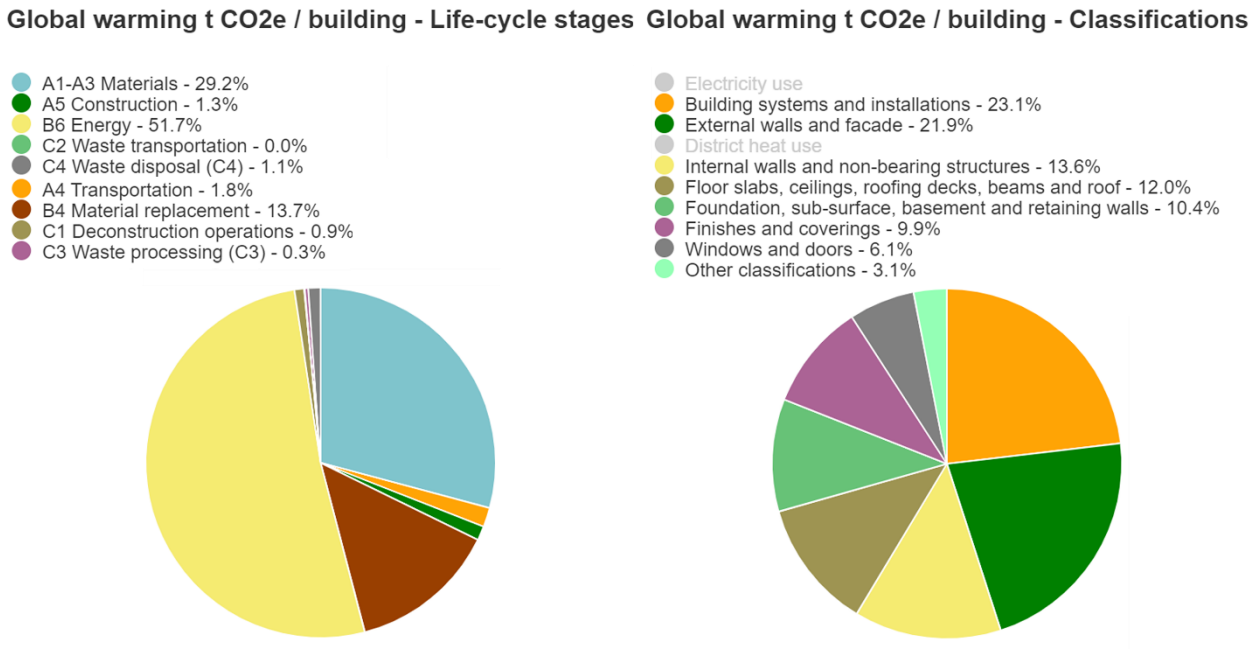

Figure 10. Pärnu building life cycle carbon footprint share per assessment module (left); Pärnu building embodied carbon impacts per building element (right).

3. Validation of results

An overview of different carbon footprint reporting schemes/methods scope of included life cycle stages is presented in Table 17.

Table 17. Modules covered in three different methods.

Methodology comparison	Modules	Level(s)	Low-carbon (FI)	Hoone süs kalk (EST)
Unit		$kgCO_2e$	$kgCO_2e/(m^2a)$	tCO_2e/building
Material impacts	A1–A3	✓	✓	✓
Transport to site	A4	✓	✓	✓
Site impacts	A5	✓	✓	✓
Use	B1			
Maintenance	B2			
Repair	B3	✓	-	-
Replacements	B4	✓	✓	✓
Refurbishment	B5		-	-
Operational energy	B6	✓	✓	✓
Water	B7	✓	-	-
Demolition	C1	✓	✓	✓
Transport	C2		✓	✓
Recycling	C3		✓	✓
Disposal	C4		✓	✓
Benefits	D	✓	✓	✓

Table 18 illustrates that the case study calculation results indicate very similar overall results for the five projects when comparing different methods. It is the expected since the underlying standard for all of the methods is the same, even if the detailed calculation rules may vary to some extent.

Table 18. Case-study result comparison between three different methods.

$kgCO_2e/(m^2a)$	Level(s)	Low-carbon (FI)	Hoone süs kalk (EST)
Maardu	28.0	27.2	26.5
Sõpruse	27.5	26.3	28.2
Mäemaja	22.2	21.7	23.0
Kuuma	17.3	17.2	17.3
Pärnu	30.4	29.9	31.9

Table 19 shows the results for each life cycle module for Maardu case study. In A1–A3 module Estonian method demonstrates slightly higher impacts than FI or Level(s) methods. This is likely due to the limited database that was used to define the material manufacturing impacts, developed within this project (Annex 6). The results are likely to be more similar once the Estonian database expands. A4 module impacts are not assessed with the FI method, since it's using a default valu, which has not been yet confirmed, therefore was not incorporated into the calculation tool at this stage. Comparisons for the A4 module in the future are possible. Compared with the Level(s) method Estonina method has much higher impacts in A4. This is expected since the proposed method suggests using conservative transportation distances if no actual data is available. At the early stage of the assessment it is justified to slightly overestimate the impacts, but also A4 module does not have proportionally high impacts in comparison with other modules. Calculating A5 module according to Estonian method demonstrates lower impacts when compared to other methods. This is most probably due to the fact that the other methods also include impacts related with energy and material consumption on site, whereas the Estonian method (at this stage) includes impacts related to material wastage, it's transportation, and end of life processing. The site impacts related with energy and auxiliary material consumption can be added in the later stage, however, further studies are required to determine the average scenario for site impacts Estonia. B4 impacts are rather similar for all the methods. Slight deviation is most probably to do with the limitations of the database. B6 impacts are almost identical for Level(s) and Estonian method. It is not completely clear where the deviation with the Finnish method comes from, but most likely due to different variables that were not defined for the case study. C1–C4 impacts are also similar for all methods. Estonian method indicates here slightly smaller impacts, which is again probably to do with the database limitation.

The D module results indicate higher benefits for concrete buildings than for wooden structure buildings. This is so for the following reasons:

- the method does not include biogenic carbon

- for Estonian material database it is assumed that by defauly there is no recycled content for any material (in order to keep the assumption conservative), hence the metal resources (e.g. reinforcement) recycling benefits are very high.
- Timber material D module accounts the benefits of energy recovery.

The D module accounting method can be adjusted in the future if there is a need for more exact and better quality results.

The more detailed model, the easier were calculations. But it is important to keep in mind that estimated carbon footprint calculations will be done in preliminary design. RKAS BIM 2020 requirements and EVS 932 standard for the preliminary design stage were analyzed. For RKAS BIM 2020 none of the finishing information is needed in this stage. In the EVS 932 standard under the interior architecture section, it is needed to describe the main concept for building, not the specific rooms. So which materials will be used for floor, wall and ceilings are not specified at this stage.

Table 19. Comparison of Maardu case study results by life cycle module.

$kgCO_2e/(m^2a)$	EST	FI	Level(s)
A1–A3	6.5	6.2	6.4
A4	0.3	0.0	0.1
A5	0.5	1.6	1.7
B4	2.4	2.5	2.8
B6	16.3	16.3	16.3
C1–C4	0.6	0.7	0.8

Tables 20–24 present the 20 materials that are the highest CO_2e emission sources in modules A1–A3 per each case study. This provides the necessary background information for the evaluation of calculation results.

Table 20. Maardu: 20 materials that cause most CO_2e emissions in the modules A1–A3.

MAARDU No.	Resource	Cradle to gate impacts (A1–A3) tCO_2e	% of cradle to gate (A1–A3)
1.	Building services, Educational building (value per m^2)	68	18.9 %
2.	Rock wool	43	11.9 %
3.	Ready-mix concrete, C30/37	38	10.7 %
4.	Structural steel	35	9.8 %
5.	XPS insulation	29	8.0 %
6.	Sawn timber	23	6.5 %
7.	Window, wood-aluminium, triple-glazed	23	6.5 %
8.	Fibreboard	20	5.6 %
9.	Ready-mix concrete, C25/30 and below	18	5.0 %
10.	Gypsum board	17	4.7 %
11.	Reinforcement steel	16	4.4 %
12.	Paint	8.1	2.3 %
13.	Door, outdoor, glass with aluminium frame	8	2.2 %
14.	Ceramic flooring tiles	5	1.4 %
15.	Bitumen waterproofing membrane	3.5	1.0 %
16.	PIR insulation	1.9	0.5 %
17.	Laminated veneer lumber	0.97	0.3 %
18.	Float glass	0.54	0.2 %
19.	Flooring, parquet	0.75	0.2 %
20.	Door, indoor flush door	0.1	0.0 %

Table 21. Sõpruse: 20 materials that cause most CO_2e emissions in the modules A1–A3.

No.	Resource	Cradle to gate impacts (A1–A3) tCO_2e	% of cradle to gate (A1–A3)
1.	Reinforcement steel	740	25.5 %
2.	Ready-mix concrete, C40/50	420	14.5 %
3.	Ready-mix concrete, C25/30 and below	350	12.1 %
4.	Building services, Apartment building (value per m²)	290	9.8 %
5.	Structural steel	250	8.7 %
6.	Ready-mix concrete, C30/37	200	6.8 %
7.	Other reinforced precast concrete products	150	5.0 %
8.	Window, wood-aluminium, triple-glazed	140	4.9 %
9.	Solar panel, monocrystalline	87	3.0 %
10.	Glass-aluminium facade, triple-glazed	49	1.7 %
11.	Glass wool	47	1.6 %
12.	EPS insulation	40	1.4 %
13.	Ceramic flooring tiles	35	1.2 %
14.	Flooring, parquet	31	1.1 %
15.	Paint	14	0.5 %
16.	Door, outdoor, glass with aluminium frame	15	0.5 %
17.	Door, metallic, fire-rated	11	0.4 %
18.	Door, indoor flush door	11	0.4 %
19.	Bitumen waterproofing membrane	9.9	0.3 %
20.	Gypsum board	9.8	0.3 %

Table 22. Mäemaja: 20 materials that cause most CO_2e emissions in the modules A1–A3.

MÄEMAJA

No.	Resource	Cradle to gate impacts (A1–A3) tCO_2e	% of cradle to gate (A1–A3)
1.	Building services, Educational building (value per m2)	250	20.8 %
2.	Ready-mix concrete, C30/37	130	10.5 %
3.	Precast concrete, internal wall element	99	8.3 %
4.	Cross-Laminated Timber	85	7.1 %
5.	Reinforcement steel	80	6.7 %
6.	Structural steel	79	6.7 %
7.	Precast concrete, hollow core slabs	75	6.3 %
8.	Aluminium profiles or sheeting	51	4.3 %
9.	Glass wool	50	4.2 %
10.	Laminated veneer lumber	42	3.5 %
11.	Ready-mix concrete, C40/50	36	3.1 %
12.	Ready-mix concrete, C25/30 and below	36	3.0 %
13.	EPS insulation	34	2.8 %
14.	Fibreboard	22	1.8 %
15.	Gypsum board	22	1.8 %
16.	Float glass	14	1.2 %
17.	Flooring, polyamid textile	14	1.2 %
18.	Rock wool	13	1.1 %
19.	Door, metallic, fire-rated	11	1.0 %
20.	Window, wood-aluminium, triple-glazed	11	0.9 %

Table 23. Kuuma: 20 materials that cause most CO_2e emissions in the modules A1–A3.

KUUMA

No.	Resource	Cradle to gate impacts (A1–A3) tCO_2e	% of cradle to gate (A1–A3)
1.	Building services, Apartment building (value per m2)	140	33.0 %
2.	Solar panel, monocrystalline	77	18.6 %
3.	Glass wool	71	17.2 %
4.	Window, wood-aluminium, triple-glazed	45	10.9 %
5.	Structural steel	31	7.5 %
6.	Rock wool	30	7.1 %
7.	EPS insulation	8.3	2.0 %
8.	Gypsum board	4.2	1.0 %
9.	Sawn timber	3.8	0.9 %
10.	Natural stone slabs	3.8	0.9 %
11.	Bitumen waterproofing membrane	2.7	0.6 %
12.	Door, outdoor, wooden with wooden frame	0.54	0.1 %
13.	XPS insulation	0.04	0.0 %
14.	Precast concrete, hollow core slabs	0.08	0.0 %

Table 24. Pärnu: 20 materials that cause most CO_2e emissions in the modules A1–A3.

PÄRNU

No.	Resource	Cradle to gate impacts (A1–A3) tCO_2e	% of cradle to gate (A1–A3)
1.	Precast concrete, hollow core slabs	180	21.3 %
2.	Structural steel	160	16.3 %
3.	Building services, Office (value per m2)	160	14.3 %
4.	Ready-mix concrete, C25/30 and below	140	7.8 %
5.	Ready-mix concrete, C60/75 and above	130	6.3 %
6.	Precast concrete, internal wall element	120	6.0 %
7.	Paint	110	5.2 %
8.	Solar panel, monocrystalline	70	3.2 %
9.	Gypsum board	51	2.8 %
10.	Window, wood-aluminium, triple-glazed	40	2.8 %
11.	Flooring, parquet	29	2.5 %
12.	Aluminium profiles or sheeting	30	2.4 %
13.	Glass wool	23	2.1 %
14.	Glass-aluminium facade, triple-glazed	180	2.0 %
15.	Door, outdoor, glass with aluminium frame	160	1.2 %
16.	EPS insulation	160	0.9 %
17.	Portland cement, generic, CEM I	140	0.7 %
18.	Clay bricks	130	0.5 %
19.	Ceramic flooring tiles	120	0.5 %
20.	Door, metallic, fire-rated	110	0.4 %