Can Timber Construction Help Achieve Climate Goals?

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Why is the environment important?

Buildings use:

- 40% of global energy
- 25% of global water
- 40% of global resources

Buildings emit:

- 1/3 of greenhouse gases

According to United Nations Environment Programme

Why should the environment be important to the construction industry?

Actors

- Architects
- Engineers
- Contractors
- Developers
- Financers

Soft **Hard**

(social/environmental value) (economic value)

Architects

Engineers

Contractors

Developers

Financers

Actors and their motivations

In Denmark, approximately 80% of new residential buildings are built using concrete

Construction system is coupled with low cost and low risk

- Developed in response to the need to rebuild following the Second World War
- Well-known in terms of design, cost and risk
- Local supply chain

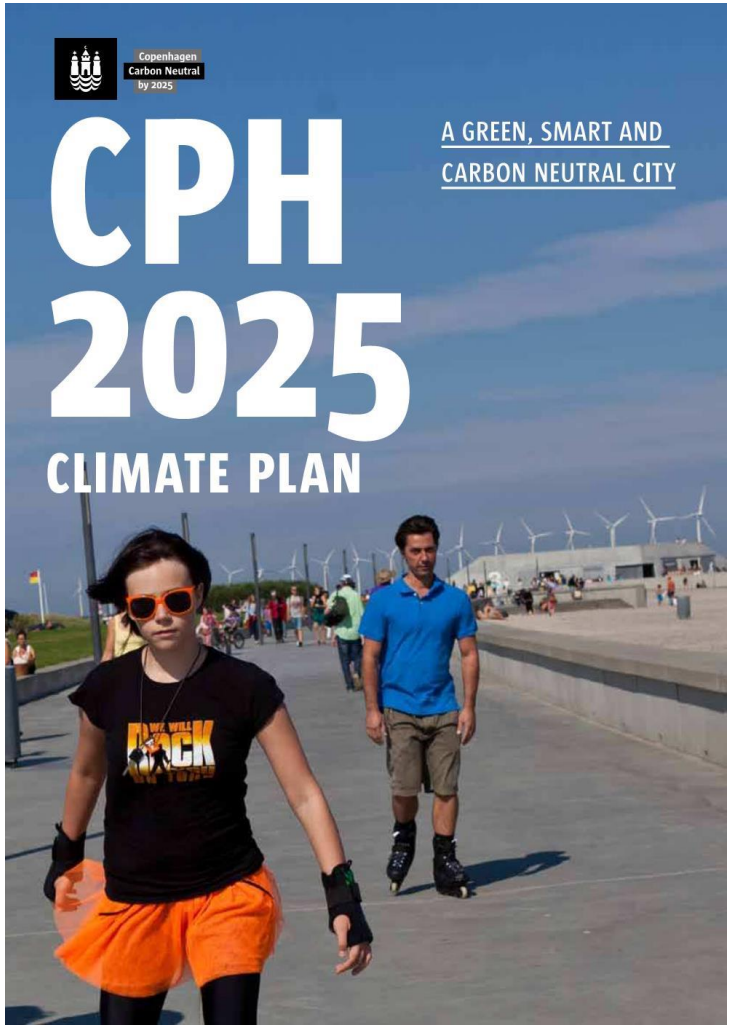
BUT

- Cement production contributes significantly to global CO2 emissions and has a high embodied energy

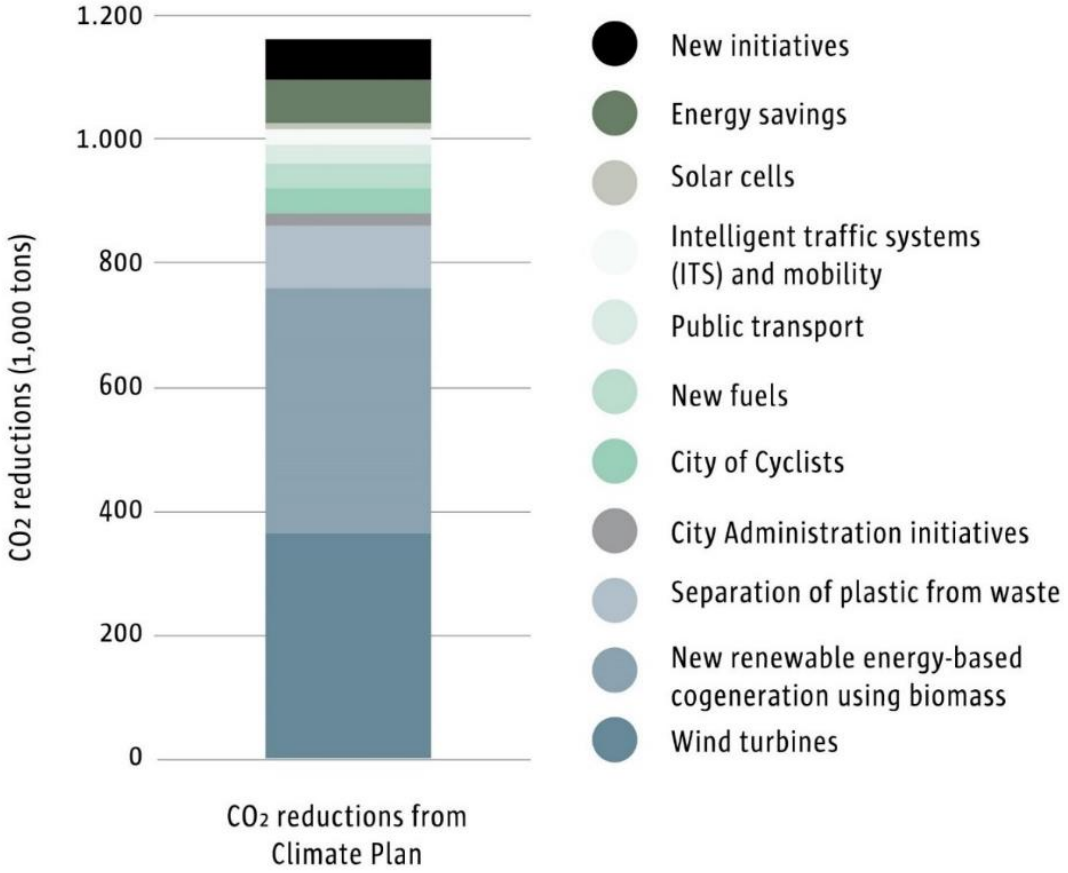
?

How do we couple the choice of construction system with the environment?

Copenhagen’s sustainability agenda - First city to be carbon neutral by 2025

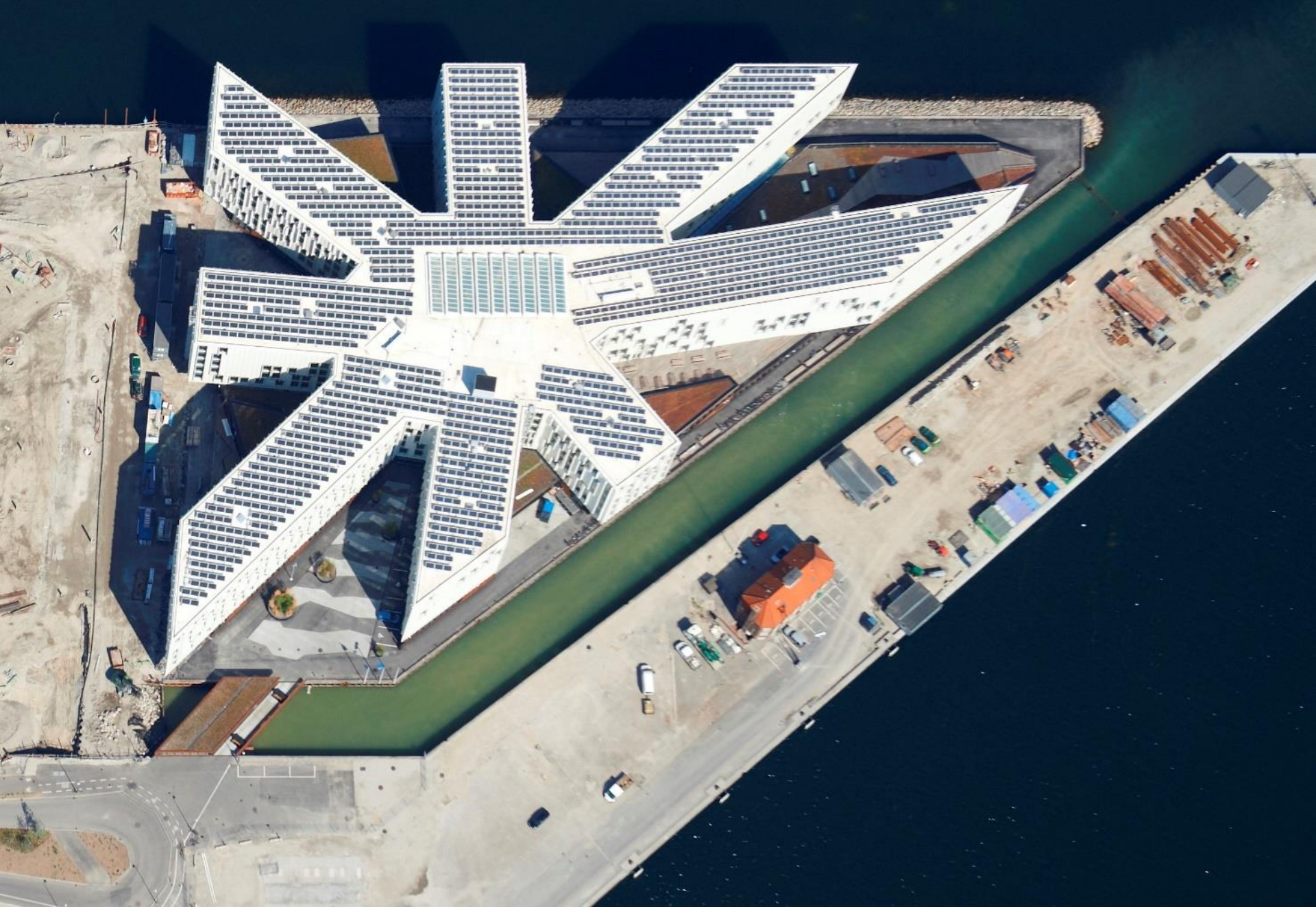


Copenhagen's Climate Plan



CO2 reduction plan

40MW per year



1,400 solar panels

400,000 tons of waste per year

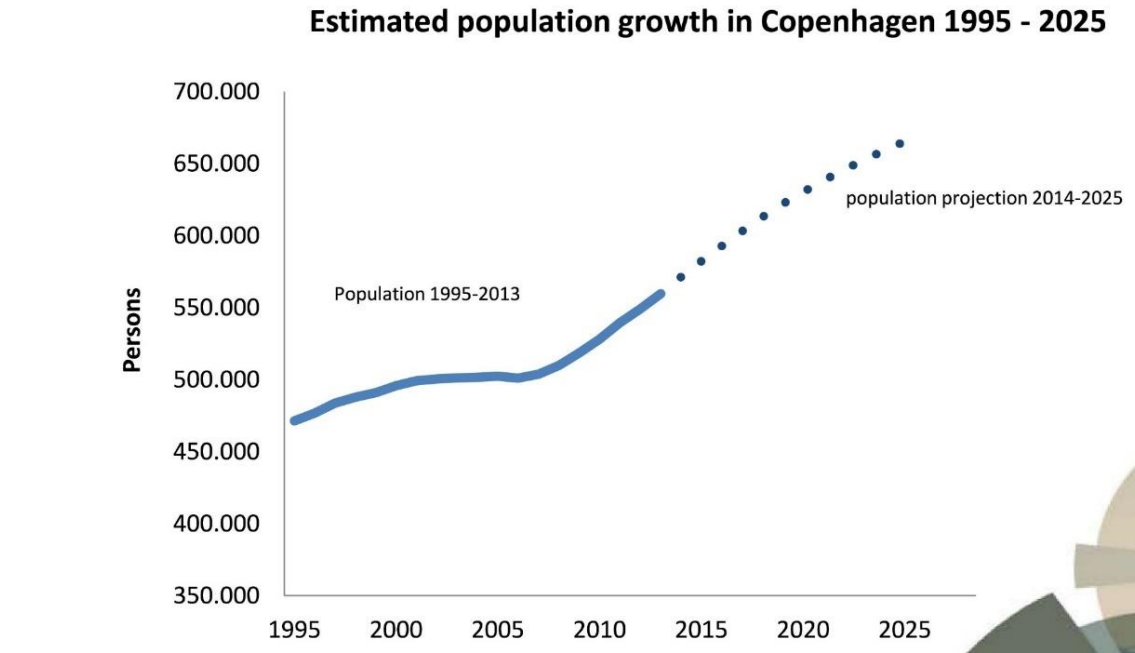
50% commute by bike

2,000 city bikes

400 electric DriveNow cars

No reference to what we build with!

POPULATION GROWTH



NEW DEMANDS

Need for:

- New build squaremeters due to growth
- 45.000 new housing units by 2027 to make room for 100.000 new citizens
- Investment in cultural institutions, recreational areas and infrastructure to maintain liveability as population grow

The alternative – Cross Laminated Timber

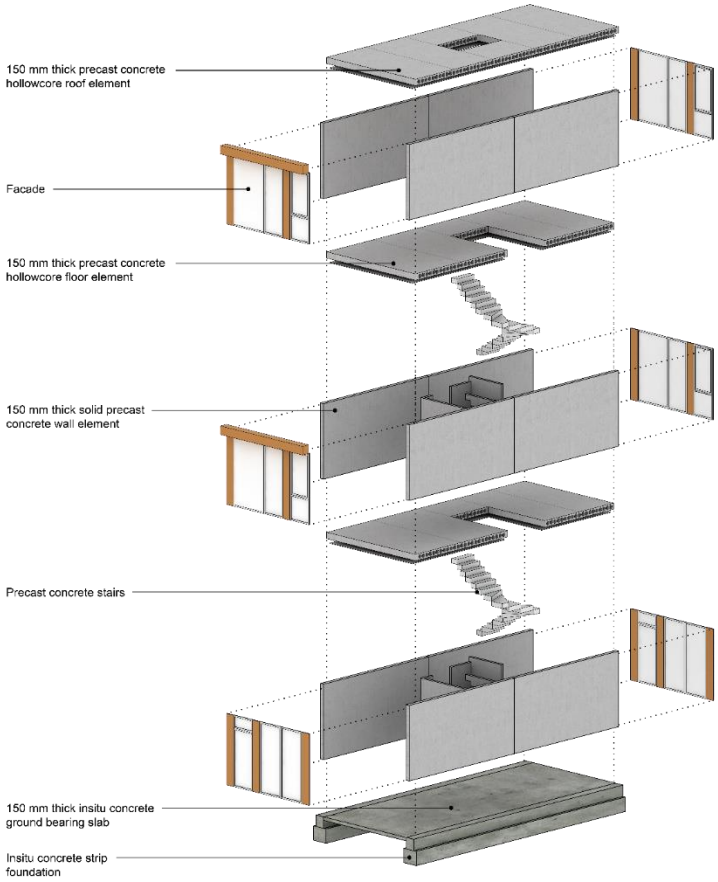
- Undeveloped
- Relatively unknown in terms of design, cost and risk
- No local supply chain in Denmark

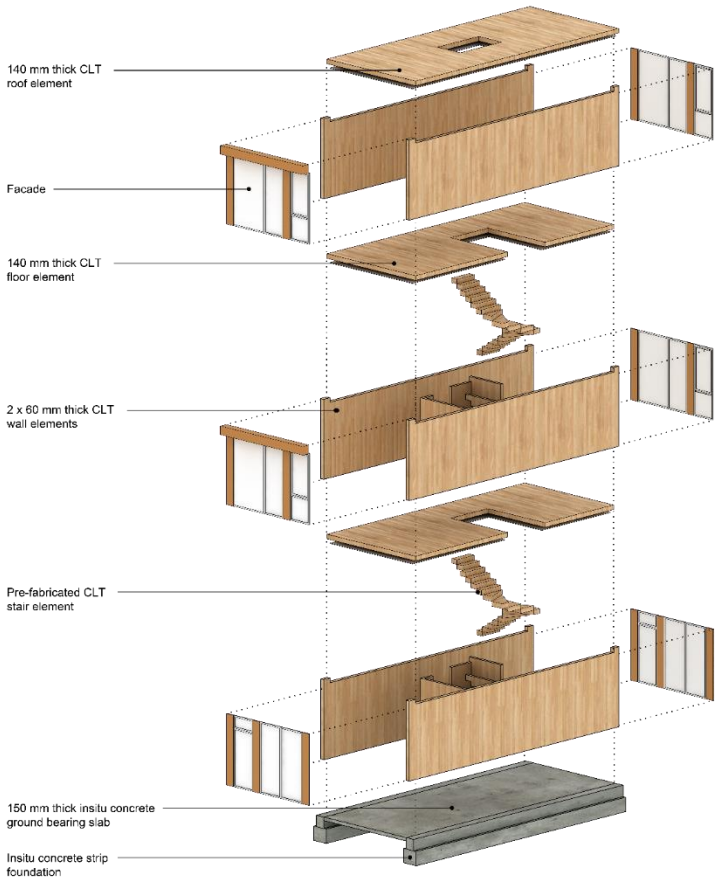
- Timber is carbon negative when sequestration is considered
- Low embodied energy
- Can be designed for disassembly

Cross laminated timber – the arguments for

Comparison of CLT and precast concrete - Remisevej

- Area: 6,100 m2 residential
- Budget: 75 mio DKK
- Architect: Force 4, Cubo Arkitekter (competition 2015)


150 mm thick precast concrete hollowcore roof element
Facade
150 mm thick precast concrete hollowcore floor element
150 mm thick solid precast concrete wall element
Precast concrete stairs
150 mm thick insitu concrete ground bearing slab
Insitu concrete strip foundation


140 mm thick CLT roof element
Facade
140 mm thick CLT floor element
2 x 60 mm thick CLT wall elements
Pre-fabricated CLT stair element
150 mm thick insitu concrete ground bearing slab
Insitu concrete strip foundation

INPUT

CLT Building

Material volumes		
CLT	26.12	m^3
PCC	5.78	m^3
Total	31.9	m^3

End Of Life	
0 Recycling 1 Incineration 2 Landfill	0

PCC Building

Material Volumes		
PCC	32.9	m^3
Total	32.9	

In the left (blue) columns type in the amount of CLT used in building along with the amount of concrete used for foundations etc. If a comparison is made it is possible to type in the data for a building entirely in PCC on the right (grey column)

RESULTS

	CO_2e emission			Material usage		
CLT Building	CLT	-19139	kg CO_2e	CLT	13060	kg Material
	PCC	2252	kg CO_2e	PCC	13872	kg Material
	Sum	**-16887**	kg CO_2e	Sum	**26932**	kg Material
PCC Building	CO_2e emission			Material usage		
	PCC	**12446**	kg CO_2e	PCC	**78960**	kg Material
Difference	CO_2e emission			Material usage		
		-29333	kg CO_2e		**-52028**	kg Material

LIFE CYCLE ASSESSMENT CALCULATIONS

CLT

CLT

Cradle to gate

	kg CO_2e / kg	kg CO_2e	Notes	References
Sequesteration	-1.80	-23508.00	(1)	[1][2]
Manufacture	0.14	1763.10	(2)	[1][3]
Total	**-1.67**	**-21744.90**		

Transport to site, assembly, dismantling and transport from site is not handled

	km	kg CO_2e / tkm	kg CO_2e	Notes	References
Austria -> Copenhage	1050	0.19	2605.47	(14)(15)(18)	[9]
Total		**0.19**	**2605.47**		

End of Life - Scenario 0: Reuse/recycle (10)(11)

	kg CO_2e / kg	kg CO_2e	Notes	References
Total	**0.00**	**0.00**	(3)	[1]

End of Life - Scenario 1: Incineration

	kg CO_2e / kg	kg CO_2e	Notes	References
CO2 released	1.80	23508.00	(4)	[1]
Avoided emission	-0.24	-3134.40	(5)(6)	[1][4][5]
Total	**1.56**	**20373.60**		

End of Life - Scenario 2: Landfill

	kg CO_2e / kg	kg CO_2e	Notes	References
Total	**2.15**	**28079.00**	(7)	[1]

Concrete

Cradle to gate

	kg CO_2e / kg	kg CO_2e	Notes	References
Manufacture	0.13	1849.14	(17)(8)(9)	[10][7][8]
Total	**0.13**	**1849.14**		

Transport to site, assembly, dismantling and transport from site is not handled

	km	kg CO_2e / tkm	kg CO_2e	Notes	References
	150	0.19	395.35	(16)	
Total		**0.19**	**395.35**		

End of Life - Scenario 0: Reuse/recycle (10)(11)

	kg CO_2e / kg	kg CO_2e	Notes	References
Treatment	0.001	7.98	(12)	[7]
(Carbonisation)	0.00	0.00	(13)	[7]
Total	**0.00**	**7.98**		

Pre cast concrete

Cradle to gate

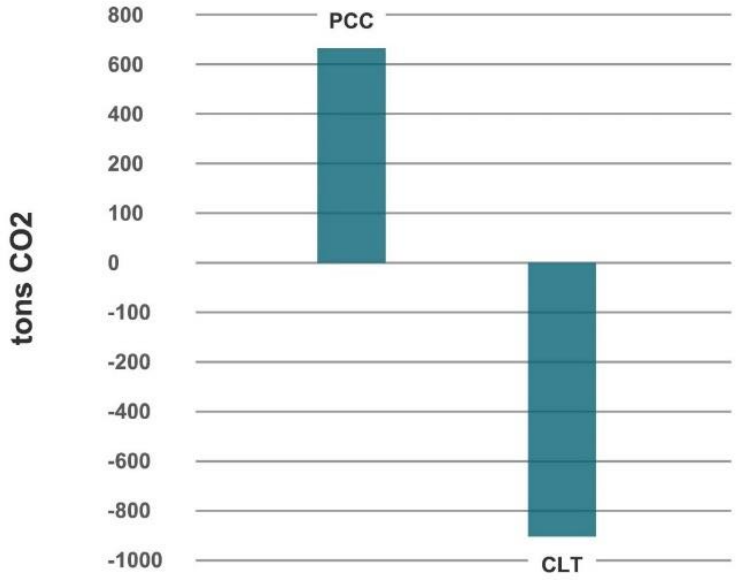
	kg CO2e / kg	kg CO2e	Notes	References
Manufacture	0.1333	10525.37	(17)(8)(9)	[10][7][8]
Total	0.1333	**10525.37**		

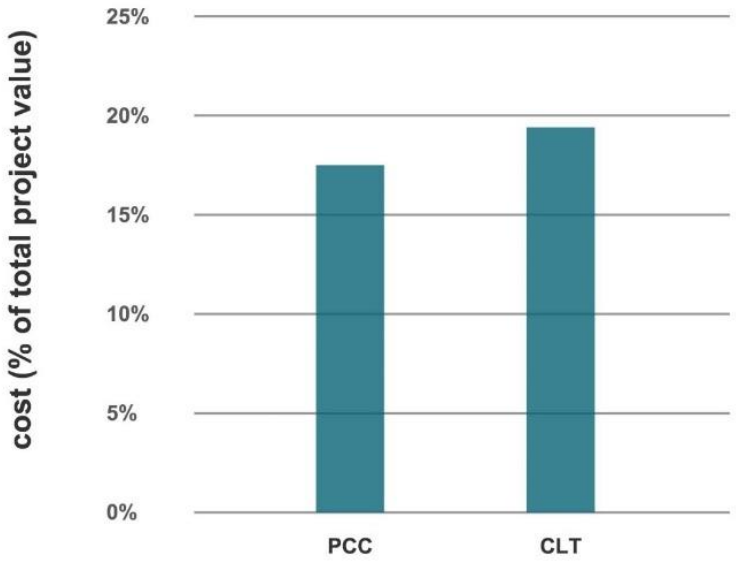
Transport to site, assembly, dismantling and transport from site is not handled

	km	kg CO2e / tkm	kg CO2e	Notes	References
	125	0.19	1875.30	(16)	
Total		**0.19**	**1875.30**		

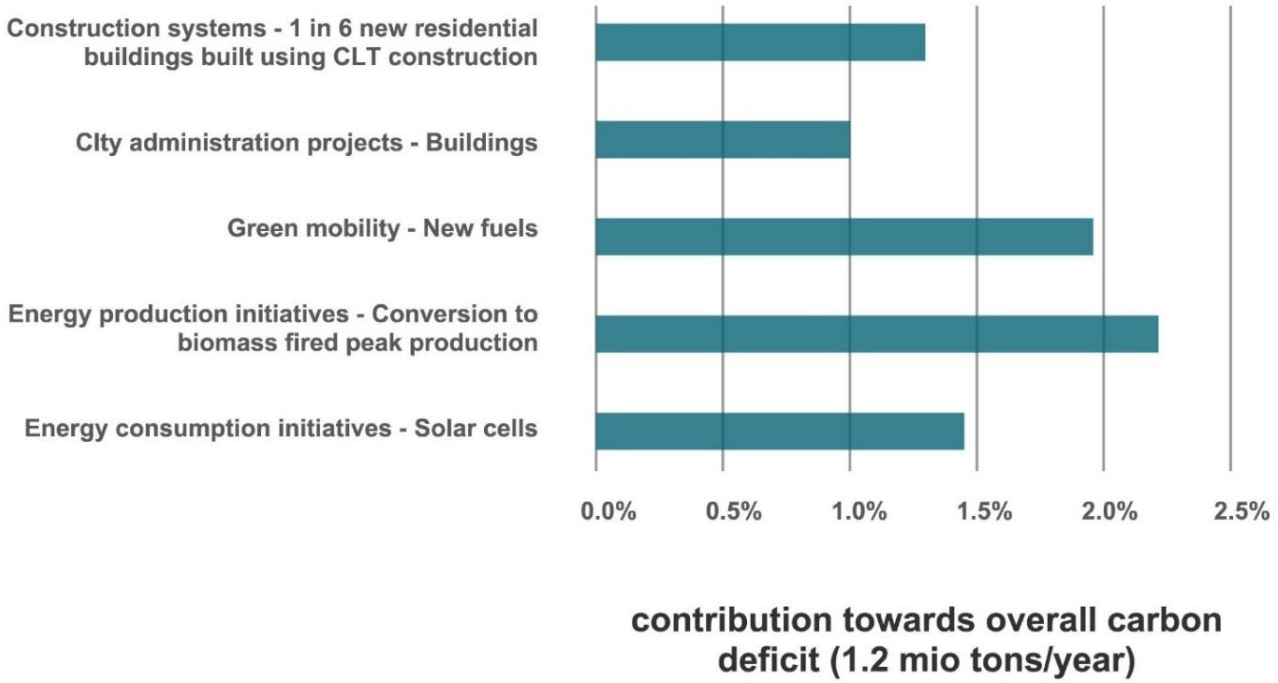
End of Life - Scenario 0: Reuse/recycle (10)(11)

	kg CO2e / kg	kg CO2e	Notes	References
Treatment	0.000575	45.40	(12)	[7]
(Carbonisation)	0	0.00	(13)	[7]
Total	**0.00**	**45.40**		





Remesivej: Carbon and cost comparison



Contribution of CLT towards Copenhagen’s CO2 deficit

- Certain actors are only motivated by time and money – not sustainability
- These actors could be motivated to use CLT if there were clear financial incentives – faster construction, lower energy bills, competitive market conditions etc
- Governments should incentivise CLT as part of their sustainable agendas
- Embodied energy of CLT should be taken into account when calculating energy demands for buildings

Thank you

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