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Comparative LCA of a concrete and steel apartment building and a cross laminated timber apartment building

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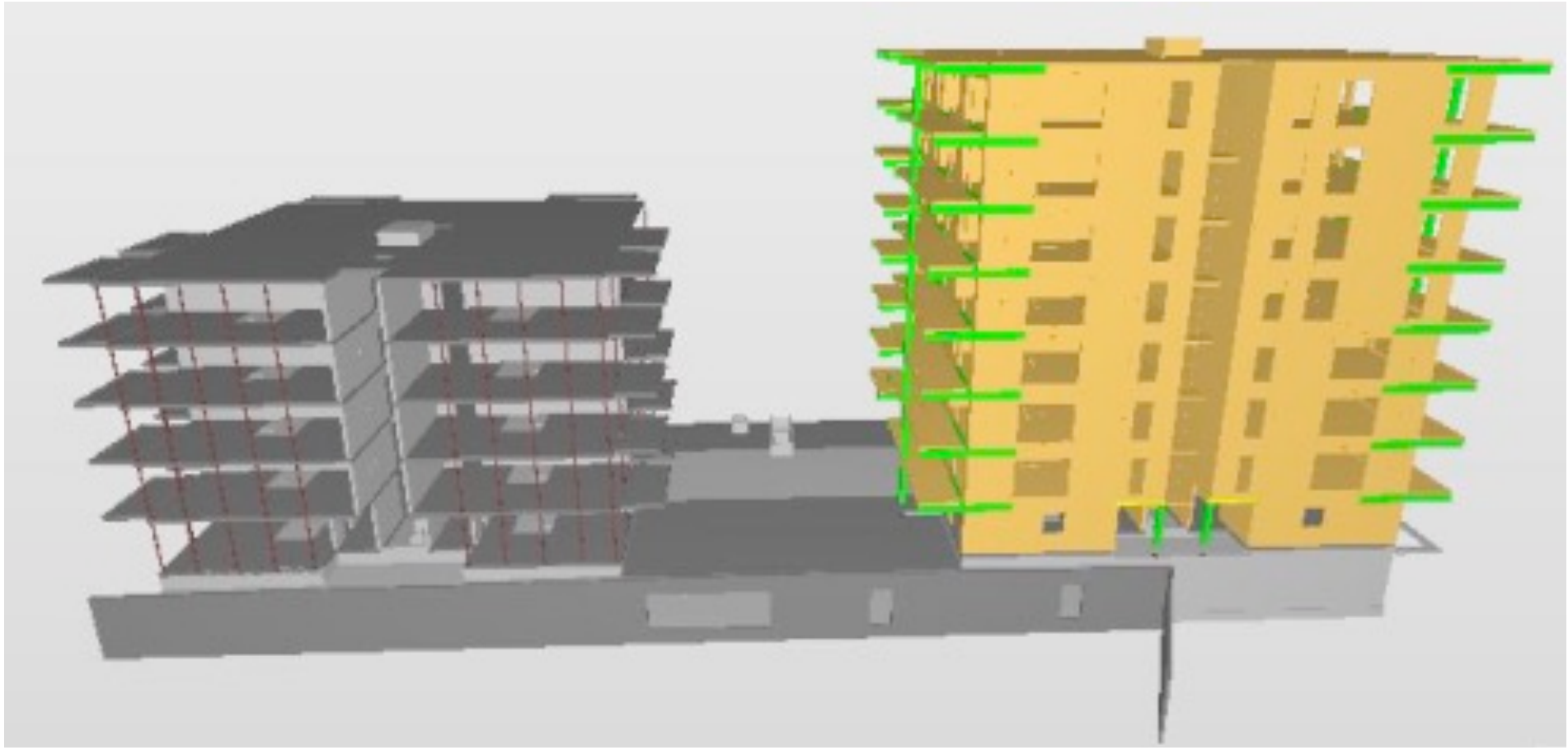
Introduction

- In this paper it will be investigated whether or not it is possible to save greenhouse gas emissions by using CLT elements to construct apartment buildings instead of concrete.
- The case which will be examined is Maskinparken 2 and TRE, which are two new apartment buildings constructed by Veidekke AS in Trondheim, Norway.'
- Maskinparken 2 is a five-story apartment building which is constructed in concrete and steel, while
- Maskinparken TRE is an eight-story apartment building constructed using CLT-elements.
- What makes the two buildings comparable is that they are constructed side by side and they are almost identical except for the number of floors and the structural system.
- An LCA of the two buildings looking at the impact category climate change will be carried out to compare the greenhouse gas emissions from the buildings.

Case: Maskinparken 2 and TRE



Maskinparken TRE to the right and Maskinparken 2 to the left with the concrete underground car park underneath.

Differences between the two buildings

	Maskinparken 2	Maskinparken TRE
Gross internal area	2376,1 m^2	3784,8 m^2
Number of stories	5	8
Number of apartments	31	47
Construction system	Reinforced concrete and steel	CLT
Foundation	Concrete underground car park	Concrete underground car park
Façade	Aired plaster	Wood panelling
Balconies	Prefabricated concrete	CLT
Outer walls	Insulated stud work	Lined CLT walls

	Maskinparken 2 [kWh/m^2]	Maskinparken TRE [kWh/m^2]
Direct electricity	34,0	36,4
District heating	63,9	49,9

Material quantities of the two buildings

	Maskinparken 2 [ton]	[%]	Maskinparken TRE [ton]	[%]
Cast-in-place concrete	3874	82,8	3185	65,6
Prefabricated concrete	227	4,9	66	1,4
Steel	20	0,4	23	0,5
Screed	196	4,2	417	8,6
Reinforcement	151	3,2	125	2,6
Cross laminated timber	4	0,1	540	11,1
Wood	34	0,7	51	1,1
EPS	2	0,1	0	0,0
Bathroom cabins	62	1,3	102	2,1
Façade panel and plaster	13	0,3	0	0,0
Gypsum board	51	1,1	207	4,3
Stone wool insulation	8	0,2	71	1,5
Windows and balcony doors	16	0,3	25	0,5
Doors	11	0,2	16	0,3
Glass railing	0	0,0	17	0,3
Other materials	10	0,2	10	0,2

Results

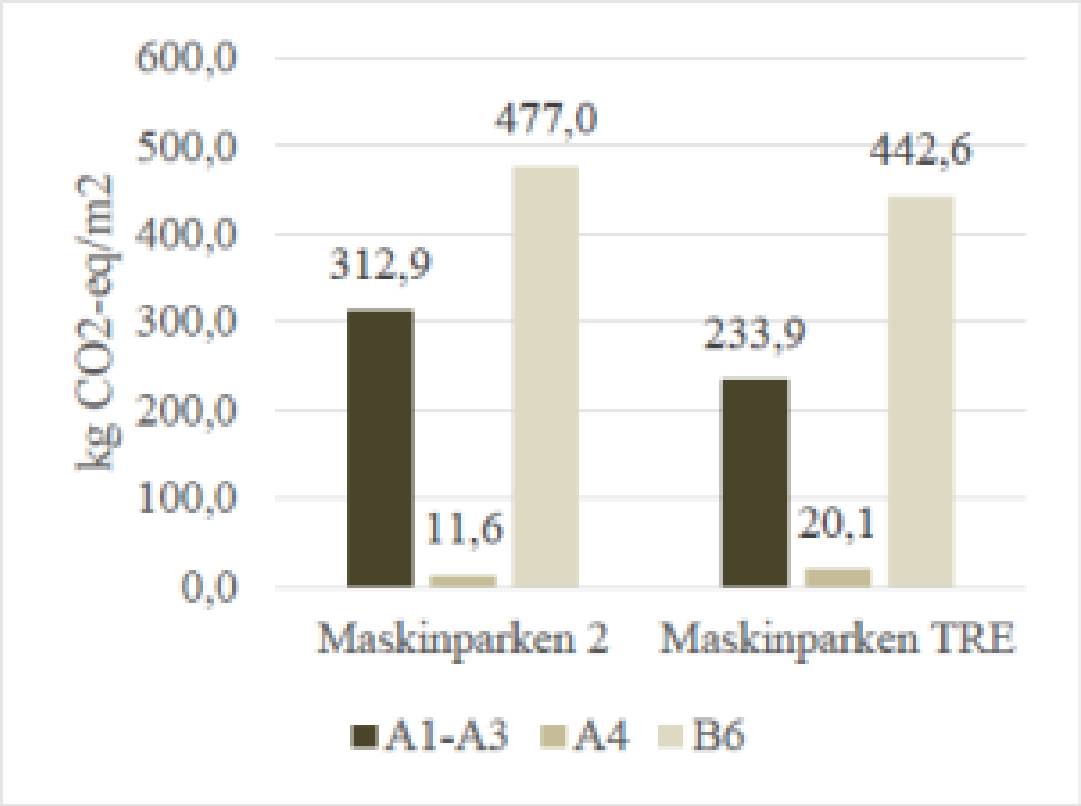


Figure 2: GHG emissions from Maskinparken 2 and TRE for the production stage (A1-A3), transport (A4) and operational energy use (B6).

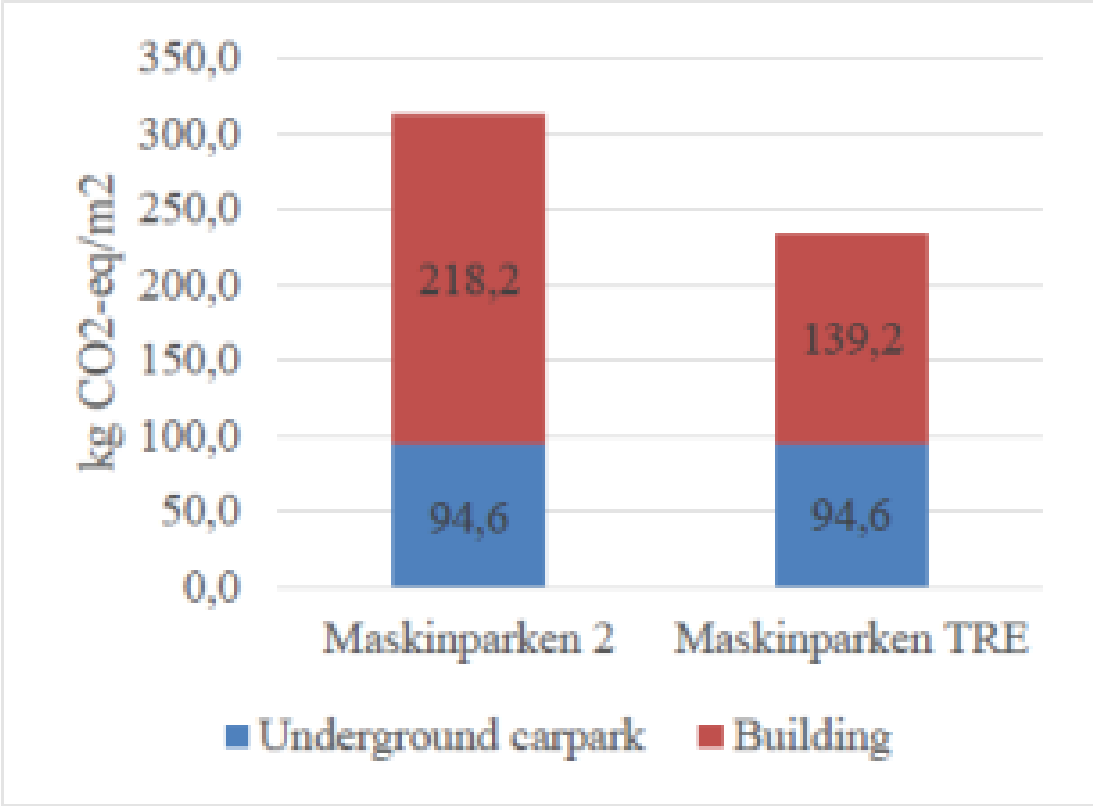


Figure 3: GHG emissions from the underground car park and the building (A1-A3).

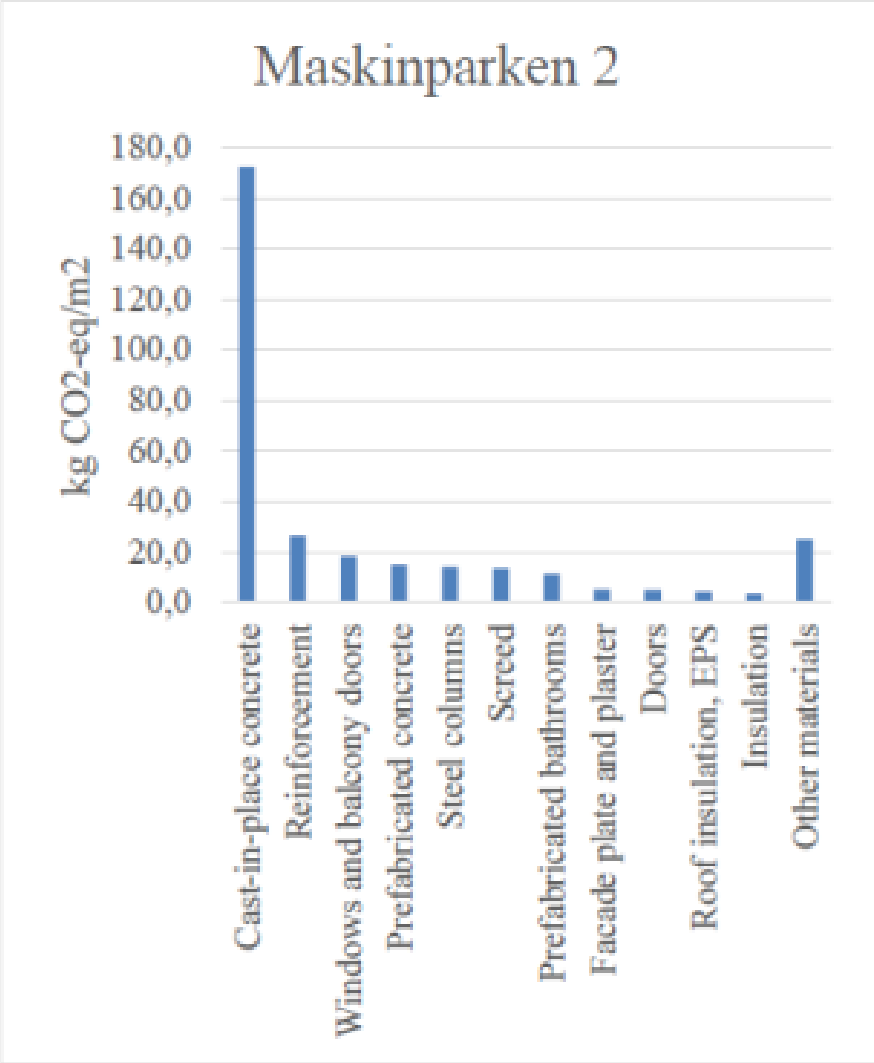


Figure 4: GHG emissions from the materials that emit the most greenhouse gases in Maskinparken 2 for the production stage (A1-A3).

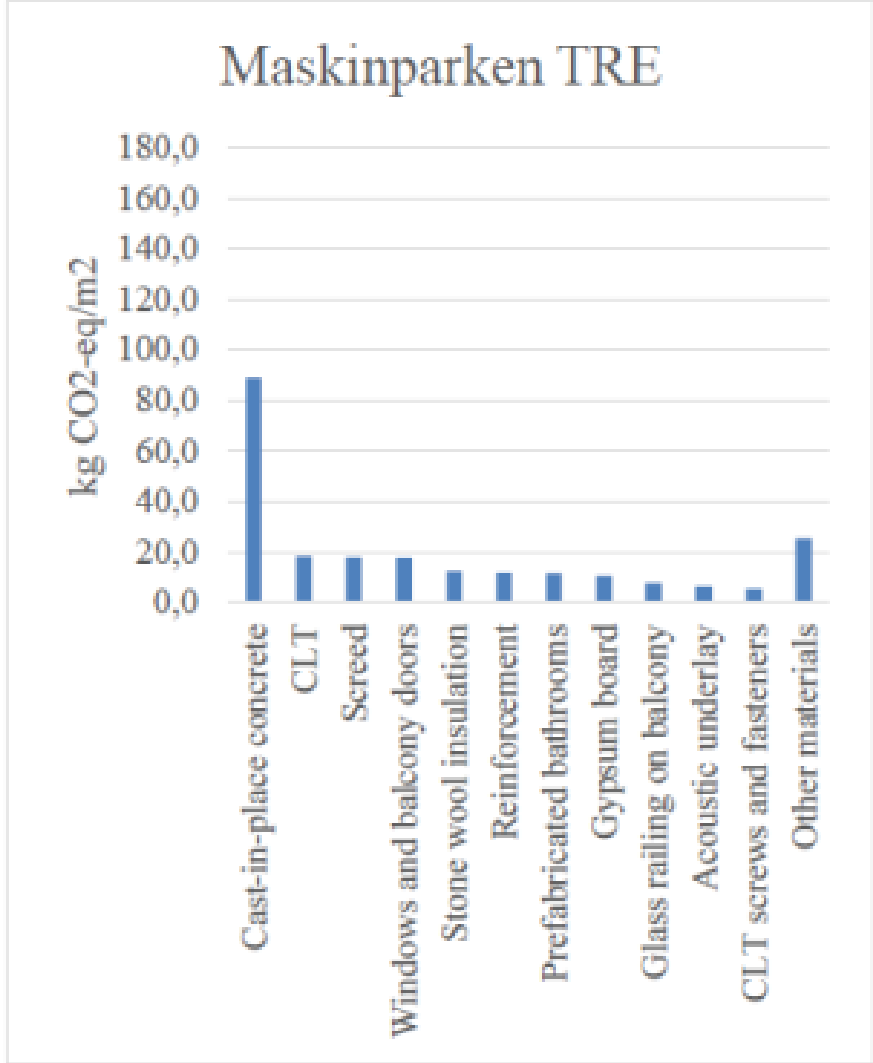


Figure 5: GHG emissions from the materials that emit the most greenhouse gases in Maskinparken TRE for the production stage (A1-A3).

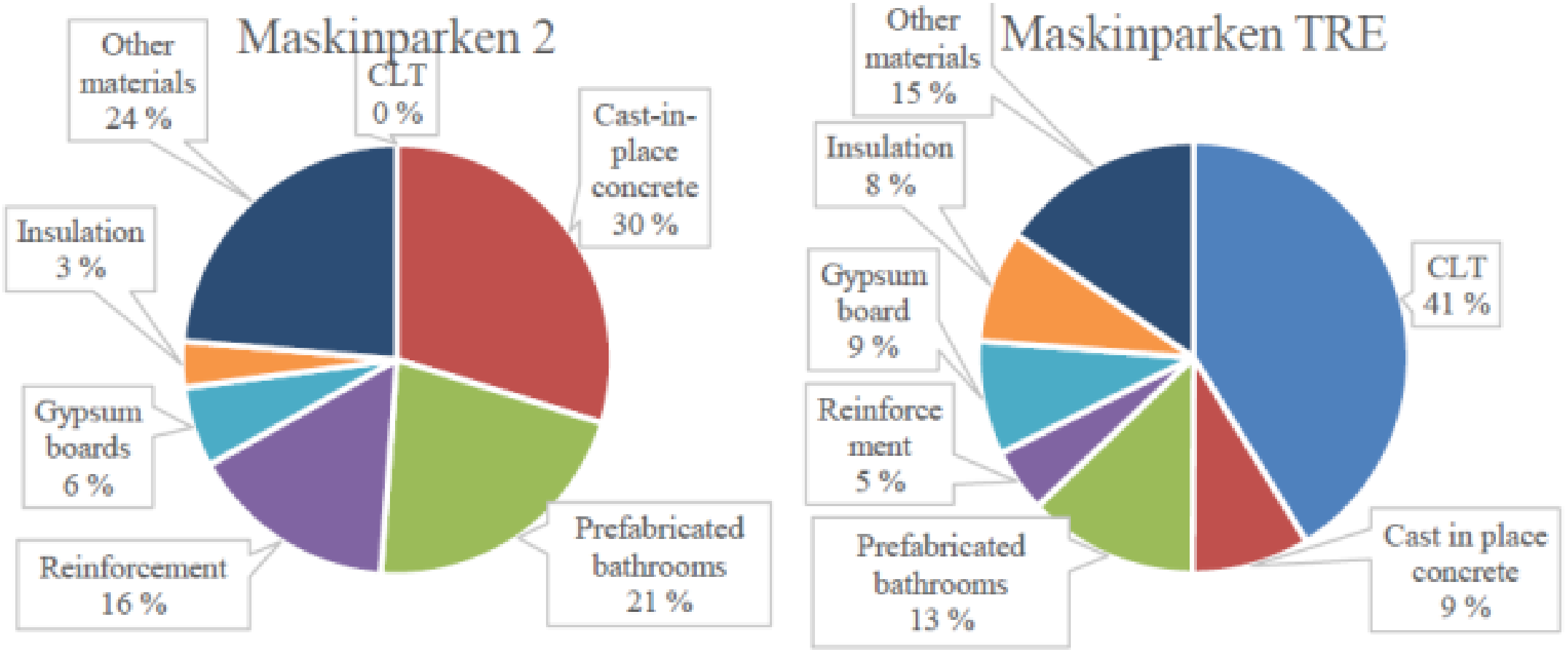


Figure 6: Greenhouse gas emissions from transport in percentage of the total emissions from transport for the products used in Maskinparken 2 and TRE.

Discussion and conclusion

- The results show that in both the production phase and operational energy use, Maskinparken TRE has a lower emission of greenhouse gases than Maskinparken 2.
- The emissions per gross internal area (GIA) for the product phase are 25% lower for Maskinparken TRE compared to Maskinparken 2.
- The greenhouse gas emissions from operational energy use are 7% lower for Maskinparken TRE compared to Maskinparken 2.
- The underground car park contributes significantly to greenhouse gas emissions.
- The main reason Maskinparken TRE has a higher emission from transport is because of the CLT-elements which are transported from Ybbs in Austria to Trondheim.
- **CLT buildings have lower embodied emissions than comparable buildings in concrete and steel. However, maintenance emissions over the lifetime of the building needs to be confirmed**.

Thank you.....
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